In Puerto Rico endangered and threatened species are protected by two regulations:
1. Regulations for the Conservation and Management of Threatened and Endangered Species in the Commonwealth of Puerto Rico (Department of Natural Resources, 1985, 2004), and;
2. The Endangered and Threatened Wildlife and Plants Rule (50 CFR 17.11 and 17.12, August 20, 1994).

These regulations include endangered species, threatened species, species similar to endanger and threatened species and their habitats. The PRDNER Regulations for the Management of Threatened and Endangered Species in the Commonwealth of Puerto Rico (Department of Natural Resources, 1985, 2004) refers to these species by the collective name of "Critical Biological Species" and catalog them by status.

The following statuses are recognized:

- E; Species determined by the local authorities to be endangered.
- EF; Species determined by Federal authorities to be endangered.
- V; Species determined by local authorities to be threatened.
- VF; Species determined by Federal authorities to be threatened.
- NHDCE; Species adopted by the PRDNER Natural Heritage Division as a critical element because of its similarity to a threatened or endangered species.

The Natural Heritage Division inventories were reviewed for the occurrence of critical biological species in the study area. **No listed species were observed within the studied area.** Nonetheless, several species with conservation categories do exist in the surroundings.

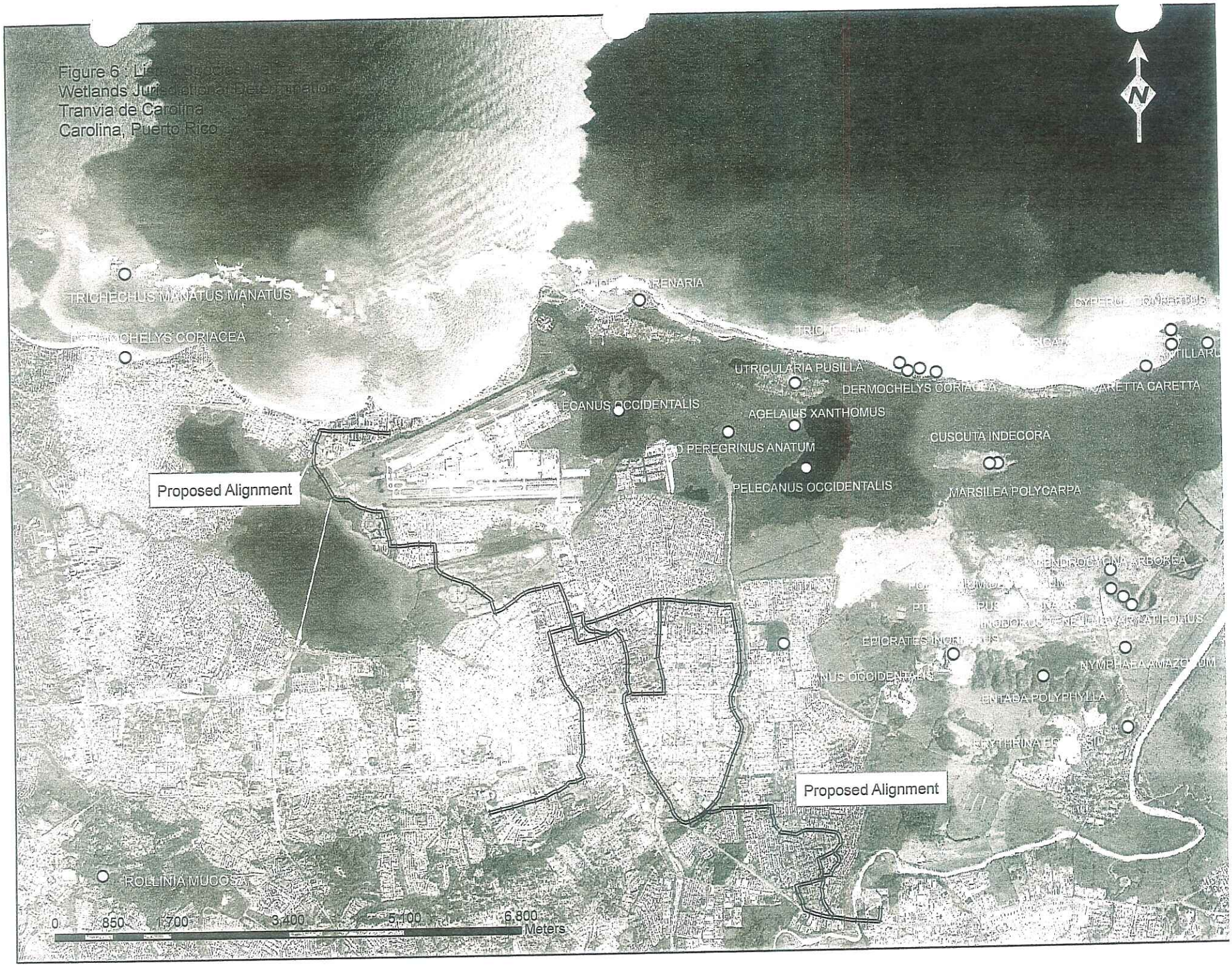
Figure 6 - Li
Wetlands Juri
Tranvia de Carolina
Carolina, Puerto Rico
N
TRICHECHUS MANATUS MANATUS
CHELYS CORIACEA
RENARIA
UTRICULARIA PUSILLA
DERMOCHELYS CORIACEA
ECANUS OCCIDENTALIS
AGELAIUS XANTHOMUS
O PEREGRINUS ANATUM
CUSCUTA INDECORA
PELECANUS OCCIDENTALIS
MARSILEA POLYCARPA
Proposed Alignment
EPICRATES
NYMPHAEA AMAZO
ENTADA POLYPHYLLA
Proposed Alignment
ROLLINIA MUCOSA
0
850
1,700
3,400
5,100
6,800
Meters

F. Hydrology

The study area hydrology is driven by the high table water level as the influence of tides. A complex system of rivers, channels creeks and even rivers flow through the proposed corridor. Important hydrographic elements are found along the study area including Rio Grande de Loíza, Canal Suarez, Canal Blasina and various smaller channels and creeks. Refer to Figure 7: Wetland Inventory Map.

G. Cultural Resources

We did not found obvious elements associated to pre-Columbian and or historic settlements. A general land use analysis shows plenty evidence of human utilization across recent time periods. Nonetheless, that a specialized study should be conducted as needed and/or requested from regulatory agencies.

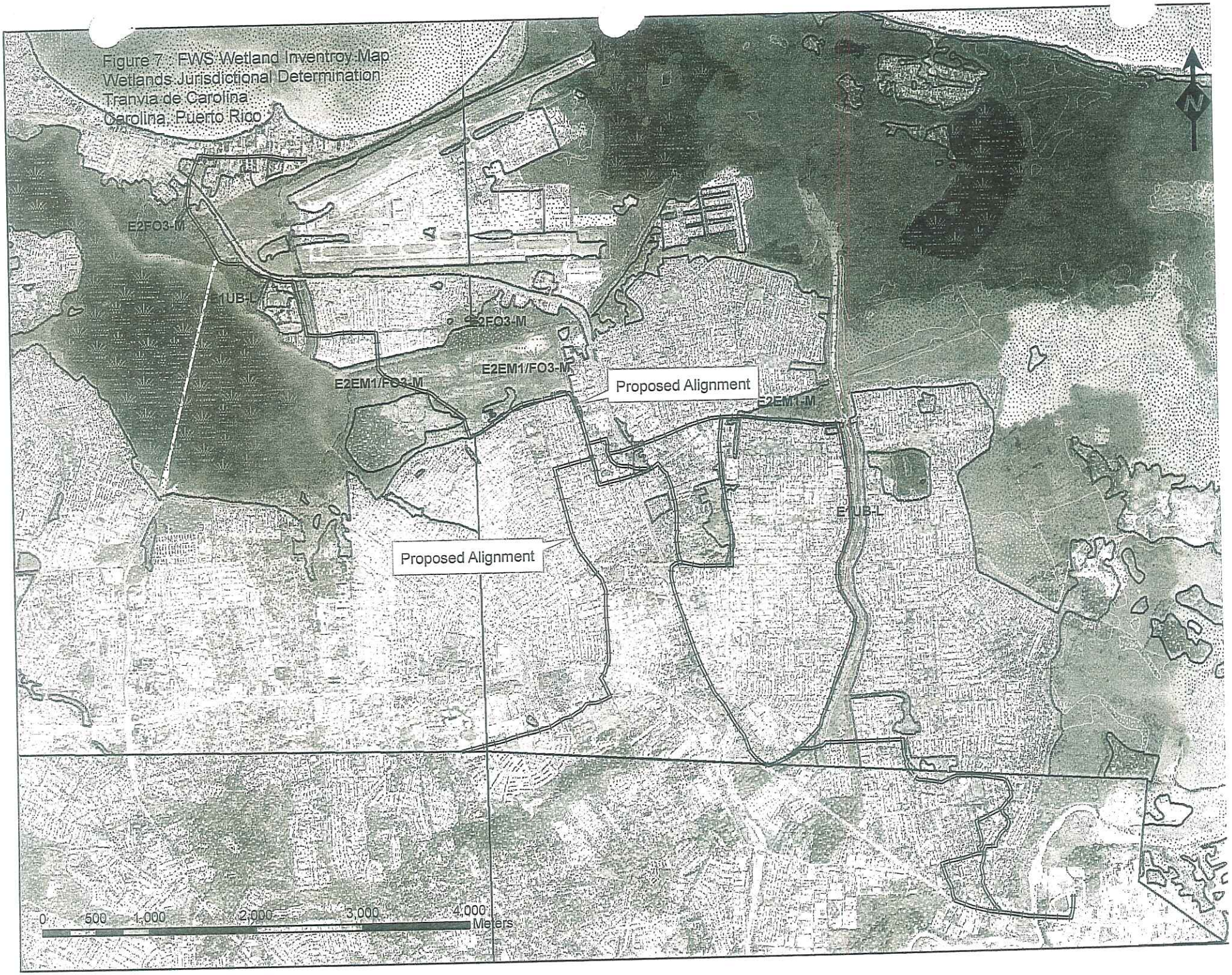
Figure 7 FWS Wetland Inventroy Map
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto Rico
N
E2FO3-M
E1UB-L
E2FO3-M
E2EM1/FO3-M
E2EM1/FO3-M
Proposed Alignment
E2EM1-M
E1UB-L
Proposed Alignment
0 500 1,000 2,000 3,000 4,000
Meters

V. DELINEATION AND DESCRIPTION OF THE WETLANDS

This section of the report includes; (1) a jurisdictional delineation of the wetlands occurring in the corridor along the study area, (2) a qualitative and quantitative description of the wetlands plant composition, soils and hydrology, and (3) an evaluation of the wetland functional values.

According to the U.S. Fish and Wildlife National Wetland Inventory (Figure 7), the study site is composed of a complex mosaic of uplands and wetlands upon an urban landscape.

The protocols described in the 1987 USA CoE Wetland Delineation Manual were followed in the jurisdictional delineation of these wetlands. The USA CoE (Federal Register 1982) and the U.S. Environmental Protection Agency (Federal Register 1980) jointly defined wetlands as *"those areas that are inundated by surface water or ground water at a frequency and duration to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions".*

According to the above definition, wetlands have the following diagnostic environmental characteristics: (1) hydrophitic vegetation, (2) hydric soils, and (3) hydrographic regime resulting in saturated or flooded conditions. The USA CoE considers an area a jurisdictional wetland only when a positive wetland indicator is present for each of the diagnostic environmental characteristics (USA CoE, 1987).

Wetlands

In general terms, wetlands are habitats between terrestrial and aquatic ecosystems where standing waters or saturated soil conditions occur at least periodically and where a prevalence of vegetation typically adapted for anoxic soil conditions occur. Wetlands are important ecosystems with a myriad of functional values such as habitat, erosion control, water quality, and flood control.

The classification system used in the inventory defines five systems:

1. Marine

Consist of the open ocean overlying the continental shelf and it is associated with a high-energy coastline. They are exposed to the waves and currents of the open ocean, and the Marine system extends from the outer edge of the continental shelf shoreward to one of two lines:

a. The landward limit of tidal inundation
b. The seaward limit of the Estuarine System

2. Estuarine

Consist of deep water tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land, but are connected to the ocean; in which ocean water is at least occasionally diluted by freshwater runoff from the land. This system extends upstream and landward to where ocean-derived salts measure less than 0.5 percent during the period of average annual low flow; to an imaginary line closing the mouth of river, bay or sound; and to the seaward limit of wetland emergent, shrub, and trees. The Estuarine system also includes offshore areas of continuously diluted seawater and lagoons.

Estuarine wetlands may be divided into subtidal and intertidal subsystems. In the subtidal subsystem, the substrate is continuously submerged, whereas in the intertidal subsystem the substrate is exposed and floods only during high tides.

3. Riverine Wetlands

Includes all wetland and deep-water habitats contained within the channel, with two exceptions:

a. wetlands dominated by trees, shrubs, persistent emergent, mosses, or lichens.

b. habitats with water containing ocean-derived salts in excess of 0.5 percent.

The Riverine system is bounded on the landward side by upland, channel bank, or wetlands dominated by trees, shrubs, persistent emergent, mosses, or lichens. It terminates at the downstream end where the concentrations of ocean-derived salts in the water exceed 0.5 percent during the period of annual average low flow, or where the channel enters a lake. It terminates at the upstream end where tributary steams originate, or where the channel leaves a lake. The Riverine is divided into four (4) subsystems:

a. tidal - the grading is low and water velocity fluctuates under tidal influence,

b. lower perennial- the grading is low and water velocity is low,

c. upper perennial - the grading is high and velocity of the water fast, and

d. Intermittent - the channel contains non-tidal flowing water for only part of the year.

4. Lacustrine

Include wetlands or deep-water habitats with the following characteristics:

a. situated in topographic depression or a dammed river channel,

b. blacks trees, shrubs, persistent, emergent, mosses or lichens with aerial coverage greater than 30 percent, and

c. total area exceeds 0.08 km^2 (0.03 square miles).

The Lacustrine system is divided into two subsystems: limnetic and littoral. The limnetic subsystem includes all deep-water habitats within the Lacustrine system and in the littoral, all wetlands habitats in the Lacustrine system. It extends from the shore boundary of the system to a depth of 2 m (6.6 feet.) below water or to the maximum extent of non-persistent emergents, if these grow at depth greater than 2 m.

5. Palustrine

Includes all non-tidal wetlands dominated by trees, shrubs, persistent emergent, mosses or lichens and all such wetlands that occur in tidal areas were the salinity due to ocean-derived salts is below 0.5 percent. It also includes wetlands lacking the above mentioned vegetation, but with the characteristics: area less than 8 ha (20 acres), active wave-formed of bedrock shoreline feature lacking water depth in the deepest part of the basin less than 2 m (6.6 feet) at low water, and salinity due to ocean-derived salts measuring less than 0.5%. This system is bounded by upland or by any of the other four systems. The Palustrine system was developed to group the vegetated wetlands, traditionally known as swamp, mash, bog, prairie, and/or ponds and it is a system that lacks subsystems.

VI. METHODS

The information available was congruent and allows us to characterize the site vegetation, soils, and hydrology. Therefore, a "Routine Approach-On Site Inspection", was used for this jurisdictional delineation. Note that both the wetland definitions, as well as the indicators used, have the underlying assumptions of normal conditions.

A systematic sampling approach was developed along the studied area. See figure 8 Sampling Design. A total of 92 transects with three point counts each, 5m diameter each were established perpendicular to the proposed alignment footprint. Transects were 50 meters long with three points counts each at 0m, 25m and 50m.

Soils and hydrologic data were collected from an 18" deep by 6" wide soil-bore hole at each sampling site. (See Appendix D: Photos that shows soil sample collection and analyses). Vegetation was observed and identified around the point sampling site in a 5 meters diameter. Please refer to Figure 8: Sampling Design for the Study Site. It shows points (point counts) over aerial image. Refer to Table 4 that summarizes GPS points coordinate, given in degrees minutes and seconds (hddd° mm'ss.s") on NAD 83 Harn Datum.


Figure 8: Sampling Design
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto Rico
Proposed Alignment
Proposed Alignment
Sampling Stations
N
0 490 980 1,960 2,940 3,920
Meters

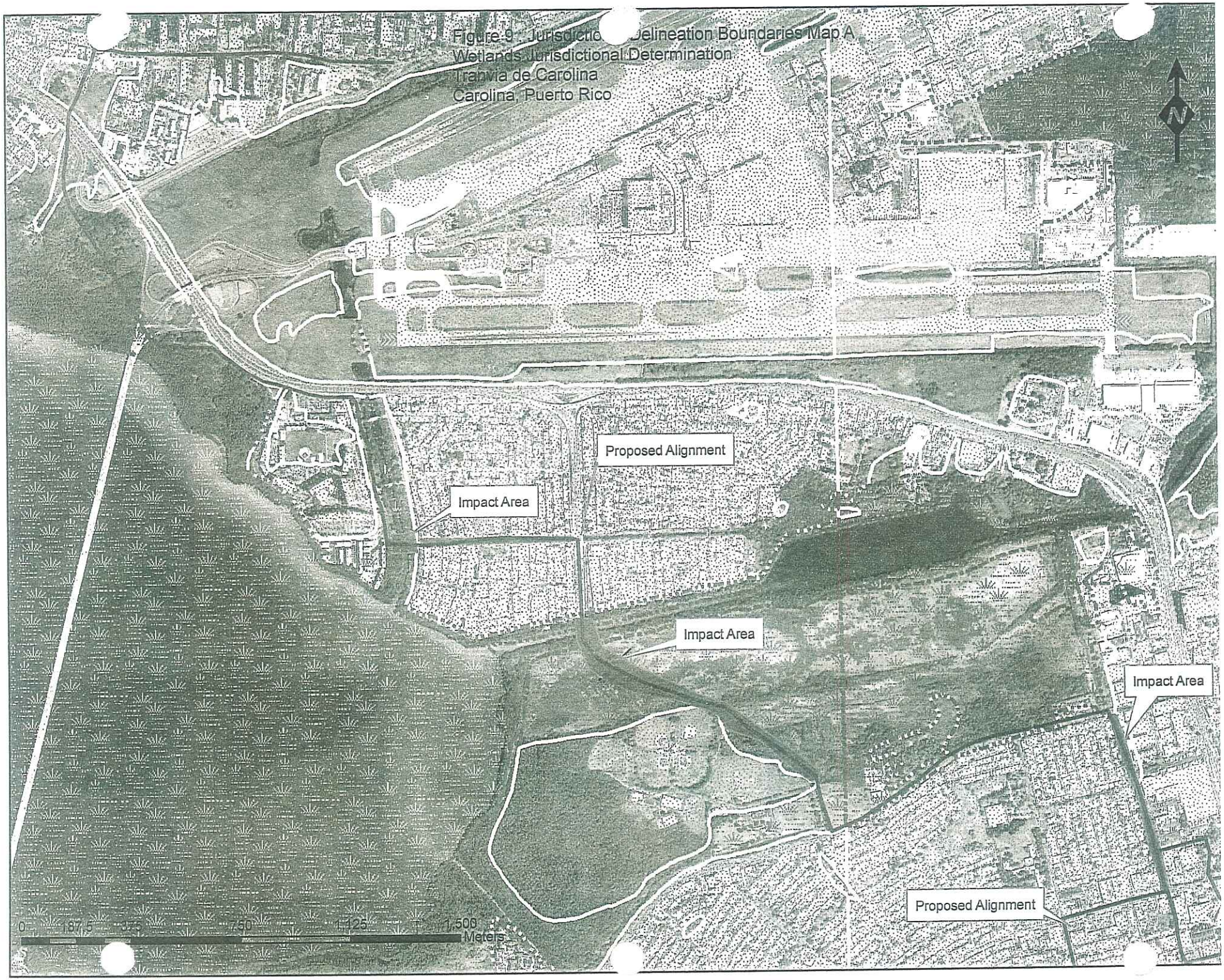
Figure 9 - Jurisdictional Delineation Boundaries Map A
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto Rico
N
Proposed Alignment
Impact Area
Impact Area
Impact Area
Proposed Alignment
0
187.5
375
750
1,125
1,500
Meters

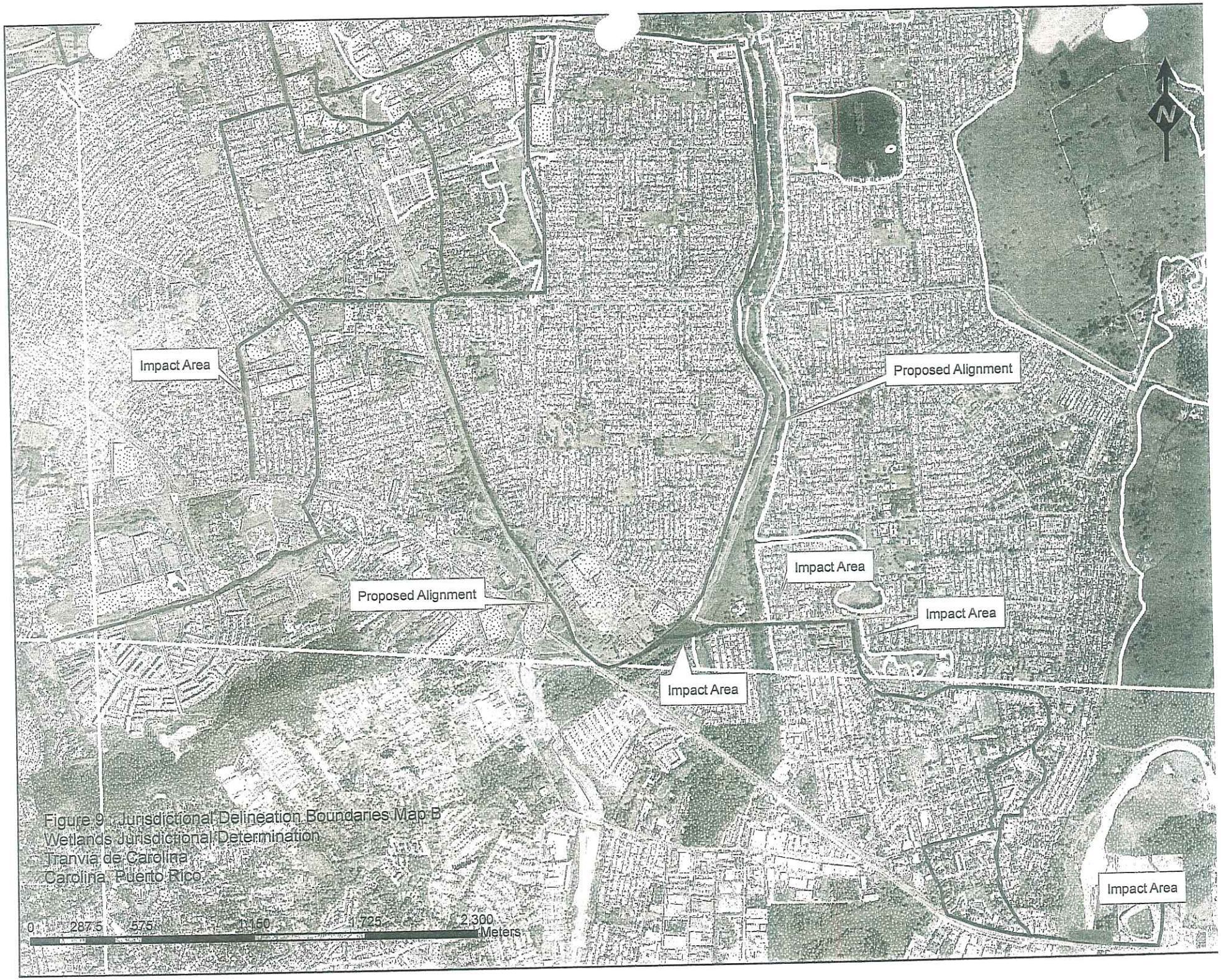

Figure 9 . Jurisdictional Delineation Boundaries Map B
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto Rico

Table 4: GPS Coordinates

Sampling Site	LAT	LONG	Sampling Site	LAT	LONG
1	18.41877884	-65.96731335	47	18.37860806	-65.95604788
2	18.41968727	-65.96764150	48	18.37651138	-65.95481035
3	18.42056033	-65.96782414	49	18.37669945	-65.94717761
4	18.42075194	-65.96779799	50	18.37863548	-65.94715346
5	18.42257484	-65.96827744	51	18.41575394	-65.98970782
6	18.42400211	-65.96836301	52	18.41537882	-65.98347159
7	18.43229449	-65.97624167	53	18.41347121	-65.98237128
8	18.43274661	-65.97744472	54	18.39127632	-65.96926585
9	18.43290260	-65.97838400	55	18.39141577	-65.96720289
10	18.43287201	-65.98010162	56	18.39137515	-65.96367590
11	18.43286044	-65.98151280	57	18.38491979	-65.95401612
12	18.43263715	-65.98345161	58	18.38160965	-65.95595898
13	18.43161271	-65.98431973	59	18.37860806	-65.95604788
14	18.43152294	-65.98508290	60	18.37651138	-65.95481035
15	18.42999022	-65.98648461	61	18.37669945	-65.94717761
16	18.42947021	-65.98691963	62	18.37863548	-65.94715346
17	18.42923585	-65.98668954	63	18.42472295	-66.00761488
18	18.42769199	-65.98616618	64	18.42436538	-66.00746082
19	18.42472295	-66.00761488	65	18.42458465	-66.00724306
20	18.42436538	-66.00746082	66	18.42489101	-66.00805057
21	18.42458465	-66.00724306	67	18.42714063	-66.01016566
22	18.42992208	-65.98750460	68	18.42048950	-65.99580444
23	18.42992526	-65.98750577	69	18.41960748	-65.99741000
24	18.42983591	-65.98724937	70	18.41899677	-66.00013210
25	18.42992065	-65.98708173	71	18.41356312	-65.99234574
26	18.42993884	-65.98696413	72	18.40993158	-65.99147854
27	18.42967959	-65.98705927	73	18.40618352	-65.98931492
28	18.42489101	-66.00805057	74	18.40337927	-65.98862375
29	18.41575394	-65.98970782	75	18.40058441	-65.98854530
30	18.41537882	-65.98347159	76	18.39727675	-65.98925306
31	18.41347121	-65.98237128	77	18.39671390	-65.98897202
32	18.41265718	-65.97789750	78	18.39561696	-65.98928014
33	18.40749911	-65.97748415	79	18.39473552	-65.99112784
34	18.40446064	-65.97783833	80	18.39226252	-65.99928319
35	18.40099666	-65.97795657	81	18.39310348	-65.99548467
36	18.39675318	-65.97802463	82	18.39402901	-65.96964033
37	18.39454511	-65.97476602	83	18.39791184	-65.96800134
38	18.39127632	-65.96926585	84	18.40292950	-65.96740010
39	18.39141577	-65.96720289	85	18.40783015	-65.96744503
40	18.39137515	-65.96367590	86	18.41391407	-65.96689291
41	18.39144840	-65.96009387	87	18.42224518	-66.00425969
42	18.39173300	-65.95642675	88	18.42227720	-66.00495622
43	18.39160777	-65.95245318	89	18.42190580	-66.00327733
44	18.38773265	-65.95291778	90	18.41999413	-66.00176993
45	18.38491979	-65.95401612	91	18.41965894	-66.00054584
46	18.38160965	-65.95595898	92	18.39060567	-65.97195198

This inventory was complemented with computerized (ERDAS Imagine) analysis of high-resolution aerial photographs. Wetlands were identified on the photographs based on vegetation, visible hydrology, and geography according to the classification system developed by Cowarding, et al (1979). Remote sensing techniques were applied to categorize color bands and depict wet areas by means of infrared bands. The aerial photographs typically reflect conditions during the specific year and season when they were taken. In addition, there is a margin of error inherent in the use of aerial photographs. Thus, a detailed field survey using submetric GPS , real time and WAAS enabled to located specific boundaries with a precision degree of less than 10cm per waypoint.

A sub metrical GPS unit using DGPS and post processed data was used to take geo referenced points associated to sampling points, upland and wetland boundaries. All data collection and GIS/RS database was projected on the Lambert Conformal Conic with the NAD 83 datum in the UTM zone 19N grid.

All geographical data and figures were developed and processed using ArcGIS 9.2 with extensions from ESRI and the imagery was analyzed using ERDAS Imagine 8.7 for RS. A total of 276 point counts were sampled and geo-referenced to existing datasets. In addition, a series of points were collected with the GPS unit to define property lines and wetland boundaries as well.

This GIS/ Remote sensing involved compiling existing data, creating new digital data, and geoprocessing digital data including among others;

1) NWI polygon data,
2) Digital line graph (DLG) hydrology coverage for study area quad
3) Digital raster graphics (DRGs) and digital ortho quad (DOQ) for study quads
4) Aerial and Satellite RS imagery

The NWI polygon data served as the prime source of wetland habitat data, while the DLG hydrology layer was the major source of stream data. DRGs were used as collateral data to evaluate wetlands that were not readily identified as isolated or non-isolated. The analysis was a series of a GIS operations complemented with real data.

A. Vegetation: As used in the definition, a prevalence of vegetation refers to the dominant vegetation plant community or communities in an area at some point in time. For the area to be considered a wetland, the prevalent vegetation must consist of macrophytes that are typically adapted for life in flooded or saturated soils. Operationally, it is determined that a positive wetland vegetation indicator is present when more than 50 percent of the dominant plant species are:

1. Obligated Wetland Plants (OBL) - Plants that occur almost always (probability > 99°_) in wetlands under natural conditions, but which may occur rarely (probability < 1%) in non-wetlands.
2. Facultative Wetland Plants (FACW) - Plants that occur usually (Probability 67% to 99%) in wetlands, but also occur (probability 15 to 33%) in non-wetlands; 3. Facultative Plants (FAC) - Plants with a similar likelihood (probability 33% to 67%) of occurring in both wetlands and non-wetlands.

B. Soils: According to the 1987 USA CoE Wetland Delineation Manual, only hydric soils that support hydrophitic vegetation may be classified as wetland soils. A hydric soil is saturated or flooded for a long enough period during the growing season to develop anaerobic conditions (U.S. Department of Agriculture, Soil Conservation Service, 1985, and Technical Committee for Hydric Soils, 1986).

The following criteria for sandy soils were used during this jurisdictional delineation:

1. Occurrence of organic soil - Qualitative estimates of organic matter content was used as indicators of sandy hydric soils by observing whether the following conditions were present:
    a. High organic matter content in the surface horizon.
    b. Streaking of subsurface horizons by organic matter.
    c. Organic pans.
2. Soil color - Grayed or low matrix chrome «1). It was determined that a positive wetland soil indicator was present when: (a) more than 50 percent (by volume) of the upper 32 inches of soil is composed of organic soil material; or (b) organic soil material of any thickness rests on bedrock. Organic soils are saturated for long periods and are commonly called peat or mucks. Note that during the determination the soil color criteria were used as an indicator for non-sandy soils only. Our field survey shows that most of the land is composed of Rio Lajas sands. (Figure 5: Soils Map).

C. Hydrology: The 1987 USA CoE Wetland Delineation Manual defines wetland hydrology as all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface at some time during the growing season.

The following hydrologic criteria were used during this jurisdictional delineation.

1. Visual observation of inundation - Standing waters occurring at the site.
2. Visual observation of soil saturation - Water level in a soil pit is less than 18 inches from land surface.
3. Tide elevation - Site is within the intertidal zone.
4. Physiological adaptations-Occurrence of gas-exchange structures in woody vegetation.

Water is the principal feature of a wetland. The occurrence, quantity, and movement of water (the hydrologic regime) are fundamental to the functional values that a particular wetland possesses. Furthermore, the hydrologic regime controls the wetland diversity found in a given area. The hydrologic regime is the most important factor controlling the wetlands' plant composition, succession and zonation.

The hydrologic regime may be defined in terms of:

1. Water sources - the source(s) of water that subsidize a wetland,
2. Hydroperiod - duration, depth and frequency, with which floodwaters occurred,
3. Water flow - movement of water within the wetland, in terms of velocity and direction.

Direct rainfall, overland runoff, stream flow, and ground water are sources to wetlands. The other two components of the hydrologic regime, hydroperiod, and water flow are intimately related to the water sources. The differences between water inputs and outputs result in water storage or deficit. Water storage within a wetland will determine whether standing waters will occur at any particular time. The hydroperiod is expressed in terms of duration, frequency, and depth at which the flooded water occurs within a wetland.

VII. RESULTS

After groundtruthing and field sampling, we found jurisdictional wetlands within the studied area.

According to the National Wetlands Inventory, we may find in the study area the following associations.
E2FO3= Estuarine Intertidal Forested Broad Leave
E1UBL= Estuarine Subtidal Unconsolidated Bottom
E2EM1 FO3M= Estuarine Intertidal Emergent Persistent Forested Mangrove
E2FO3M= Estuarine Intertidal Forested Broad Leave Mangrove

The studied area shows about 34.56 acres of wetland with potential impact approximately, including 31.08 acres of herbaceous wetland and 3.38 acres of forested wetland mainly fringe mangroves. Refer to Figure 7 Wetlands Inventory Map.

The vegetation along the studied area is diverse in composition and structure. Plant species associated to human settlements are common like *Cocos, Tabebuia, Delonix, Pterocarpus indicus*. Ornamental plants and trees are common along landscaped areas. Tracts of mangroves are found along Suarez Channel, San Jose Lagoon and Blasina Channel. Large tracts of herbaceous wetlands area are found near Cuidad Deportiva Roberto Clemente.

Most of the studied area soils have been modified either by fill or by move. Mostly soils from mixed origin used as fill for urban developments were found. The soils found are considered non-hydric soil (Soil Conservation Service, 1993).

The studied area does contain natural hydrographical features including rivers, channels, creek, lagoons, pond, and mangroves. Influence of tide are driven force to hydro features.

The vegetation, soil, and hydrologic data were used to delineate the area that met the wetland jurisdictional criteria. Figure 9 Jurisdictional Delineation of existing wetlands shows the results of the jurisdictional determination.

The remote sensing and GIS effort included the categorization of aerial imagery. Images were analyzed for color in the infrared spectrum to check for wet sites. Please refer to Figures 10 and 11; Infrared Image and Band Categorization

The analysis of the field data shows that a total of approximately 34.56 acres of land are to be considered wetlands. 31.8 acres of those are herbaceous and 3.48 acres are mangrove forested wetlands.

Table 5 summarizes the field results of the wetland jurisdictional determination based on the three indicators used (vegetation, soils, and hydrology).

Figure 10 - Infrared Band Image
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto Rico