Apéndice D

Wetland Jurisdiccional Determination for theTLMAC, Carolina, Puerto Rico

WETLAND JURISDICTIONAL DETERMINATION FOR TRANVIA DE CAROLINA LIGHT RAIL TRANSIT PROJECT , CAROLINA, PUERTO RICO.

Presented to:
Regulatory Program
USACE, San Juan, P.R.

Prepared for:
ERM PR

Prepared by:
EA Environmental Consultants
San Juan, Puerto Rico

February 2007

CERTIFICACION

Yo, Pedro J. Rivera-Lugo, PhD, Ecólogo Senior para la empresa de consultoría "EA Environmental Consultants & Services" (Ecoaventuras Environmental Consultants), entidad responsable designada por la empresa "Environmental Resources Management de Puerto Rico" para efectuar el estudio denominado como "Jurisdiccional Determination for the "Tranvía de Carolina", así como el "Joint Permit" para dicho proyecto.

En relación con el proyecto antes mencionado que ha de ser incorporado en la Declaración de Impacto Ambiental como parte integral de ésta, CERTIFICO QUE:

1. Toda la información vertida en el documento antes descrito es CIERTA, CORRECTA Y COMPLETA a mi mejor entender y conocimiento, y

2. AFIRMO Y RECONOZCO las consecuencias de incluir y someter información incompleta, inconclusa o falsa en dicho documento.

Y para que así conste, firmo la presente certificación en Juncos, Puerto Rico, hoy 9 de julio de 2007.

Firma
Pedro J. Rivera-Lugo, PhD
Fecha: 9 de julio de 2007

WETLAND JURISDICTIONAL DETERMINATION: TRANVIA DE CAROLINA LIGHT RAIL TRANSIT PROJECT ,CAROLINA, PUERTO RICO.

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Pedro J Rivera Lugo, PhD.
Senior Ecologist

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I. EXECUTIVE SUMMARY

A wetland jurisdictional delineation was conducted along the proposed alignment corridor for the Tranvia de Carolina including Urban Center, Luis Muñoz Marín International Airport, the Isla Verde area that stands out for its hotels and tourist zones, the urbanized zone of *barrios* such as: Sabana Abajo, Hoyo Mulas, Martín González and San Antón, and the territories south of the 65th Infantry Avenue that have been considered for residential development, all at the Municipality of Carolina.

Warm wet summers and cooler dry winters with an average annual precipitation of 82 inches characterize the climate. Alluvium, artificial fill, and Rio Piedras Siltstone dominate the geology of the area. The principal soil unit within the study area is edaphic material from mixed origins used a fill for settlements and developments. Outside the urban setting, we can find Yunes and Toa silty clay loams.

The Wetland delineation was conducted following the guidelines of the 1987 US Army Corps of Engineers Wetland Delineation Manual. A "Routine Approach, On-site Inspection" was used for this jurisdictional delineation. This wetland jurisdictional delineation was developed by characterizing the vegetation, soils, and hydrology of the study area. Approximately 34.5 acres of wetlands can be impacted along the proposed alignment.

The analysis of the field data showed that the land is covered by a mosaic of coverage including mangroves, herbaceous wetlands, and urban forests with landscape treatments as well herbaceous areas under mowing regimes. Disturbance regime is obvious particularly soils, which have been modified by filling since the early sixties as, showed in aerial images. The study area is leveled through the topography of the landscape. A series of drainage channels creeks, lagoons, and ponds area distributed throughout the study area.

II. INTRODUCTION

A Jurisdictional Determination was commissioned to delineate potential existing wetlands. ERM contracted EcoAventuras Inc., Environmental Consultants & Services to conduct the jurisdictional wetland delineation at the proposed project.

This report contains the results of a wetland jurisdictional delineation for the property studied in Carolina, Puerto Rico. The procedures outlined in the 1987 Corps of Engineers Wetland Delineation Manual were followed. As part of the delineation, the available literature including published FWS, Planning Board, NRCS, DNER and technical journal/articles were revised. In addition sampling of soils, vegetation and hydrology was collected systematically along the study area.

Figure 1(Location Map) depicts the study area which comprises the more intensely urbanized Municipality of Carolina from the Atlantic Ocean on the north, south to the area along and just south of the PR-3 corridor.

The study has presumed a platform length of 45 m. (150 feet) for conceptual planning purposes.

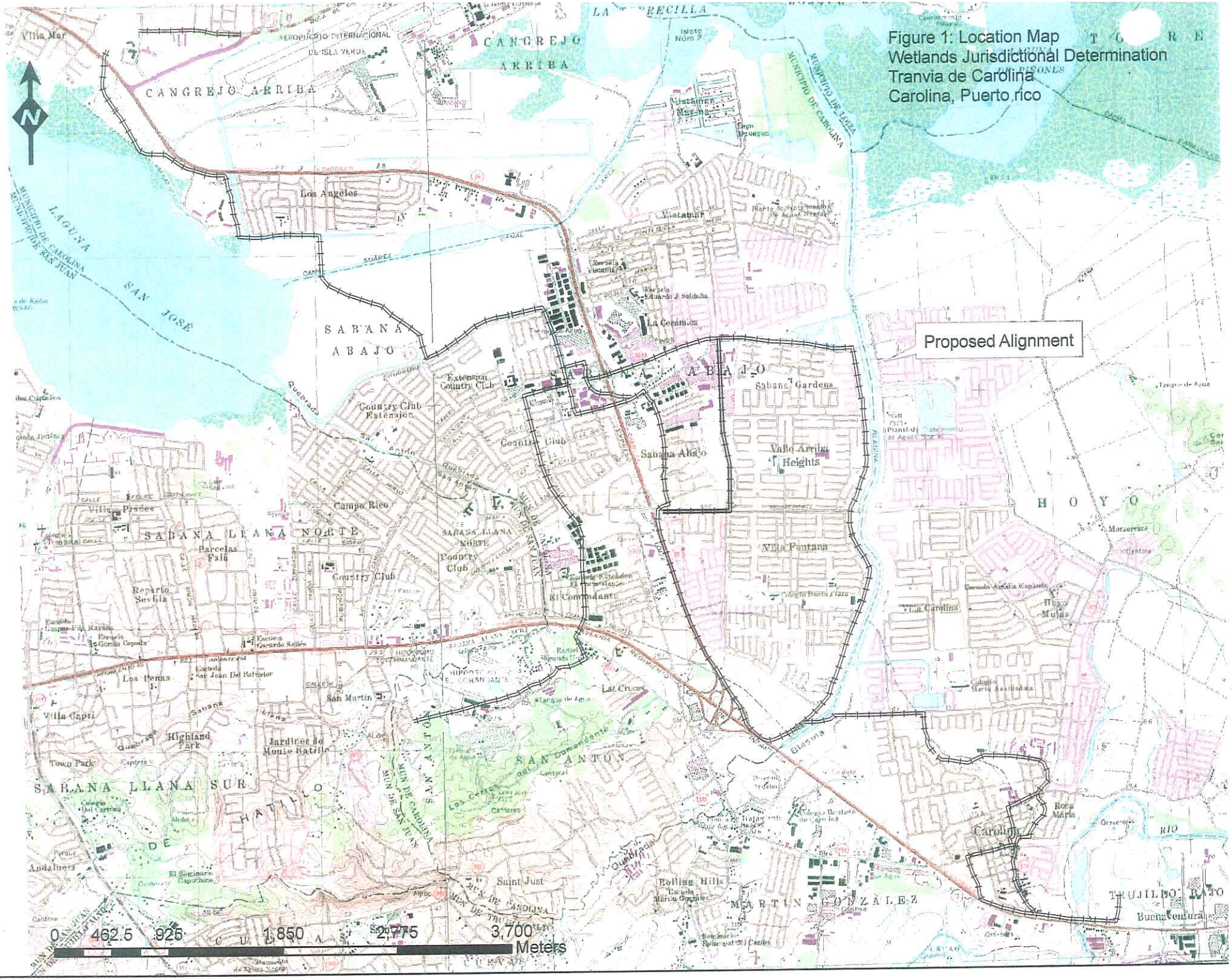


Figure 1: Location Map
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto rico

III. GENERAL DESCRIPTION OF TRANVIA DE CAROLINA

The municipality of Carolina was founded in 1857 and has grown to a population approaching 200,000 persons, making it Puerto Rico's fourth largest city. Carolina enjoys a strategic location immediately east of San Juan, stretching from the Isla Verde tourist district on its north coast line at the Atlantic Ocean southward past the San Juan International Airport, through numerous residential districts, educational facilities, and industrial district to the PR-3 commercial/retail corridor and beyond to newer residential districts and rural areas in the rolling hills south of PR-3 and the proposed PR-66 corridor. The city has been called the "industrial capital" of Puerto Rico for its factory, warehouse, and industrial districts, reflective of its proximity to the airfreight facilities of the airport, the seaport facilities further west, and several major trunk highways, including PR-26 and PR-3.

The municipality has a rich mix of land uses and a generally dense pattern of development intensity outside of the environmentally sensitive habitats, which comprise a significant part of the city. These land use patterns have led to relatively congested conditions on the major roadways, compounded by the fact that residential and commercial land uses lying to the east generate trips for work commuting, business, shopping and other types of trips that traverse the main road arteries of Carolina, compounding the municipality's congestion. Long-range projections anticipate a worsening situation for Carolina and the San Juan metropolitan area. This outlook was the impetus for the Tren Urbano urban rail project, Phase 1 of which was recently completed.

As a trunk heavy rail system for the metropolitan region, Tren Urbano can provide regional mobility to the area's primary activity and employment centers. A planned Tren Urbano extension would run along the PR-3 corridor from Trujillo Alto eastward to Roberto Clemente Stadium just east of the Rio Grande de Loíza. Carolina would be served by this eastward route of Tren Urbano, with five of the nine new stations on this extension lying within Carolina.

Strategically located around the north and east side of the Lagoon San José, Carolina experiences a significant proportion of linearly-oriented travel patterns that would be candidates for consideration of alternative travel modes. While Carolina is served by a number of AMA public transit routes as well as "carros publicos", these services become trapped in the congestion of major intersections and corridors, reducing them in some respects to an alternative service of last resort. As a result of these conditions, and with a view to a better future, a study of future travel alternatives was conducted. That study was presented in a report entitled: Study for the Design of a Mass Transportation System in the Municipal Territory of Carolina (Second Final Report) - February 2005, Innovative Transport, Inc. The study evaluated various routings and transit technologies (Metro - heavy rail transit, light rail transit, bus rapid transit) and recommended the light rail transit technology along a specific proposed route alignment.

The primary guiding document for the planning and management of land use and transportation for the Carolina municipality is the Plan de Ordenacion Territorial (POT).

The Territorial Ordering Plan ("*Plan de Ordenación Territorial*", POT) stipulates the public policy toward the municipality's development and land use, becoming a land use planning tool in the municipality.

The POT highlights as a premise that the municipality's areas or focal points (Airport, Isla Verde and the Urban Center) must be linked in a mass transportation network able to allow the maximum development of each focal point conserving or improving the physical surroundings, environment and natural resources of the municipality.

The POT stipulates important public policies that must be taken into consideration:

- To turn the Traditional Urban Center (CUT) into one of the main spots of social, economic, and cultural activities.
- To improve physical accessibility conditions of public and private facilities.
- To minimize environmental impacts associated with transportation.
- To strengthen the tourism sector in the municipality.
- To delimit the following areas: Urban Center, 65th Infantry Avenue (between Loíza Expressway and the Río Grande de Loíza) and Isla Verde, as first-class strategic centers and to establish a system of distinctive urban furniture for each area.
- To recognize Campo Rico Avenue, Paseo de los Gigantes Avenue; Fragoso-Sánchez Castaño Avenue; Sánchez Osorio Avenue; Fidalgo Díaz Avenue; and Roberto Clemente Avenue as Commercial Avenues.
- To group the governmental, commercial, institutional, recreational and sport facilities, among others, based on population distribution.
- <u>To improve the mass transportation system in the CUT (taxis, public transportation and AMA) making it more integral.</u>

  A. Establish a *Mass Transportation System* that emphasizes:

  1. Integration of mass transportation for residents and visitors.
  2. Reduction of traffic congestion.
  3. Prevention of congestion where it has not yet begun.
  4. Reduction in environmental problems associated with traffic congestion.

  B. Link the focal points stated in the Territorial Plan of the Autonomous Municipality of Carolina. These are: Urban Center, Luis Muñoz Marín International Airport, the Isla Verde area that stands out for its hotels and tourist zones, the urbanized zone of *barrios* such as: Sabana Abajo, Hoyo Mulas, Martín González and San Antón, and the territories south of the 65th Infantry Avenue that have been considered for residential development.

The POT proposes and identifies several nuclei that must be integrated into a mass transportation system. Within the main reasons to identify these nuclei, is the fact that the Central Government approved the Tren Urbano extension to the Municipality of Carolina. This situation compels the municipality to refocus its spatial and physical development vision. In order to identify these nuclei, the population increase directly related with the increase of the automobiles in the municipality was considered.

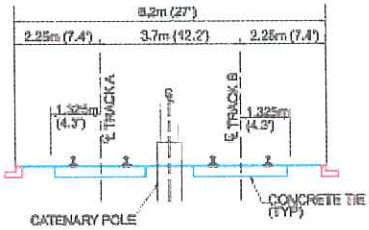
The Tranvia de Carolina service configuration of the transit operations consists of several interrelated components. These are the route layout, station location and spacing, service frequency, demand levels (daily and peak), and the size and number of train cars to be used on each circuit of the transit route, which in turn defines the length of the station platform.

Other estimates in the prior reports ranged up to 34,800 daily passengers, a higher figure, but the final recommended headway was 5 minutes on the common section which compensates for the higher rider ship.

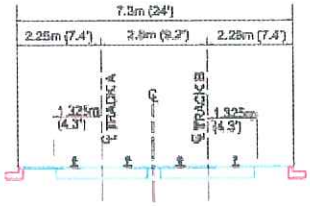
Criteria utilized assumed for the purposes of this work that the proposed technology is light rail transit, with propulsion to be provided by electricity conveyed to the vehicles by an overhead catenary system (or possibly some segments with power supplied from an underground rail), and that the alignment will operate within an exclusive guide way, with some segments within the right-of-way for existing streets and roads, except for at-grade crossings at street level.

Figure 2 depict the proposed typical sections along the alignment and at station locations, and the plan configurations for the different station configurations.

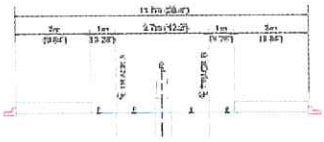
Figure 2: Typical Section



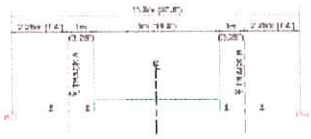
TYPICAL SECTION
WITH CENTER CATENARY POLES



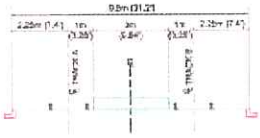
TYPICAL SECTION
WITHOUT CENTER CATENARY POLES



TYPICAL STATION SECTION
SIDE PLATFORMS



TYPICAL STATION SECTION
CENTER PLATFORM



TYPICAL STATION SECTION
STAGGERED CENTER PLATFORMS

The urbanized and developed areas of the municipality are characterized by relatively efficient use of land areas, with relatively modest street rights-of-way, usually limited building setbacks, and intensive use of public and private space between buildings and the street by commercial properties. Relatively few open corridors could accommodate a facility such as the light rail transit without some disruption of the existing built urban environment. There are open spaces around the municipality, some developed as parks, and others, which are undeveloped due to the presence of wetlands or low-lying lands subject to occasional flooding.

As a result of these conditions, initial alternatives for the light rail transit system had alignments largely located within existing street rights-of-way. While this configuration avoided property acquisition, it introduced dramatic changes to the traffic operations on the affected streets. Namely, there is a loss of traffic capacity along the affected segment, implied but not fully defined or recognized in the prior study, changes in property access and circulation patterns, impacts in some cases to truck delivery, and loss of on street parking. The presence of the light rail transit system in an "in-street" configuration also reduces the capacity of traffic signals at existing street intersections, as the light rail transit will require a separate traffic phase for passage through the intersection, over and above the possible loss of traffic lanes at the intersection.

Using existing streets for the light rail transit avoids right-of-way acquisition, but it creates other disadvantages to traffic operations and there is still an inherent cost of constructing the facility within the street pavement area, including installing the light rail section and adjustment of utilities, among other items. The "in-street" configuration usually dictates the acquisition of property for the placement of light rail transit stations as well, as the width of existing streets is relatively constrained.

The most likely situation is that in order to best accommodate the light rail within existing streets while minimizing adverse traffic operations impacts and property access conflicts to the extent possible, the placement of the alignment to reduce utility conflicts and relocations becomes a secondary consideration.

Certainly, it is prudent to avoid major longitudinal utility conflicts along the length of a light rail segment and costly "point" conflicts with major trunk utilities. However, in this built-up urban environment, it is inevitable that there may be some trunk transmission utility conflicts, more distribution utility conflicts, and many service connection utility conflicts.

As Alternatives 1 and 2 as provided for this study both had substantial amounts of their alignments in existing street rights-of-way, Alternative 3 was devised to provide an alternate approach to inserting the light rail corridor into the compact and relatively dense urban environment. This approach attempted to minimize use of existing traffic lanes on arterial streets, and maximize use of open areas with fewer improvements and utilities, though involving some right-of-way acquisition.

APPENDIX B: PROPOSED ALIGNMENT & PROFILES describe the features of the proposed alignment alternative, each subdivided into a number of short segments with profiles of the alignment, the typical section, stations, structures, traffic and circulation, utilities, and environmental and community factors. For each segment, the appropriate alignment plan sheets are identified for cross referencing.

IV. GENERAL DESCRIPTION OF STUDY AREA

A. Site Location and Landscape Features

The proposed project is located in a corridor of approximately 28 kilometers along the Municipality of Carolina, Puerto Rico. The study area is located along major roads, avenues, and urban settlements in Carolina. (Refer to Figure 1 Location Map and Figure 3 Aerial Image)

Figure 1 depicts the study area, which comprises the more intensely urbanized lands of the Municipality of Carolina, from Isla Verde on the north and up to the south along urban settlements and just of the PR-3 corridor. The study has presumed a platform length of 45 m. (150 feet) for conceptual planning purposes.

B. Geology

The study area is in the Northern coastal plateau in Puerto Rico. Alluvium, artificial fill, and Rio Piedras Siltstone underlie the area. See Figure 4 Geologic map for the Carolina.

Alluvium from the Holocene- Sand, clay, and sandy clay with variable thickness. Beds of sand containing gravel at the sides of the Rio Grande de Loíza

Artificial Fill from the Holocene and Pleistocene- Material from various sources hauled in and dumped in low, swampy places to provide foundations for housing and industrial development.

Rio Piedras Siltstone- Well stratified, thin-bedded, partly laminated, mostly tuffaceous siltstone and fine-grained sandstone. In fresh exposures, the formation is medium gray, but in most outcrops, it is weathered to yellowish, reddish, and greenish gray and brown.

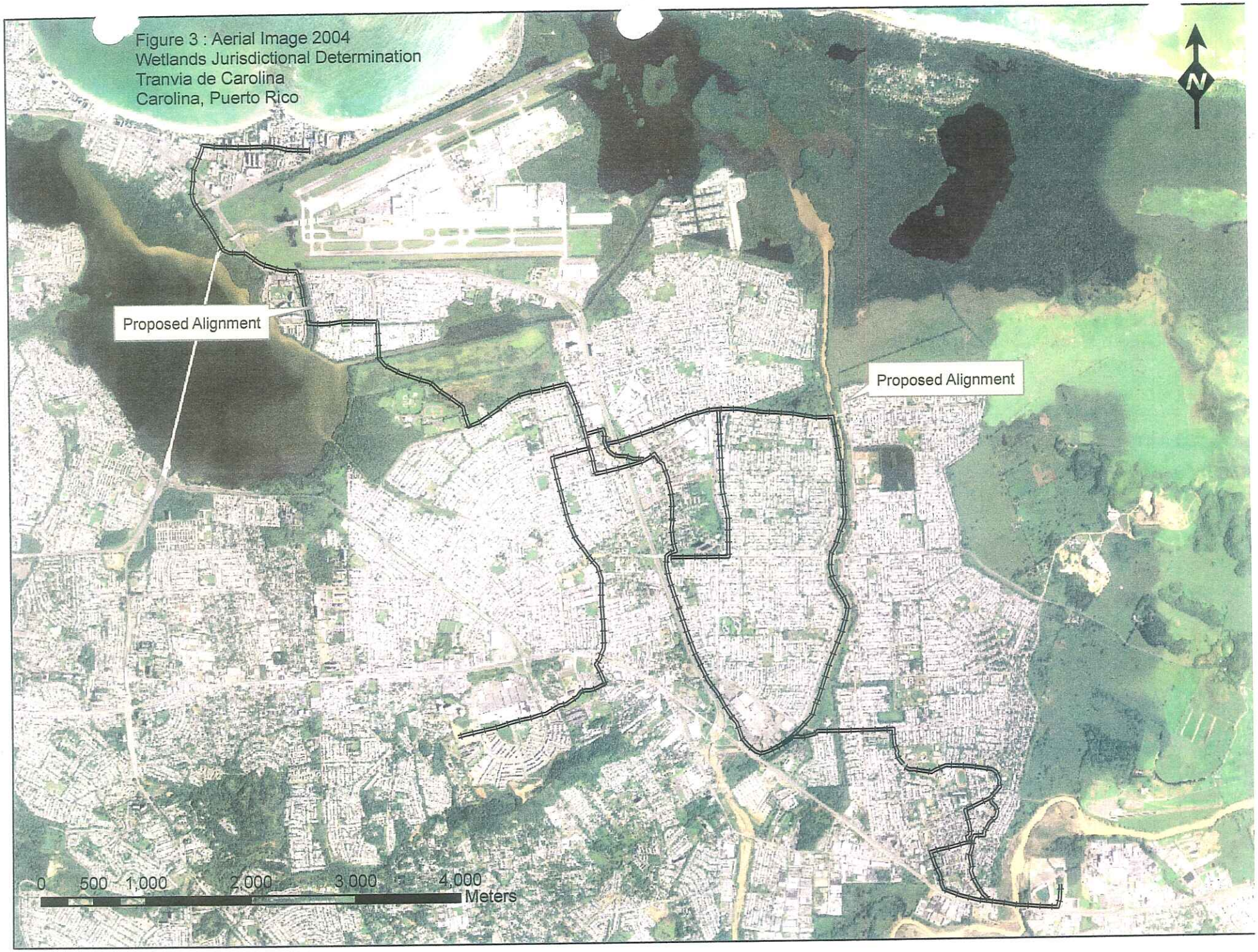


Figure 3 : Aerial Image 2004
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto Rico
Proposed Alignment
Proposed Alignment
N
0 500 1,000 2,000 3,000 4,000
Meters

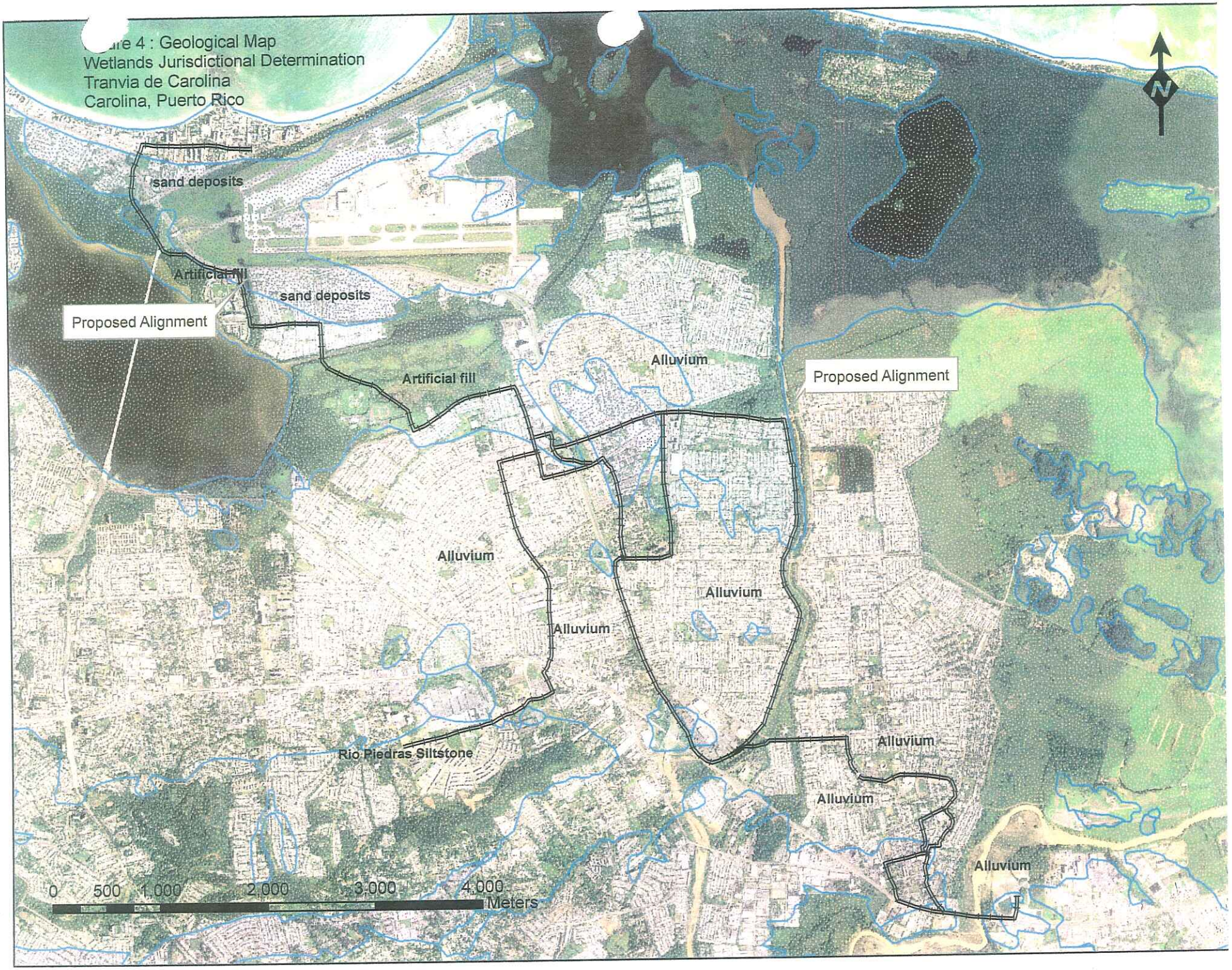


Figure 4 : Geological Map
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto Rico
N
sand deposits
Artificial fill
sand deposits
Proposed Alignment
Artificial fill
Alluvium
Proposed Alignment
Alluvium
Alluvium
Alluvium
Rio Piedras Siltstone
Alluvium
Alluvium
Alluvium
0 500 1,000 2,000 3,000 4,000
Meters

C. Soils

The San Juan Soil Survey shows the prevalence of Yunes silty clay loam, Toa silty clay loam, Made Land and Soils not survey. See Figure 5 Soils map for the Carolina area. The following soil series were found in the study area:

Yunes silty clay loam- The Yunes series consists of loamy-skeletal, mixed isohyperthermic, shallow Typic Dystrotepts. These soils are shallow, are well drained and have B horizons of dark brown and brown very salty silty clay loam, They formed in residuum of thin bedded shale. The Yunes soils are on side slopes and tops of strongly dissected uplands.

Toa silty clay loam- The Toa series consists of mixed isohyperthermic Fluventic Hapludolls. These soils are deep moderately well drained to well drained, and have a B horizon of brown silty clay loam. They formed in sediments of mixed origins. The Toa soils are on river flood plains in the humid portions of the island.

Made Land- Made Land consists of areas that have been covered with gravel, rock, concrete blocks, and other debris. It has been built up for industrial uses and is not suited for farming.

Soils not survey are those areas where soils were already impervious or covered with urban settlements at the time of the soil survey.

Table 1: General characteristics of the soils in the studied area

(Adopted from the U.S. Department of Agriculture, Soil Conservation Service)

Map Symbol	Soil Name	Depth (in)	Shrink Swell Potential	Permeability (in. Per hour)	Available Water Capacity (cm/ per cm of soil)	Soil React (pH)
YuF2	Yunes silty clay loam	16	Low	.6 - .2	.07 - .10	4.5 – 5.5
Tt	Toa Alta silty clay loam	0-60	Moderate	.6 - .2	.1 - .15	5.6 – 7.3

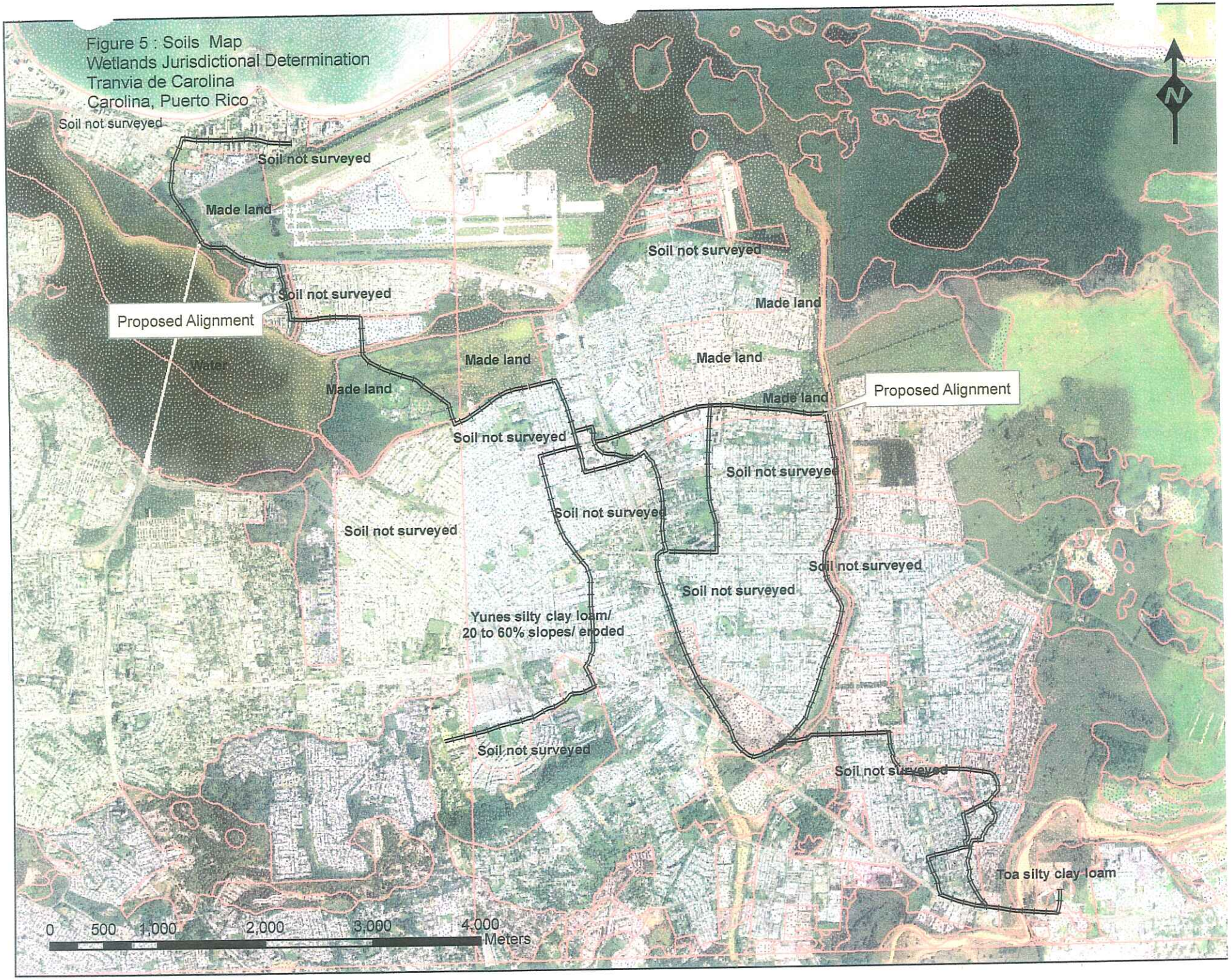


Figure 5 : Soils Map
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto Rico
N
Soil not surveyed
Soil not surveyed
Made land
Soil not surveyed
Proposed Alignment
Water
Made land
Made land
Soil not surveyed
Made land
Made land
Made land
Proposed Alignment
Soil not surveyed
Soil not surveyed
Soil not surveyed
Soil not surveyed
Soil not surveyed
Soil not surveyed
Yunes silty clay loam/
20 to 60% slopes/ eroded
Soil not surveyed
Soil not surveyed
Toa silty clay loam
0 500 1,000 2,000 3,000 4,000
Meters

D. Climatology

The study area is located in the humid subtropical zone. The average annual rainfall is 82" and the average annual temperature is 78F. Rainfall is more frequent during the months of July to October. The average relative humidity is 80%. The winds blow usually from the Northeast. The area is subject to the influence of marine breeze.

E. Flora and Fauna

During the assessment, we recorded a cumulative list of plant and animal species that we observed along the sampling array period. A list of species is provided as baseline data obtained during our field visits.

Table 2: Flora Composition List for the study site

Scientific name	Common Name	Family	Habit
Achyranthes aspera	Rabo de ratón	Amaranthaceae	H
Acrocomia media	Palma Corozo	Arecaceae	T
Acrostichum aureum	Golden Leatherfern	Pteridaceae	S
Aeschynomene americana	Shyleaf,morivivi bobo	Fabaceae-Papilonoidea	H
Albizia lebbek	Lengua de mujer	Fabaceae-Mimosoidea	T
Albizia procera	Tall Albizia	Fabaceae-Mimosoidea	T
Allamanda cathartica	Canario amarrillo	Apocynaceae	S
Alysacarpus vaginalis	Yerba de Contrabando	Fabaceae-Papilonoidea	H
Amaranthus dubius	Blero manso	Amaranthaceae	V
Ammannia latifolia	Pink red stem	Lythraceae	H
Avicenia germinans	Mangle negro	Verbenaceae	T
Axonopus compressus	Gramalote	Poaceae	H
Bacopa monnieri	Coasta warehyssops	Scrophullariaceae	H
Bambusa vulgaris	Bambú	Poaceae	H
Bauhinia monandra	Orquídea de pobre	Fabaceae-Caesalpinoidea	T
Bidens alba var radiata	Clavelillo	Asteraceae	H
Blechnum serrulatum	Toothed midsorus fern	Blechnaceae	H
Bothriochloa pertusa	Pajón	Poaceae	H
Bounganvillea sp	Trinitaria	Nyctaginaceae	V
Bucidas buceras	Ucar	Combretaceae	T
Callistemon citrinus	Calistemon	Myrtaceae	T
Calophyllum calaba	Maria	Guttiferaceae	T
Cananga odorata	Ilan ilan	Annonaceae	T
Canna glauca	Maraca	Cannaceae	H

Caperonia palustris	Sacatrapo	Euphorbiaceae	H
Casuarina equisetifolia	Pino Australiano	Casuarinaceae	T
Ceiba pentandra	Ceiba	Bombacaceae	T
Cenchrus echinatus	Cadillo	Poaceae	H
Centrosema pubescens	Flor de pito	Fabaceae-Papilonoidea	V
Centrosema virginianum	Flor de Pito	Fabaceae-Papilonoidea	V
Chamaesyce hirta	Verruguilla	Euphorbiaceae	H
Chamaesyce hyssopifolia	Lechesilla	Euphorbiaceae	H
Chloris barbata	Paraguita	Poaceae	H
Chromolaena odorata	Santa María	Asteraceae	S
Cissampelos pareira	Bejuco luna	Menispermaceae	V
Cissus verticillata	Bejuco caro	Cucurbitaceae	V
Citrus x paradisii	Toronja	Rutaceae	T
Cleome spinosa	Clavelitos	Capparaceae	S
Cocos nucifera	Coco	Arecaceae	T
Collocasia esculenta	Malanga	Araceae	H
Commelina diffusa	Cohitre	Commelinaceae	H
Commelina erecta	Cohitre	Commelinaceae	H
Conocarpus erectus	Mangle botón	Combretaceae	T
Cordia sebestana	Vomitel	Boraginaceae	T
Cordylene sp	Bayoneta	Liliaceae	S
Crotalaria pallida	Crotalaria	Fabaceae-Papilonoidea	H
Cryptostegia sp	Canario morado	Apocynaceae	S
Cycas revoluta	Cycas	Cycadaceae	S
Cydista aequinoctalis	Bejuco blanco	Bignonaceae	T
Cynodon dactylon	Bermuda grass	Poaceae	H
Cyperus alternifolius	Palmita	Cyperaceae	H
Cyperus difformis	Smallflower umbrella sedge	Cyperaceae	H
Cyperus esculentus	Coquí	Cyperaceae	H
Cyperus imbricatus	Shingle flatsedge	Cyperaceae	H
Cyperus ligularis	Swamp flatsedge	Cyperaceae	H
Cyperus odoratus	Rusty flat sedge	Cyperaceae	H
Cyperus polystachios	Manyspike flatsedge	Cyperaceae	H
Cyperus rotundus	Coqui	Cyperaceae	H
Cyperus sphacellatus	Roadside sedge	Cyperaceae	H
Cyperus surinamensis	Tropical flatsedge	Cyperaceae	H
Cyperus virens	Green flat sedge	Cyperaceae	H
Cytharexyllum fruticosum	Pendula	Verbenaceae	T
Dalbergia ecastaphylla	Brasilete	Fabaceae-Papilonoidea	T
Delonix regia	Flamboyán	Fabaceae-Caesalpinoidea	T
Desmanthus leptophyllus	Slenderleaf bundle flower	Fabaceae-Mimosoidea	H
Desmodioum incanum	Zarzabacoa común	Fabaceae-Papilonoidea	H
Desmodium axillare	Zarzabacoa	Fabaceae-Papilonoidea	H
Desmodium scorpiurus	Zarzabacoa cola de escorpión	Fabaceae-Papilonoidea	H
Desmodium triflorum	Zarzabacia triflorada	Fabaceae-Papilonoidea	H
Digitaria ciliaris	Finger Grass	Poaceae	H
Digitaria eriantha	Pangola	Poaceae	H
Digitaria ischaemun	Small crabgrass	Poaceae	H
Digitaria longiflora	Indian crab grass	Poaceae	H

Draceanea fragans	Dracinia	Liliaceae	S
Drymaria cordata	Pega pollo	Caryophyllaceae	H
Dypsis lutescens	Arecas	Arecaceae	T
Echinochloa colona	Arrocillo	Poaceae	H
Echinochloa cruz pavoni	gulf cockspur grass	Poaceae	H
Echinodorus aff tenellus	Mudbabies	Alismataceae	H
Eclipta prostrata	Eclipta blanca	Asteraceae	H
Eichornia crassipes	Jacinto de agua	Pontederiaceae	H
Eleocharis geniculata	spikesedge	Cyperaceae	H
Eleocharis interstincta	Knotted spike rush	Cyperaceae	H
Eleocharis mutata	Scallion grass	Cyperaceae	H
Eleusine indica	Pata de Gallina	Poaceae	H
Enterolobium cyclocarpum	Guanacaste	Leguminoseae	T
Epipremnum pinnatum var aureum	Pothos de agua	Araceae	V
Epipremnum pinnatum var pinnatum	Pothos de agua	Araceae	V
Eriochloa punctata	Malojilla	Poaceae	H
Erythrina fusca	Bucayo salmón	Fabaceae-Papilonoidea	H
Eucalyptus deglupta	Indonesian Gum	Myrtaceae	T
Euphorbia heterophylla	Verruguilla	Euphorbiaceae	H
Ficus microcarpa	Ficus	Moraceae	T
Fimbristylis dichotoma	forked fimbry	Cyperaceae	H
Fimbristylis ferruginea	West indian fimbry	Cyperaceae	H
Fimbristylis thermalis	None	Cyperaceae	H
Fimristylis cymosa	tropical fimbry	Cyperaceae	H
Gossypium hirsutum	Algodón	Malvaceae	S
Grevillea robusta	Roble de Seda	Proteaceae	T
Heliconia caribaea	Plátano indio	Heliconaceae	S
Heliconia psittacorum	Parakeetflower	Heliconaceae	H
Heteropogon contortus	Yerba torcida	Poaceae	H
Hibiscus bifurcatus	Buenas tardes	Malvaceae	S
Hibiscus rosa sinensis	Amapola	Malvaceae	S
Hymenocallis latifolia	Lirio de playa	Amaryllidaceae	H
Indigofera spicata	Añil rastreroo	Fabaceae-Papilonoidea	H
Ipomea violaceae	Bejuco de puerco	Fabaceae	V
Ipomoea setifera	Bejuco de puerco	Convolvulaceae	V
Ipomoea tiliacea	Bejuco de puerco	Convolvulaceae	V
Ixora coccinea	Ixora,Cruz de malta	Rubiaceae	S
Jasminum multiflorum	Jasmin peludo	Oleaceae	H
Kyllinga brevifolia	Shortleaf spikesedge	Cyperaceae	H
Kyllinga pumila	Low spikesedge	Cyperaceae	H
Lablab purpureus	Chícharo	Fabaceae-Papilonoidea	V
Lagerstroemia speciosa	Reina de las flores	Lythraceae	T
Laguncularia racemosa	Mangle blanco	Combretaceae	T
Leptochloa mucronata	Yerba de hilo	Poaceae	H
Leptochloa scabra	rough sprangletop	Poaceae	H
Leucaena leucocephala	Zarcilla	Fabaceae-Mimosoidea	T
Lindernia crustacea	False pimpernel	Scrophullariaceae	H
Lippia nodiflora	Yerba de Sapo	Verbenaceae	H
Livinstona chinensis	Palma china	Arecaceae	T

Ludwigia deccurrens	wingleaf primrose	Onagraceae	H
Ludwigia erecta	Yerba de Jicotea	Onagraceae	H
Ludwigia octovalvis	Yerba Kangá	Onagraceae	H
Macroptilium lathyroides	Habichuela parada	Fabaceae-Papilonoidea	H
Malachra alceifolia	Malva	Malvaceae	S
Mangifera indica	Mango	Anacardiaceae	T
Mecardonia procumbens	Baby jumpup	Scrophullariaceae	H
Melanthera aspera	Salaillo	Asteraceae	H
Meliccocus bijugatus	Quenepa	Sapindaceae	T
Merremia aegyptica	Aguinaldo egipcio	Convolvulaceae	V
Merremia quinquefolia	Rock rosemary	Convolvulaceae	V
Merremia umbelata	Aguinaldo amarillo	Convolvulaceae	V
Mikania cordifolia	Guaco	Asteraceae	V
Mimosa casta	graceful mimosa	Fabaceae-Mimosoidea	V
Mimosa diplotricha	False mimosa	Fabaceae-Mimosoidea	H
Mimosa pellita	Moriviví gigante	Fabaceae-Mimosoidea	S
Mimosa pudica	Moriviví	Fabaceae-Mimosoidea	H
Momordica charantia	Cundeamor	Cucurbitaceae	V
Murdania nodiflora	nakedstem dewflower	Commelinaceae	H
Musa sp	Bananas	Musaceae	S
Neptunia plena	Desmanto amarrillo	Fabaceae-Mimosoidea	H
Osmunda cinnamomea*	Cinnamon fern	Osmundaceae	H
Paspalum conjugatum	Pendejuelo	Poaceae	H
Paspalum millegrana	Cortadora	Poaceae	H
Paspalum notatum	Bahia Grass	Poaceae	H
Paspalum panniculatum	Yerba peluda	Poaceae	H
Paspalum vaginatum	Sea shore paspalum	Poaceae	H
Passiflora suberosa	Parchita	Passifloraceae	V
Paullinia pinnata	Bejuco de costilla	Sapindaceae	V
Peltophorum pterocarpum	Yellow poinciana	Fabaceae-Caesalpinoidea	T
Pennisetum purpureum	Yerba de elefante	Poaceae	H
Phoenix dactylifera	Dátil	Arecaceae	T
Phyla nodiflora	Yerba de Sapo	Verbenaceae	H
Phyllanthus amarus	Cientoun grano	Euphorbiaceae	H
Phyllanthus urinaria	Cientoun grano	Euphorbiaceae	H
Physalis angulata	Sacabuche	Solanaceae	H
Piper aduncum	Higuillo	Piperaceae	T
Pithecellobium dulce	Guamá americano	Fabaceae-Mimosoidea	T
Pluchea carolinensis	Salvai	Asteraceae	S
Polygonum acimunatum	Yerba jicotea	Polygonaceae	H
Portulaca oleracea	Verdolaga	Portulacacea	H
Pritchardia pacifica	Palma de Jardín	Arecaceae	T
Pterocarpus indicus	Terocarpo	Leguminoseae	T
Pueraria phaseoloides	Kudzú	Fabaceae-Papilonoidea	V
Rhyzophora mangle	Mangle Rojo	Rhizophoraceae	T
Ricinus comunis	Higuereta	Euphorbiaceae	S
Rotala ramosior	Rotala	Lythraceae	H
Roystonea borinquena	Palma real	Arecaceae	T
Ruellia britoniana	Petunia brittoniana	Acanthaceae	H
Ruellia tuberosa	Ruellia	Acanthaceae	H

Sagittaria lancifolia ssp media	Arrow head	Alismataceae	H
Sansevieria trisfasciata	Lengua de vaca	Liliaceae	H
Schefflera arboricola variegated	Schefflera enana	Araliaceae	S
Schinus terebinthifolius	Pimienta del Brazil	Anacardiaceae	S
Scoparia dulcis	Escoba amarga	Scrophullariaceae	H
Senna alata	Talán talán	Fabaceae-Caesalpinoidea	T
Senna siameae	Casia amarilla	Fabaceae	T
Sesbania sericea	Papagayo	Fabaceae-Papilonoidea	S
Sesuvium portulacastrum	Yerba de vidrio	Aizoaceae	H
Sida acuta	Escobilla	Malvaceae	H
Sida rhombifolia	Escobilla blanca	Malvaceae	H
Solanum americanum	Mata gallina	Solanaceae	H
Solanum torvum	Berenjena cimmarrona	Solanaceae	S
Sorghum halapense	Jhonson Grass	Poaceae	H
Spathodea campanulata	Tulipán africano	Bignonaceae	T
Sphagneticola trilobata	Clavelillo de playa	Asteraceae	H
Spigelia anthelmia	Lombricera	Loganaciae	H
Sporobolus jacquemontii	Burrillo	Poaceae	H
Sterculia apetala	Anacaguita	Sterculiaceae	T
Strelitzia sp	Ave del paraiso	Strelitziaceae	H
Stylosanthes hamata	Tebenteque	Fabaceae-Papilonoidea	H
Swietenia aubrivelana	Caoba hibrida	Meliaceae	T
Swietenia macrophylla	Caoba hondureña	Meliaceae	T
Swietenia mahagony	Caoba dominicana	Meliaceae	T
Syagarus romazifolium	Coco plumoso	Arecaceae	T
Syngonium podophyllum	Cinco dedos	Araceae	V
Tabebuia aurea	Roble amarillo	Bignonaceae	T
Tabebuia heterophylla	Roble	Bignonaceae	T
Tabebuia rosea	Roble venezolano	Bignonaceae	T
Tecoma stans	Sauco amarillo	Bignonaceae	T
Terminalia cattapa	Almendra	Combretaceae	T
Thelypteris dentata	Downy maiden fern	Thelypteridaceae	H
Thespesia grandiflora	Maga	Malvaceae	T
Thespesia populnea	Majaguilla	Malvaceae	T
Thumbergia grandiflora	Tumbegia grande	Acanthaceae	V
Trema micrantha	Guacimilla	Ulmaceae	T
Trichostigma octandrum	Bejuco naza	Phytolaccaceae	V
Tridax procumbens	Pancha	Asteraceae	H
Typha dominguensis	Eneas	Thyphaceae	H
Urochloa fasciculata	Browntop signal grass	Poaceae	H
Urochloa maxima	Yerba Guinea	Poaceae	H
Urochloa mutica	Malojillo	Poaceae	H
Urochloa subquadripara	Tropical signal grass	Poaceae	H
Veithchia merillii	Veitchia	Arecaceae	T
Vernonia cinerea	Yerba socialista	Asteraceae	H
Vigna adenatha	Wild pea	Fabaceae-Papilonoidea	V
Vigna luteola	deer pea	Fabaceae-Papilonoidea	V
Vigna vexillata	Zombi pea	Fabaceae-Papilonoidea	V
Xanthosoma sagittifolium	Yautía blanca	Araceae	H
Xanthosoma violacens	Yautía lila	Araceae	H

Table 3: Fauna of the study site

Vertebrates

Class	Family	Genus/Species	Common Name (Spanish)
Amphibia	Bufonidae	Bufo marinus	sapo
Amphibia	Leptodactylidae	Eleutherodactylus portoricensis	coquí
Amphibia	Leptodactylidae	Leptodactylus albilabris	rana labio blanco
Reptilia	Testudinae	Pseudemys stenjgerii	jicotea de puerto rico
Reptilia	Testudinae	Chrusemis scripta	tortuga oreja roja
Reptilia	Iguanidae	Iguana iguana	iguana verde
Reptilia	Iguanidae	Anolis cristatellus	lagartijo
Reptilia	Iguanidae	Anolis stratulus	lagartijo
Reptilia	Iguanidae	Anolis pulchelus	lagartijo de jardín
Aves	Pelicanidae	Pelicanus occidentalis	Pelicano pardo
Aves	Ardeidae	Ardea herodias	Garzon cenizo
Aves	Ardeidae	Eggreta tricolor	Garza pechiblanca
Aves	Ardeidae	Butorides virescens	Martinete
Aves	Ardeidae	Ardea alba	Garza Real
Aves	Ardeidae	Bubulcus ibis	garza ganadera
Aves	Scolopacidae	Actitis macularia	Playero Coleador
Aves	Rallidae	Gallinula chloropus	Gallareta Común
Aves	Falconidae	Falco sparverius	falcón comun
Aves	Accipitridae	Buteus jamaicensis	guaraguao
Aves	Cuculidae	Coccyzus minor	Pájaro Bobo Menor
Aves	Picidae	Melanerpes portoricensis	Carpintero de Puerto Rico
Aves	Columbidae	Columbina passerina	rolitade P. R.
Aves	Columbidae	Zenaida asiatica	tórtola aliblanca
Aves	Columbidae	Zenaida aurita	Tórtola Cardosantera
Aves	Columbidae	Columba livia	paloma casera
Aves	Trochilidae	Anthracothorax dominicus	Zumbador Dorado
Aves	Todidae	Todus mexicanus	San Pedrito de Puerto Rico
Aves	Tyranidae	Tyranus dominicensis	pitirre
Aves	Mimidae	Mimos polyglotus	ruiseñor
Aves	Mimidae	Margarops fuscatus	zorzal pardo
Aves	Emberizidae	Coereba flaveola	reinita comun
Aves	Emberizidae	Seiurus motacilla	Pizpita de rio
Aves	Emberizidae	Tiaris bicolor	Gorrion negro
Aves	Emberizidae	Spindalis portoricensis	Reina Mora
Aves	Emberizidae	Ammodramus savannarum	chamorro
Aves	Emberizidae	Tiaris olivacea	Gorrión Barba Amarilla
Aves	Emberizidae	Molothrus bonariensis	Tordo
Aves	Emberizidae	Icterus dominicensis	Calandria
Aves	Icteridae	Quiscalus niger	chango
Aves	Estrilididadae	Estrilda melpoda	veterano
Aves	Estrilididadae	Lonchura cucullata	diablito
Aves	Muscicapidae	Turdus plumbeus	zorzal de patas coloradas
Aves	Ploceidae	Euplectes orix	obispo

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.

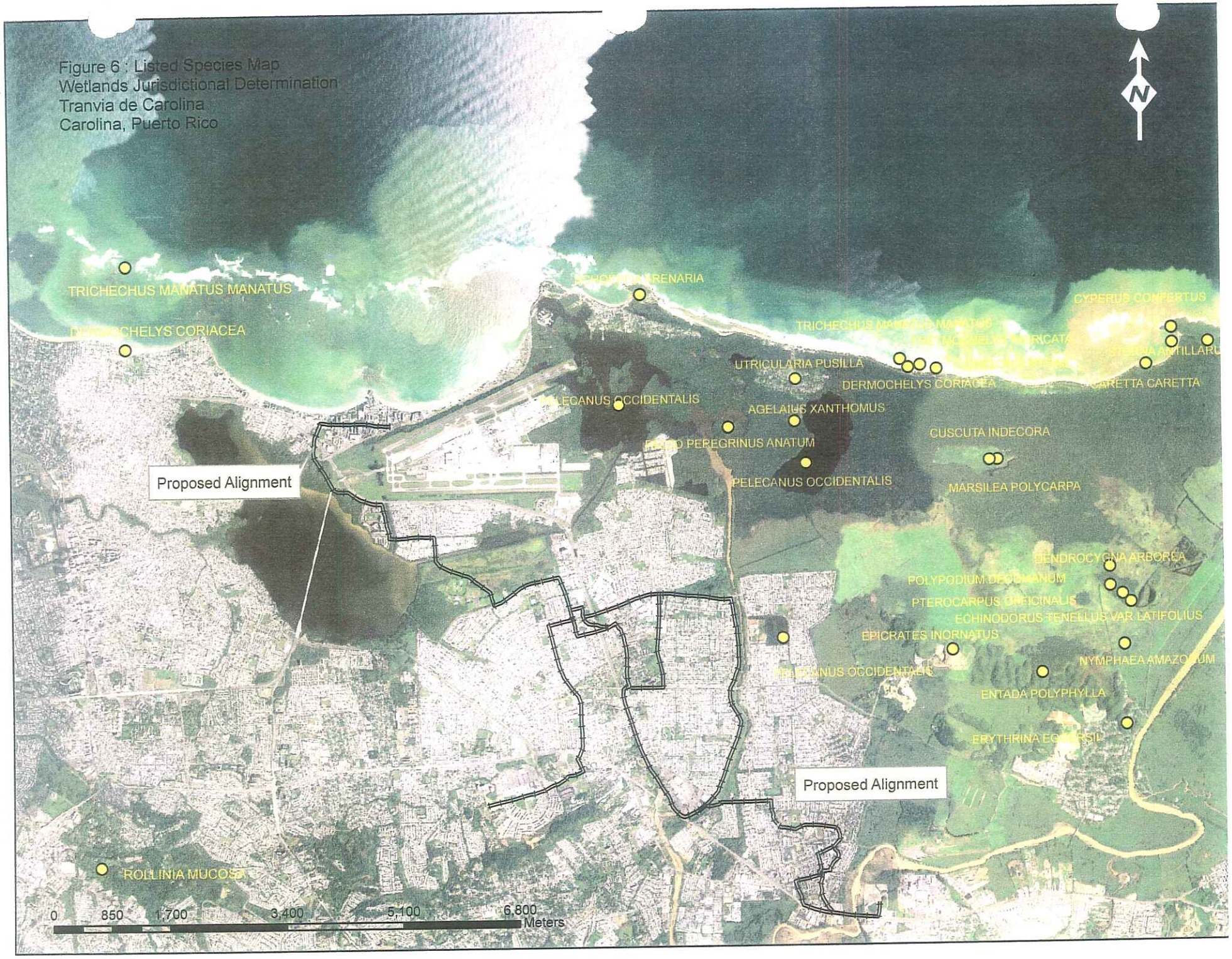


Figure 6 : Listed Species Map
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto Rico
N
TRICHECHUS MANATUS MANATUS
DERMOCHELYS CORIACEA
SCHOENUS ARENARIA
TRICHECHUS MANATUS MANATUS
CYPERUS CONFERTUS
UTRICULARIA PUSILLA
DERMOCHELYS CORIACEA
CARETTA CARETTA
PELECANUS OCCIDENTALIS
AGELAIUS XANTHOMUS
PEREGRINUS ANATUM
CUSCUTA INDECORA
PELECANUS OCCIDENTALIS
MARSILEA POLYCARPA
Proposed Alignment
DENDROCYGNA ARBOREA
POLYPODIUM DECUMANUM
PTEROCARPUS OFFICINALIS
ECHINODORUS TENELLUS VAR LATIFOLIUS
EPICRATES INORNATUS
NYMPHAEA AMAZONUM
PELECANUS OCCIDENTALIS
ENTADA POLYPHYLLA
ERYTHRINA EGLANDULOSA
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.

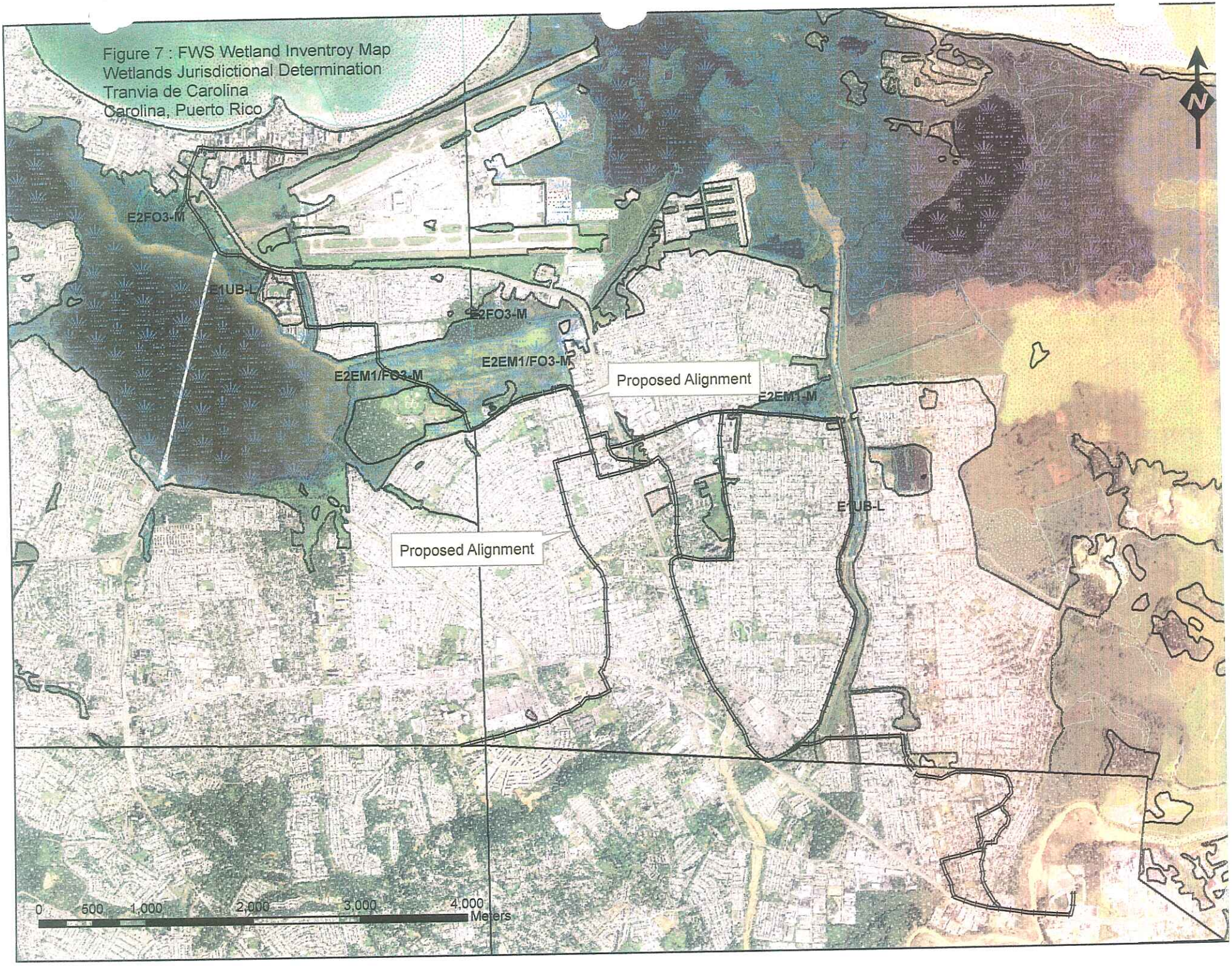


Figure 7 : FWS Wetland Inventroy Map
Wetlands Jurisdictional Determination
Tranvia de Carolina
Carolina, Puerto Rico
N
E2FO3-M
E1UB-L
E2FO3-M
E2EM1/FO3-M
E2EM1/FO3-M
Proposed Alignment
E2EM1-M
E1UB-L
Proposed Alignment
0
500
1,000
2,000
3,000
4,000
Meters