APÉNDICE 4 Jurisdictional Determination

Jurisdictional Wetland and U.S. Waters Determination Study



Vía Verde Pipeline Project

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Executive Summary

The Puerto Rico Electric Power Authority (PREPA) has proposed the construction of the Vía Verde Pipeline Project (Project). The Project consists in the construction of a natural gas pipeline from the municipality of Peñuelas to the municipality of Guaynabo, Puerto Rico. The length of this pipeline is approximately 90.5 miles long, and runs through the municipalities of Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja, Cataño, and Guaynabo (**Appendix 1, Figures 1** and **2**). The study area included 100 feet to each side of the centerline of the route.

This document represents the Wetlands and U.S. Waters (JD) for the Project, as described above. The methodology employed for this study consisted first in a preliminary screening process to determine the potential jurisdictional wetlands along the Project route. Then, a detailed screening using Geographic Information System (GIS) and data collected at the field identified those wetland areas that potentially are under the jurisdiction of the United States Army Corps of Engineers (USACE). The **Methodology** section of this report describes the employed methodology in more detail.

Approximately 2,988,833.3 m² or 738.6 acres of jurisdictional wetlands, and 79 U.S Waters crossings (rivers, creeks or channels) were identified and delineated along the Project route. **Appendix A, Figure 6** shows the Wetlands and U.S. Jurisdictional Determination Map for this Project.

These delineated wetlands were classified under the following categories:

❖ Palustrine Forested Wetlands

Palustrine forested wetlands were found in the Punta Salinas Public Beach entrance in the municipality of Toa Baja. These are dominated by tree species, mostly by María (*Calophyllum calaba*). These wetlands were probably formed by the construction of the public beach facilities, which included sand extraction and the construction of the

entrance road, which functions as a dike promoting flooding in certain areas. Approximately 8,265.31 m² or 2.0 acres of these wetlands were delineated.

Hydric soil indicators included sandy redox. Most common wetland hydrology indicator was a shallow water table or water in soil pit.

❖ Palustrine herbaceous wetlands.

These are palustrine wetlands dominated by herbaceous species, with no apparent recent anthropogenic use. They were obviously impacted in the past, but present conditions are somewhat stable or undisturbed. Approximately 1,254,890.40 m² or 310.1 acres of these wetlands were delineated.

Most common wetland species under this type of wetland include Yerba de enéas (*Typha domingensis Pers.*), Cortadora (*Paspalum millegrana* Schrad.), Junco de agua (*Cyperus ligularis* L.), *Cyperus iria* (L.), Malojillo (*Brachiaria purpurascens* (Raddi.) Henr.), Cangá (*Ludwigia octovalvis* (Jacquin) Raven), Desmanto Amarillo (*Neptunia plena* (L.) Benth. **in** Hook.), Margarita amarilla (*Wedelia trilobata* (L.) Hitchc.), Bejuco de puerco (*Ipomoea setifera* Poir. **in** Lam), *Mimosa pellita* HBK, Arrocillo (*Echinochloa colona* (L.) Link), among others.

In terms of hydric soil indicators, 10YR was the most abundant soil hue, as expected. Low chroma soils were not too abundant along the Project route; nevertheless, most common hydric soil indicators found are redox concentrations, gleyed matrix, depleted matrix, and in some cases, hydrogen sulfide.

Most common wetland hydrology indicators were inundation, saturation in upper twelve inches, sediment deposits, water stained leaves, oxidized root channels, drainage patterns, among others.

❖ Palustrine herbaceous wetlands under present or recent agricultural use.

These are palustrine wetlands that are currently, or have been recently under anthropogenic use. Most of these wetlands show characteristics of some agricultural use, such as cattle grazing, pasture management (for hay, for example), Pineapple or other crops. Approximately 1,609,804.9 m² or 397.8 acres of these wetlands were delineated.

Dominant vegetation varied according to use, but there were large areas with managed pastures such as Rodes (*Chloris gayana*), Pangola (*Digitaria decumbens* Steud), and Millo (*Sorghum bicolor* (L.) Moench) that showed hydric soil and wetland hydrology indicators. Areas around these managed pastures zones included other herbaceous vegetation such as *Cyperus iria* (L.), Coquí (*Cyperus rotundus* L.), Malojillo (*Brachiaria purpurascens* (Raddi.) Henr.), Cangá (*Ludwigia octovalvis* (Jacquin) Raven), Desmanto Amarillo (*Neptunia plena* (L.) Benth. in Hook.), and others. Yerba Venezolana (*Paspalum fasciculatum* Willd.), although not indicated in the National List of Plants that Occur in Wetlands: Caribbean (region C), was very common on abandoned or "resting" agricultural areas. According to the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Caribbean Islands Region (the Caribbean supplement), Yerba Venezolana is considered a hydrophyte if hydric soil indicators and wetland hydrology are present.

Hydric soil and wetland hydrology indicators were similar to those under the palustrine herbaceous wetlands that are not under current or recent anthropogenic use.

Section Estuarine forested.

These are forested wetlands, mainly covered by mangrove trees, under an estuarine system. The estuarine classification was given due to the type of dominant vegetation (halophytes). Some of them are relicts of former larger systems that are encroached by urban, commercial or industrial development. Approximately 95,388.66 m² or 23.6 acres of these wetlands were delineated.

Most common tree species are Mangle negro (*Avicennia germinans* (L.) L.), Mangle blanco (*Laguncularia racemosa* (L.) Gaertn.), and Mangle rojo (*Rhizopora mangle* L.). Some of these wetlands included herbaceous species within, depending on the salinity regime of the system. Palmita del río (*Acrostichum aureum* L.) and Bejuco negro (*Rhabdadenia biflora* (Jacq.) Muell. Arg.), among others, are found in these systems.

Most common hydric soil indicators include histic epipedon (some areas), gleyed matrix, depleted matrix, and hydrogen sulfide.

Inundation and saturation were the most common wetland hydrology indicators. These areas are along or adjacent to canals, or are located within depressional landforms.

Section Estuarine forested canal.

Estuarine forested canal is located at southwest Peñuelas end of the route. It is a canal colonized mostly by Mangle negro (*Avicennia germinans* (L.) L.). Approximately 4,740.10 m² or 1.2 acres of these wetlands were delineated.

These are inundated areas with obligated wetland species. Although no soil samples were taken, but hydric soil indicators shall include histic epipedon, gleyed matrix, and depleted matrix.

. Estuarine salt flat.

These wetlands are located at the Peñuelas end of the route. These are salt flats dominated by dwarf Mangle negro trees. Approximately 15,745.06 m² or 3.9 acres of these wetlands were delineated.

The water table in these areas is close to soil surface. Salinity concentrations are very high, limiting the growth and development of vegetation.

Desk determination was necessary on areas that, for various reasons, access was not possible. On these areas, Geographic Information Systems, or GIS, was used to determine jurisdiction. Some of these areas may include field data such as vegetation species assessment, but soils or hydrology indicators could not be assessed.

Canals or creeks that were found to be covered with emergent vegetation were sometimes considered as wetlands, not as U.S. Waters or open water. These systems are often managed by the Public Works division of municipalities to control flooding.

Introduction

The Puerto Rico Electric Power Authority (PREPA) has proposed the construction of the Vía Verde Pipeline Project (Project). The Project consists in the construction of a liquefied natural gas pipeline from the municipality of Peñuelas to the municipality of Guaynabo, Puerto Rico. The length of this pipeline is approximately 90.5 miles long, and runs through the municipalities of Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja, Cataño, and Guaynabo (**Appendix 1, Figures 1** and **2**). The study area included 100 feet to each side of the centerline of the route.

This document represents the Wetlands and U.S. Waters Jurisdictional Determination Study (JD) for the project described above. The methodology employed for this study followed the 1987 Corps of Engineers Wetland Delineation Manual, and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Caribbean Islands Region (the Caribbean supplement). It included first a preliminary screening process to determine the potential jurisdictional wetlands at the Project route. Then, a detailed screening using Geographic Information System (GIS) and data collected at the field identified those wetland areas that are under the jurisdiction of the USACE. The Methodology section of this report describes the employed methodology in more detail.

Most of the delineated wetlands have been impacted by different ways. For example, nearly all of the herbaceous wetlands show disturbed soil conditions. They were mostly used for sugar cane cultivation for many years. Some of them still have hydraulic control structures, such as dikes, canals, pump stations, gates, etc., to manage water regime within the areas. Then, they were abandoned and afterwards planted with specific herbaceous species for cattle grazing. Recently, some of these areas are being used for hay production, or are still abandoned with no use at all. These uses have changed the native soil structure, as well as the original water regime patterns within the Project route.

In areas such as the Puerto Rico's north plains, specifically from the municipalities of Dorado to Arecibo, pasture management is very active. This includes landscape grasses and hay production. This type of land use has significant impact on soil structure. However, given that some areas have been under such uses for many years, these conditions now represent "normal circumstances".

This report is organized into four sections: a site description, methodology, results and discussion, conclusions and recommendations. **Appendix 1** contains topographic, aerial photograph, hydrographic, and soil survey maps. The Jurisdictional wetlands and U.S Waters delineation figure was overlaid on a satellite photograph of the area, which was taken in 2006. Photographic documentation of the wetland areas is included in **Appendix 2**. **Appendix 3** includes the Data Forms from the Caribbean supplement.

The field work for this JD was performed from May to July 2010.

Project Route Description

The Project consists in the construction of a liquefied natural gas pipeline from the municipality of Peñuelas to the municipality of Guaynabo, Puerto Rico. The length of this pipeline is approximately 90.5 miles long, and runs through the municipalities of Peñuelas, Adjuntas, Utuado, Arecibo, Barceloneta, Manatí, Vega Baja, Vega Alta, Dorado, Toa Baja, Cataño, and Guaynabo (**Appendix 1, Figures 1** and **2**). The study area included 100 feet to each side of the centerline of the route.

Topography

According to the topographic quadrangles (USGS), the north segment (Guaynabo to Arecibo) of the route basically runs across two different topographic scenarios: the coastal plains, and the haystacks ("Mogotes"). Level or nearly level topographic contours within the route are found in the municipalities of Guaynabo, Cataño, Toa Baja, Dorado, Barceloneta and northern Arecibo. Areas with higher topographic contours (although include some level areas) are found within the municipalities of Vega Alta, Vega Baja, and Manatí.

The north to south segment of the route is completely different. From south Arecibo to north Peñuelas, topographic contours are far from level. Contours rise up to Adjuntas and north Peñuelas, where the highest segment of the route is proposed. From Adjuntas to south Peñuelas, topographic contours decrease to reach level areas near the coast. **Table 1** includes a relation of topography and municipalities. **Figure 1** shows the Project route on the topographic quadrangles.

Table 1. Topographic Elevations of Project Route by Municipality*

Municipality	Minimum Elevation (meters, amsl)	Maximum Elevation (meters, amsl)
Guaynabo	1	3
Cataño	2	5

Municipality	Minimum Elevation	Maximum Elevation
	(meters, amsl)	(meters, amsl)
Toa Baja	2	2.9
Dorado	2	60
Vega Alta	40	60
Vega Baja	10	160
Manatí	80	175
Barceloneta	1	8
Arecibo	2	365
Utuado	140	405
Adjuntas	350	1040
Peñuelas	1	1040

^{*}Source: Topographic quadrangles (USGS).

Hydrology

The Project crosses many hydrographic features (open water) along its route (see **Figure 3**). High flow rivers, such as Río Grande de Manatí, and the Río Grande de Arecibo, are among the most important hydrographic features along the Project route. Other creeks and channels are also crossed by the Project. **Table 2** includes the hydrographic features along the Project route. Canals or creeks covered with vegetation are not included in **Table 2**.

Table 2. Hydrographic Features of Project Route by Municipality*

Municipality	Rivers Creeks		Channels
Guaynabo	N/A	Santa Catalina,	Concrete canal
		Diego, Las Lajas	
Cataño	Río Hondo, Río	N/A	N/A
	Bayamón		
Toa Baja	Río Hondo, Río	N/A	N/A
	Bayamón, Río Cocal		
Dorado	Río Cocal, Río La	N/A	N/A

Municipality	Rivers Creeks		Channels
	Plata		
Vega Alta	Río Cibuco	Unnamed creek	N/A
Vega Baja	Río Cibuco, Río	N/A	N/A
	Indio		
Manatí	Río Grande de	N/A	Unnamed canal
	Manatí		
Barceloneta	Río Grande de	N/A	N/A
	Manatí		
Arecibo	Río Grande de	Unnamed creek,	Perdomo
	Arecibo, Río	Jobos creek	channel
	Tanamá		
Utuado	Río Grande de	Jobos creek, Arenas	N/A
	Arecibo, Río Pellejas	creek,	
		Unnamed creeks (8)	
Adjuntas	N/A	Unnamed creeks (8)	N/A
Peñuelas	Río Tallaboa	Unnamed creeks (6)	Unnamed
			channels (2)

^{*}Source: Topographic quadrangles (USGS)

Soils

The U.S. Department of Agriculture's Soil Conservation Service classified the soils within the site in different soil series (**Appendix A, Figure 4**). **Table 3** includes a description of the soils found in sampling points along Project route.

In the San Juan Soil Survey Area, most common soils are Saladar Muck (Sm), Coloso silty clay loam (Cs), Bajura clay (Ba), Cataño loamy sand (Cn), and Toa silty clay loam (To).

Within the Arecibo Soil Survey Area, the Cataño loamy sand (Cn), the Toa silty clay

Table 3. Sampling Points Soil Description* along Project Route by Soil Survey Area

Soil Survey	Municipalities	Soil Series	Slope	Drainage	Frequency of	Depth to	Hydric?
Area	Included**			Class	Flooding	Water Table	
San Juan	Guaynabo, Cataño, Toa	Saladar muck (Sm)	0 to 2%	Very poorly drained	Frequent	0 to 6 inches	Yes
	Baja, Dorado	Martin Peña muck (Mp)	0 to 2%	Very poorly drained	Frequent	0 to 12 inches	Yes
		Almirante clay (AmB)	2 to 5%	Well drained	None	More than 80 inches	No
		Durados sandy loam (Ds)	0 to 2%	Excessively drained	None	More than 80 inches	No
		Coloso silty clay loam (Cs)	0 to 2%	Somewhat poorly drained	Ocassional	24 to 48 inches	Yes (Bajura inclusion)
		Bajura clay (Ba)	0 to 2%	Poorly drained	Frequent	6 to 30 inches	Yes
		Urban land Durados complex (Ud)	0 to 2%	Excessively drained	None	More than 80 inches	Yes (unnamed inclusion)
		Cataño loamy sand (Cn)	0 to 5%	Excessively drained	None	More than 80 inches	Yes (Reparada inclusion)
		Hydraquents, saline (Hy)	0 to 2%	Very poorly drained	Frequent	0 inches	Yes
		Toa silty clay loam (To)	0 to 2%	Well drained	Ocassional	More than 80 inches	Yes (Bajura inclusion)

Soil Survey	Municipalities	Soil Series	Slope	Drainage	Frequency of	Depth to	Hydric?
Area	Included**			Class	Flooding	Water Table	
Arecibo	Vega Alta, Vega Baja, Manatí,	Cataño loamy sand (Cn)	0 to 5%	Excessively drained	None	More than 80 inches	Yes (Reparada inclusion)
	Barceloneta, Arecibo,	Toa silty clay loam (To)	0 to 2%	Well drained	Ocassional	More than 80 inches	Yes (Bajura inclusion)
	Utuado	Almirante clay (AmB)	2 to 5%	Well drained	None	More than 80 inches	No
		Corozo fine sand (CsC)	2 to 12%	Well drained	None	More than 80 inches	Yes (Jareales inclusion)
		Bayamon clay (ByB)	2 to 5%	Well drained	None	More than 80 inches	No
		Almirante sandy loam (AlC)	5 to 12%	Well drained	None	More than 80 inches	No
		Almirante sandy loam (AlB)	2 to 5%	Well drained	None	More than 80 inches	Yes (Bajura inclusion)
		Bajura clay (Ba)	0 to 2%	Poorly drained	Frequent	6 to 30 inches	Yes
		Vega Alta clay (VcB)	2 to 5%	Well drained	None	More than 80 inches	Yes (Bajura inclusion)
		Pits, gravel (Pt)	N/A	N/A	N/A	N/A	Yes (unamed inclusion)
		Tiburones	0 to 2%	Very poorly	Frequent	0 to 30 inches	Yes

Soil Survey	Municipalities	Soil Series	Slope	Drainage	Frequency of	Depth to	Hydric?
Area	Included**			Class	Flooding	Water Table	
		muck (Tb)		drained			
		Vigia muck (Vg)	0 to 2%	Very poorly drained	Frequent	0 to 30 inches	Yes
		Vivi loam (Vm)	0 to 2%	Excessively drained	Ocassional	More than 80 inches	Yes (Bajura inclusion)
		Vega Alta sandy clay loam (VaB)	2 to 5%	Wella drained	None	More than 80 inches	Yes (Bajura inclusion)
Ponce	Adjuntas, Peñuelas	Yauco silty clay loam(YcC)	5 to 10%	Well drained	None	None	No

^{*}United States Department of Agriculture, Soil Conservation Service. **Only municipalities along the Project route.

loam (To), the Almirante sandy loam (AIC), the Bajura clay (Ba), and the Vivi loam (Vm) are the most common.

For the Ponce Soil Survey Area, the most common soil is the Yauco silty clay loam (YcC).

Between Utuado and Adjuntas, most of sampling points describe water crossings.

National Wetland Inventory

The National Wetland Inventory, prepared by the U.S. Fish and Wildlife Service (USFWS) includes the coastal areas of the Project route within its study area. Therefore, no data exists for the areas in central Puerto Rico. **Table 4** show the NWI classification along Project route by municipality. **Figure 5** shows the Project route over the NWI map.

Table 4. National Wetland Inventory classification along Project route by municipality

Municipality	National Wetland Inventory
	Classification*
Guaynabo	PFO3/EM1C, E2EM1M, E2FO3M
Cataño	E2EM1M, PFO3/EM1C, PEM1A, PEM1C,
	M1UBL
Toa Baja	E1UBLx, E2FO3M, E1UBL, PEM1C
Dorado	PEM1C, E2FO3M
Vega Alta	N/A
Vega Baja	PEM1Ad, PEM1/SS3A, PEM1A, PEM1C
Manatí	PEM1A, PEM1C,
Barceloneta	PEM1C, PEM1A, PSS3C, PSS3A
Arecibo	E2EM1M, PEM1A, PEM1C, PEM1/SS3A,
	PSS3/EM1A, PFO3C, PSS3C
Utuado	N/A
Adjuntas	N/A
Peñuelas	E1UBL

^{*}Legend:

PFO3/EM1C: palustrine, forested, broad-leaved evergreen/emergent, persistent, seasonally flooded.

E2EM1M: estuarine, intertidal, emergent, persistent, irregularly exposed.

E2FO3M: estuarine, forested, broad-leaved evergreen, irregularly exposed.

PEM1A: palustrine, emergent, persistent, temporarily flooded.

PEM1C: palustrine, emergent, persistent, seasonally flooded.

M1UBL: marine, subtidal, unconsolidated bottom, subtidal.

E1UBL: estuarine, subtidal, unconsolidated bottom, subtidal

E1UBLx: estuarine, subtidal, unconsolidated bottom, subtidal, excavated.

PEM1Ad: palustrine, emergent, persistent, temporarily flooded, partially drained/ditch

PEM1/SS3A: palustrine, emergent, persistent/scrub-shrub, broad-leaved evergreen, temporarily flooded.

PSS3C: palustrine, scrub-shrub, broad-leaved evergreen, seasonally flooded.

PSS3A: palustrine, scrub-shrub, broad-leaved evergreen, temporarily flooded.

PSS3/EM1A: palustrine, scrub-shrub, broad-leaved evergreen/emergent, persistent, temporarily flooded.

PFO3C: palustrine, forested, broad-leaved evergreen, seasonally flooded.

It is important to mention that the NWI was performed in the 70's decade. Today, there are wetlands that are not included in the NWI. In the other hand, there are areas under the NWI that are not wetlands in the present.

Methodology

The methodology employed during this study followed the Routine Determination with an onsite inspection method, as described in the 1987 Corps of Engineers Wetland Delineation Manual (the Manual) for areas greater than 5 acres in size, and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Caribbean Islands Region (the Caribbean supplement). However, desk determination was necessary on areas that, for various reasons, access was not possible. On these areas, Geographic Information Systems, or GIS, was used to determine jurisdiction. Some of these areas may include field data such as vegetation species, but soils or hydrology indicators could not be assessed. Therefore, the results of this JD are a combination of efforts from GIS methodology and field work.

In areas where differences between the Manual and the Caribbean supplement occurred, the Caribbean supplement took precedence. There were areas that determination was difficult, due to past or recent land use, or other reasons. In those cases, determination was based on the best information available, interpreted in light of professional experience and knowledge of the ecology of wetlands in the area, as stated in the Caribbean supplement.

This JD was performed in three phases. Phase 1 of the study was a screening level analysis to identify those areas within the site, constituting jurisdictional wetlands under Section 404 of the Clean Water Act. The screening analysis was performed using GIS. The data gathered from this phase provided specific and important information on the location of wetland sites. This phase included a preliminary site visit to validate the data that were obtained during the GIS analysis. It also helped in providing a better understanding of the wetland condition and location in order to develop a fieldwork plan.

Phase II of the study included the delineation field visits to map the jurisdictional wetlands on the site. Each delineation visit consisted on the sampling, collection, and

description of the site's hydrology, soils, and dominant vegetation around representative sampling locations on established transects. A total of 224 sampling points were established (**Figure 6**).

The following tasks were carried out during Phase 2:

- Establishment of the sampling transects;
- Visual inspection of the site and identification of landscape features;
- Identification of plant communities;
- Selection of a representative area within each plant community to dig a soil pit;
- Identification of dominant plant species from the various strata;
- Characterization of the soil properties and colors in the soil pit;
- Description of the hydrology around and within the soil pit;
- Photographic documentation of the site, soil pits or vegetation;
- Collection of soil and plant samples for future reference;
- Geographic Positioning System (GPS) documentation of sampling points; an
- Wetland delineation and documentation of wetland limits.

Phase 3 of the study comprised the final analysis of the data gathered during the delineation visits and the development of this report.

Results and Discussion

Approximately 2,988,833.3 m² or 738.6 acres of jurisdictional wetlands, and 79 U.S Waters crossings (rivers, creeks or channels) were identified and delineated along the Project route. **Appendix A, Figure 6** shows the Wetlands and U.S. Jurisdictional Determination Map for this Project.

Within the north segment of the Project route (Guaynabo to north Arecibo), most of the delineated areas are wetlands, although some river, creeks and channels are crossed. In the other hand, the north to south segment (southern Arecibo to northern Peñuelas) most of the delineated areas are river, creeks or channels crossings. Topography plays an important role in the wetland/U.S. Waters ratio.

Delineated wetlands were classified under the following categories:

Palustrine Forested Wetlands

Palustrine forested wetlands were found in the Punta Salinas Public Beach entrance in the municipality of Toa Baja. These are dominated by tree species, mostly by María (*Calophyllum calaba*). These wetlands were probably formed by the construction of the public beach facilities, which included sand extraction and the construction of the entrance road, which functions as a dike promoting flooding in certain areas. Approximately 8,265.31 m² or 2.0 acres of these wetlands were delineated.

Hydric soil indicators included sandy redox. Most common wetland hydrology indicator was a shallow water table or water in soil pit.

Palustrine Herbaceous Wetlands

These are palustrine wetlands dominated by herbaceous species, with no apparent recent anthropogenic use. They were obviously impacted in the past, but present conditions are somewhat stable or undisturbed. Approximately 1,254,890.40 m² or 310.1 acres of these wetlands were delineated.

Most common wetland species under this type of wetland include Yerba de enéas (*Typha domingensis Pers.*), Cortadora (*Paspalum millegrana* Schrad.), Junco de agua (*Cyperus ligularis* L.), *Cyperus iria* (L.), Malojillo (*Brachiaria purpurascens* (Raddi.) Henr.), Cangá (*Ludwigia octovalvis* (Jacquin) Raven), Desmanto Amarillo (*Neptunia plena* (L.) Benth. in Hook.), Margarita amarilla (*Wedelia trilobata* (L.) Hitchc.), Bejuco de puerco (*Ipomoea setifera* Poir. in Lam), *Mimosa pellita* HBK, Arrocillo (*Echinochloa colona* (L.) Link), among others. Table 5 includes the dominant plant species within the palustrine herbaceous wetlands, with their respective indicator.

Table 5. Dominant Plant Species within Palustrine Herbaceous Wetlands

Scientific Name	Common Name	Stratum	Indicator
Typha domingensis	Yerba de enéas	Herb	OBL
Albicia procera	Albizia	Tree	UPL
Ipomoea setifera	Bejuco de puerco	Herbaceous	FACW
Wedelia trilobata	Margarita amarilla	Herbaceous	FAC
Spathodea campanulata	Tulipán africano	Tree	UPL
Paspalum millegrana	Cortadora	Herbaceous	FACW
Mimosa pellita	-	Shrub	FACW+
Gynerium sagittatum	Caña brava	Herbaceous	FACW
Cyperus ligularis	-	Herbaceous	FAC
Ludwigia octovalvis	Yerba cangá	Shrub	OBL
Commelina diffusa	Cohítre	Herbaceous	FAC
Brachiaria purpurascens	Malojillo	Herbaceous	FACW
Paspalum fasciculatum	Yerba venezolana	Herbaceous	UPL*
Neptunia plena	Desmanto amarillo	Herbaceous	FACW

^{*}Considered FAC under certain conditions.

In terms of hydric soil indicators, 10YR was the most abundant soil hue, as expected. Low chroma soils were not too abundant along the Project route; nevertheless, most common hydric soil indicators found are redox concentrations, gleyed matrix, depleted matrix, and in some cases, hydrogen sulfide.

Most common wetland hydrology indicators were inundation, saturation in upper twelve inches, sediment deposits, water stained leaves, oxidized root channels, drainage patterns, among others.

Palustrine Herbaceous Wetlands under Present or Recent Agricultural Use

These are palustrine wetlands that are currently, or have been recently under anthropogenic use. Most of these wetlands show characteristics of some agricultural use, such as cattle grazing, pasture management (for hay, for example), Pineapple or other crops. Approximately 1,609,804.9 m² or 397.8 acres of these wetlands were delineated.

Dominant vegetation varied according to use, but there were large areas with managed pastures such as Rodes (*Chloris gayana*), Pangola (*Digitaria decumbens* Steud), and Millo (*Sorghum bicolor* (L.) Moench) that showed hydric soil and wetland hydrology indicators. Areas around these managed pastures zones included other herbaceous vegetation such as *Cyperus iria* (L.), Coquí (*Cyperus rotundus* L.), Malojillo (*Brachiaria purpurascens* (Raddi.) Henr.), Cangá (*Ludwigia octovalvis* (Jacquin) Raven), Desmanto Amarillo (*Neptunia plena* (L.) Benth. in Hook.), and others. Yerba Venezolana (*Paspalum fasciculatum* Willd.), although not indicated in the National List of Plants that Occur in Wetlands: Caribbean (region C), was very common on abandoned or "resting" agricultural areas. According to the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Caribbean Islands Region (the Caribbean supplement), Yerba Venezolana is considered a hydrophyte if hydric soil indicators and wetland hydrology are present. Table 6 includes the dominant plant species within the palustrine herbaceous wetlands under present or recent agricultural use, with their respective indicator.

Table 6. Dominant Plant Species within Palustrine Herbaceous Wetlands under Present or Recent Agricultural Use

Scientific Name	Common Name	Stratum	Indicator
Chloris gayana	Rodes	Herbaceous	UPL
Digitaria decumbens	Pangola	Herbaceous	FACU
Sorghum bicolor	Millo	Herbaceous	UPL
Cyperus iria	-	Herbaceous	FACW
Mimosa pellita	-	Shrub	FACW+
Cyperus rotundus	Coquí	Herbaceous	FAC
Ludwigia octovalvis	Yerba Cangá	Shrub	OBL
Neptunia plena	Desmanto amarillo	Shrub	UPL
Brachiaria purpurascens	Malojillo	Herbaceous	FACW
Paspalum fasciculatum	Yerba venezolana	Herbaceous	UPL

Hydric soil and wetland hydrology indicators were similar to those under the palustrine herbaceous wetlands that are not under current or recent anthropogenic use.

Estuarine Forested Wetland

These are forested wetlands, mainly covered by mangrove trees, under an estuarine system. The estuarine classification was given due to the type of dominant vegetation (halophytes). Some of them are relicts of former larger systems that are encroached by infrastructure, urban, commercial or industrial development. Approximately 95,388.66 m² or 23.6 acres of these wetlands were delineated.

Most common tree species are Mangle negro (*Avicennia germinans* (L.) L.), Mangle blanco (*Laguncularia racemosa* (L.) Gaertn.), and Mangle rojo (*Rhizopora mangle* L.). Some of these wetlands included herbaceous species within, depending on the salinity regime of the system. Palmita del río (*Acrostichum aureum* L.) and Bejuco negro (*Rhabdadenia biflora* (Jacq.) Muell. Arg.), among others, are found in these systems.

Table 7 includes the dominant plant species within the estuarine forested wetlands, with their respective indicator.

Table 7. Dominant Plant Species within Estuarine Forested Wetland

Scientific Name	Common Name	Stratum	Indicator
Avicennia germinans	Mangle negro	Tree	OBL
Laguncularia racemosa	Mangle blanco	Tree	OBL
Rhizophora mangle	Mangle rojo	Tree	OBL
Acrostichum aureum	Palmita de río	Herbaceous	OBL

Most common hydric soil indicators include histic epipedon (presumed in some areas, given that they were inundated and dominated by mangrove trees), gleyed matrix, depleted matrix, and hydrogen sulfide.

Inundation and saturation were the most common wetland hydrology indicators. These areas are along or adjacent to canals, or are located within depressional landforms.

Estuarine Forested Canal

Estuarine forested canal is located at southwest Peñuelas end of the route. It is a canal colonized mostly by Mangle negro (*Avicennia germinans* (L.) L.). Approximately 4,740.10 m² or 1.2 acres of these wetlands were delineated. **Table 8** includes the dominant plant species within the estuarine forested canal, with their respective indicator.

Table 8. Dominant Plant Species within Estuarine Forested Canal

Scientific Name	Common Name	Stratum	Indicator
Avicennia germinans	Mangle negro	Tree	OBL

These are inundated areas with obligated wetland species. Although no soil samples were taken, but hydric soil indicators shall include histic epipedon, gleyed matrix, and depleted matrix.

Estuarine Salt Flat

These wetlands are located at the Peñuelas end of the route. These are salt flats dominated by dwarf Mangle negro trees. Approximately 15,745.06 m² or 3.9 acres of these wetlands were delineated. **Table 9** includes the dominant plant species within the estuarine salt flat, with their respective indicator.

Table 9. Dominant Plant Species within Palustrine Herbaceous Wetlands

Scientific Name	Common Name	Stratum	Indicator
Avicennia germinans	Mangle negro	Tree	OBL
Sesuvium portulacastrum	Verdolaga rosada	Herbaceous	FACW
Batis maritima	Planta de sal	Herbaceous	FACW

The water table in these areas is close to soil surface. Salinity concentrations are very high, limiting the growth and development of vegetation.

Uplands

Upland areas vary immensely between the north segment (Guaynabo to north Arecibo) and the north to south segment (south Arecibo to Peñuelas) of the Project route. Along the north segment, vegetation was dominated by herbaceous species. In some cases, FAC or FACU species also occurred in uplands, although hydric soil or wetland hydrology indicators were not present. In the north to south segment of the route, specifically within the Utuado, Adjuntas, and north Peñuelas, uplands were dominated by tree species. South Peñuelas uplands are also dominated by trees, but different species are present, given that both areas are under different life zones. **Table 10** includes the dominant plant species within uplands, with their respective indicator.

Table 10. Dominant Plant Species within Uplands

North Segment of Project Route (Guaynabo to north Arecibo)				
Scientific Name	Common Name	Stratum	Indicator	
Megathyrsus maximus	Yerba de guinea	Herbaceous	FACU-	
Albicia procera	Albizia	Tree	UPL	
Spathodea campanulata	Tulipán africano	Tree	UPL	
Urena lobata	Cadillo	Herbaceous	FAC	
Peltophorum pterocarpum	Senna de Sima	Tree	UPL	
Ipomoea tiliacea	Bejuco de puerco	Herbaceous	UPL	
North to South Segme	v i	outh Arecibo to n	orth Peñuelas)	
Scientific Name	Common Name	Stratum	Indicator	
Guarea guidonia	Guaraguao	Tree	UPL	
Inga laurina	Guamá americano	Tree	UPL	
Inga vera	Guaba	Tree	FAC	
Casearia guianensis	Cafeíllo	Tree	FAC	
Casearia arborea	Cabrilla	Tree	UPL	
Coffea arabica	Café	Shrub	UPL	
Coffea liberica	Café de Liberia	Shrub	UPL	
**	gment of Project Rou	te (South Peñuelas	s)	
Scientific Name	Common Name	Stratum	Indicator	
Prosopis juliflora	Bayahonda	Tree	UPL	
Acasia farnesiana	Aroma	Tree	UPL	
Pithecelobium dulce	Guamá	Tree	UPL	
Guazuma ulmifolia	Guácima	Tree	UPL	
Энацина инијона	Guaciiia			

Figure 6 shows the Wetland and U.S. Waters Jurisdictional Determination map for the Project area. **Table 11** includes the sampling point's coordinates within the study area. During most of the field work period for this study, weather conditions were partly cloudy, sometimes with rain. Some days showed wetter conditions.

Table 11. Sampling Points Coordinates* within the Study Site

Sampling	Sampling point Location		Type of crossing
Point ID	X	y	
number 1	233,778.81	265,736.11	Channel
2	233,332.50	265,950.43	Wetland
3	233,303.70	265,971.78	Wetland
4	233,245.41	265,976.41	Wetland
5	232,611.83	265,753.56	Wetland
6	232,633.57	265,712.54	Channel
7	232,246.09	265,628.67	Upland
8	232,237.70	265,611.89	Wetland
9	232,112.73	265,432.41	Wetland
10	232,036.44	265,428.61	Wetland
11	232,022.15	265,406.41	Creek
12	232,007.53	265,936.00	Upland
13	232,961.51	265,351.59	Wetland, creek
14	231,954.15	265,326.97	Wetland
15	231,454.90	265,218.39	Creek
16	229,814.47	265,175.39	Wetland
17	229,550.43	265,166.28	Upland
18	229,454.09	265,166.53	Upland
19	229,277.28	265,922.00	Upland
20	229,256.49	266,246.29	Wetland
21	229,112.74	267,028.22	Wetland
22	229,061.97	267.364.61	Wetland
23	229,053.52	267,371.93	Upland
24	228,891.87	267,784.79	Upland
25	228,977.11	267,927.02	Wetland
26	229,214.08	267,978.49	Wetland
27	229,280.12	268,035.79	Upland
28	229,597.71	268,234.89	Wetland
29	229,818.17	268,485.46	Wetland
30	229,846.34	268,576.75	Upland
31	230,040.58	268,632.11	Wetland
32	228,923.69	267,942.55	Upland
33	228,841.44	267,922.73	River
34	228,753.73	267,909.53	Upland
35	228,677.75	267,892.52	River
36	228,631.24	267,885.13	Upland

Sampling	Sampling point Location		Type of crossing
Point ID	X	y	
number 37	228,589.18	267,879.06	Wetland
38	228,535.12	267,864.56	River
39	228,326.53	268,171.64	Upland
218	226,091.33	269,832.38	Upland
40	226,055.68	269,959.24	Wetland
41	225,970.76	269,987.55	Upland
42	225,005.17	269,995.19	Upland
43	224,843.75	270,001.17	Wetland
44	224,733.67	269,968.67	River
45	224,624.63	269,968.67	Wetland
46	224,245.12	269,906.82	Wetland
47	223,860.31	269,864.05	River
48	223,737.44	269,834.37	Wetland
49	222,842.11	269,646.20	Wetland
50	222,749.13	269,642.52	River
51	222,614.49	269,066.74	Wetland
52	222,392.93	269,559.70	Wetland
53	221,004.42	268,509.09	Wetland
54	220,983.99	268,403.74	River
55	219,342.61	266,576.90	Wetland
56	218,853.86	266,507.10	Wetland
57	218,692.95	266,451.41	Wetland
58	218,533.00	266,425.93	River
59	217,815.79	266,312.75	Wetland
60	217,508.58	266,140.20	Wetland
61	216,989.43	265,761.13	Wetland
62	210,074.18	265,438.81	Creek
63	209,968.05	265,409.03	Wetland
64	209,459.18	265,817.67	Wetland
65	209,145.63	266,173.62	Wetland
66	208,791.09	266,025.41	River
67	208,750.32	265,955.28	Wetland
68	209,149.99	266,550.13	Wetland
69	206,039.11	266,847.72	River
70	206,432.95	266,737.75	Upland
71	206,354.93	266,871.35	Upland
72	206,060.60	266,768.40	Wetland

Sampling	Sampling point Location		Type of crossing
Point ID number	x	y	
73	205,803.12	266,599.61	River
74	205,734.00	266,390.49	River
75	205,686.15	266,262.89	River
76	205,695.07	266,229.95	Upland
77	205,619.37	266,009.75	Upland
78	205,586.69	265,878.15	Upland
79	205,550.02	265,474.75	Upland
80	205,528.42	265,380.32	River
81	203,950.89	264,893.70	Upland
82	203,604.15	264,710.92	Wetland
83	202,329.90	264,642.21	Upland
84	201,851.59	265,149.81	Upland
85	201,021.46	265,200.63	Upland
86	199,520.36	265,296.17	Upland
87	197,718.73	264,333.22	Upland
88	193,539.32	263,932.41	River
89	193,453.28	264,184.83	Wetland
90	193,280.58	265,070.18	River
91	193,223.37	265,315.34	Wetland
92	192,214.01	265,755.00	Wetland
93	191,143.87	266,965.96	Wetland
94	190,521.22	267,666.49	Channel
95	190,508.04	268,381.47	Channel
219	190,524.31	268,517.21	Wetland
96	190,521.67	268,681.26	Channel
97	190,529.06	268,832.22	Channel
98	190,223.91	269,136.77	Wetland
99	189,638.66	269,598.22	River
100	189,454.86	269,773.77	Wetland
101	189,161.91	270,038.92	Channel
102	189,082.24	270,085.05	Channel
103	188,887.93	270,136.63	Wetland
104	188,849.41	270,134.80	Upland
105	188,689.85	270,131.13	Wetland
106	188,664.98	270,119.64	Channel
107	188,128.20	270,079.76	Channel
108	187,416.98	270,011.91	Wetland

Sampling point Location		Type of crossing
X	y	
197.021.11	260 079 11	Channel
· ·	+	Channel
· ·	·	Channel
·	· ·	
· ·	·	Wetland
· ·		Channel
·	· ·	Channel
·	ŕ	Upland
· · ·	· ·	Wetland
	· ·	Wetland
		Wetland
		Wetland
	· ·	Wetland
183,151.08		Wetland
183,057.08	269,881.00	Upland
182,639.82	269,952.07	Wetland
182,512.36	269,939.57	Wetland
181,119.59	269,816.34	Wetland
180,277.05	269,713.17	Wetland
179,583.24	270,061.34	Wetland
179,434.22	270,157.65	Upland
179,223.30	270,118.68	Wetland
179,101.79	270,079.70	Wetland
178,778.53	270,036.14	Wetland
178,613.46	269,990.29	Wetland
178,484.10	269,945.00	Channel
178,393.37	269,944.44	Wetland
178,306.25	269,923.81	Wetland
178,322.29	269,563.86	Wetland
178,160.30	269,493.94	Upland
177,963.68	269,515.95	Wetland
177,513.22	269,449.92	Wetland
176,993.81	269,351.61	Wetland
176,596.17	269,276.78	Wetland
176,330.59	269,199.01	Wetland
176,220.55	269,199.01	Wetland
175,931.49	269,115.38	Wetland
175,724.60	269,050.82	Upland
	** 187,021.11 186,921.51 186,523.12 186,282.81 185,858.45 185,581.67 185,306.15 185,005.82 184,826.99 183,850.33 183,774.67 183,224.44 183,151.08 183,057.08 182,639.82 182,512.36 181,119.59 180,277.05 179,583.24 179,434.22 179,223.30 179,101.79 178,778.53 178,613.46 178,484.10 178,393.37 178,306.25 178,306.25 178,322.29 178,160.30 177,963.68 177,513.22 176,993.81 176,596.17 176,330.59 176,220.55 175,931.49	x y 187,021.11 269,978.11 186,921.51 269,969.72 186,523.12 269,929.88 186,523.12 269,917.68 185,858.45 269,870.13 185,858.45 269,843.92 185,306.15 269,819.10 185,005.82 269,814.52 184,826.99 269,738.86 183,850.33 269,791.59 183,774.67 269,814.52 183,224.44 269,858.08 183,151.08 269,876.42 183,057.08 269,881.00 182,639.82 269,952.07 182,512.36 269,939.57 181,119.59 269,816.34 180,277.05 269,713.17 179,583.24 270,061.34 179,434.22 270,157.65 179,223.30 270,118.68 179,101.79 270,079.70 178,78.53 270,036.14 178,393.37 269,945.00 178,393.37 269,945.00 178,396.25 269,923.81 176,993.81

Sampling	Sampling point Location		Type of crossing
Point ID	X	y	
number	175 107 50	260 024 69	Wetland
143	175,187.58 174,147.27	269,034.68	Wetland
144	, ·	269,074.29	
	174,095.92 174,041.63	269,080.16	Upland
146	,	269,066.96	Wetland Wetland
147	173,809.80	269,083.10	
148	173,601.45	269,086.03	Wetland
149	173,524.18	269,095.37	Channel
150	173,255.17	269,109.51	Wetland
151	173,055.62	269,115.38	Wetland
152	172,839.92	269,335.47	Wetland
153	172,452.56	269,712.56	Upland
154	172,405.61	269,778.59	Wetland
155	172,242.74	270,091.12	Wetland
156	171,894.99	270,061.98	Channel
157	171,814.29	270,028.03	Wetland
158	171,510.57	269,769.79	Upland
159	171,393.37	269,318.41	Wetland
160	171,353.02	269,149.68	Upland
161	171,355.10	269,150.08	Wetland
162	171,331.19	269,043.85	River
163	171,298.91	268,929.40	Wetland
164	171,232.41	268,737.87	Channel
165	171,184.46	268,619.80	Upland
166	171,186.28	268,601.58	Channel
167	171,092.29	268,280.44	Upland
168	171,072.23	268,203.06	Channel
169	170.958.78	267,829.97	Channel
170	170,911.74	267,667.16	Wetland
171	171,038.46	267,384.40	Channel
172	171,148.17	266,641.92	Wetland
173	171,477.74	264,913.85	River
174	172,188.45	264,303.44	Creek
175	172,606.86	264,257.59	Wetland
176	173,171.42	264,039.79	River
177	173,225.87	263,581.26	Wetland
178	172,778.80	262,821.83	River
179	173,965.24	254,084.03	Creek

Sampling	Sampling point Location		Type of crossing
Point ID number	x	y	
180	173,827.68	252,711.32	River
181	173,632.81	252,181.15	Creek
182	172,985.14	251,851.59	Creek
183	171,162.50	250,604.97	River
184	170,405.93	248,994.39	Creek
185	170,325.69	248,851.10	Creek
186	169,729.60	248,266.48	Creek
187	169,703.81	247,773.57	Wetland
188	169,729.60	247,785.03	River
189	169,938.81	246,899.50	Creek
190	169,941.67	246,805.78	Creek
191	169,956.00	246,782.00	Creek
192	170,004.72	245,180.03	Creek
193	170,910.31	243,348.79	Creek
194	170,895.98	243,110.93	River
195	171,016.34	241,167.92	Creek
196	171,297.19	240,649.22	Creek
197	171,884.68	239,729.30	Creek
198	171,996.71	239,534.42	Creek
199	172,437,77	238,989.92	Creek
200	173,188.61	237,691.72	Creek
201	173,377.75	237,362.16	Creek
202	173,291.78	234,527.89	Creek
203	172,718.62	228,684.55	Creek
204	172,887.70	227,922.25	Creek
205	172,879.11	227,303.24	Creek
206	173,541.10	225,993.57	Creek
207	170,213.92	220,144.50	Creek
208	169,910.15	220,112.97	Creek
209	169,139.25	220,141.63	Wetland
210	168,268.63	218,237.55	River
211	167,547.20	218,305.71	Channel
223	166,746.49	218,060.31	Upland
212	166,740.09	218,094.07	Upland
213	166,732.91	217,955.96	Wetland
214	166,157.18	217,270.81	Wetland
215	165,918.63	216,899.54	Wetland

Sampling	Sampling point Location		Type of crossing
Point ID number	X	y	
216	165,734.80	216,512.63	Wetland
217	165,825.22	216,499.83	Wetland
224	171,889.53	270,225.41	Wetland

^{*}Position coordinates are given in Stateplane, NAD 83.

Besides the *Typha domingensis* almost homogeneous stands along the Project route between Barceloneta and Arecibo (Caño Tiburones system), the herbaceous wetlands (both categories) show degraded functional values. This is evidenced by a lack of wildlife utilization, existing debris and refuse, significant presence of introduced/non-desirable species, inadequate buffer areas, etc. As herbaceous systems, they are only providing some physical/mechanical functions to the rest of the ecosystem.

Forested wetlands along the Project route are not large systems, if we compare them with the herbaceous ones. Forested wetland within Guaynabo, close to the existing pipe rack near Highway PR-165, is relatively small and is encroached by a berm to its north, an existing pipeline maintenance road to its south, and higher grounds to east and west. It appears somewhat isolated, with no adequate connection with the rest of the Cucharillas system. This fact limits the two-ways migration of aquatic species, products, functions and values between these two systems.

Forested wetland within the Peñuelas area along the Project route has also been impacted by construction activities associated to the adjacent industrial land use. This wetland is also relatively small. The portion that is within the study area has been canalized and manipulated for anthropogenic purposes.

Palustrine forested wetland at Punta Salinas (Toa Baja) is a small system and it is also isolated from surface water connection with other hydrological sources. As mentioned above, the development of these wetlands were promoted by the construction of Punta Salinas Public Beach facilities. Depressions and accumulation of earthen material are evidence of the activities that took place within these wetlands.

Forested wetlands between Toa Baja and Dorado, which are associated to the Río Cocal, show the best conditions of all forested wetlands within study limits. Dense stands of mangrove trees are supporting significant wildlife utilization. Although buffer areas are not adequate due to actual land uses, the relatively wide herbaceous buffer to the south provides some positive attributes. Nevertheless, agricultural use on these herbaceous lands may affect water quality.

Conclusions and Recommendations

This Jurisdictional Wetland and U.S. Waters Determination Study conclude that the delineated wetlands and waters within the study site should be considered under the jurisdiction of the U.S. Army Corps of Engineers, by virtue of Section 404 of the Clean Water Act of 1972, as amended. Approximately 2,936,131.41 m² or 726.67 acres of jurisdictional wetlands, and 59 U.S Waters crossings were identified and delineated along the Project route.

As mentioned in the **Results and Discussion** section, most of the wetlands within the study area are herbaceous. Their existing conditions show that they have been under impact due to the different land uses they have supported for many years. Some of them may actually increase in size and functional values, given that the hydraulic structures controlling their hydrologic regime have been shut down. This is the case of the Caño Tiburones area.

We recommend that if the Project has any impacts on the delineated wetlands or Waters of the U.S., a comprehensive restoration plan to enhance existing degraded wetlands within Project route is implemented. This plan shall take into consideration the improvement of the hydrology regime of these wetlands, which has been altered for many years.

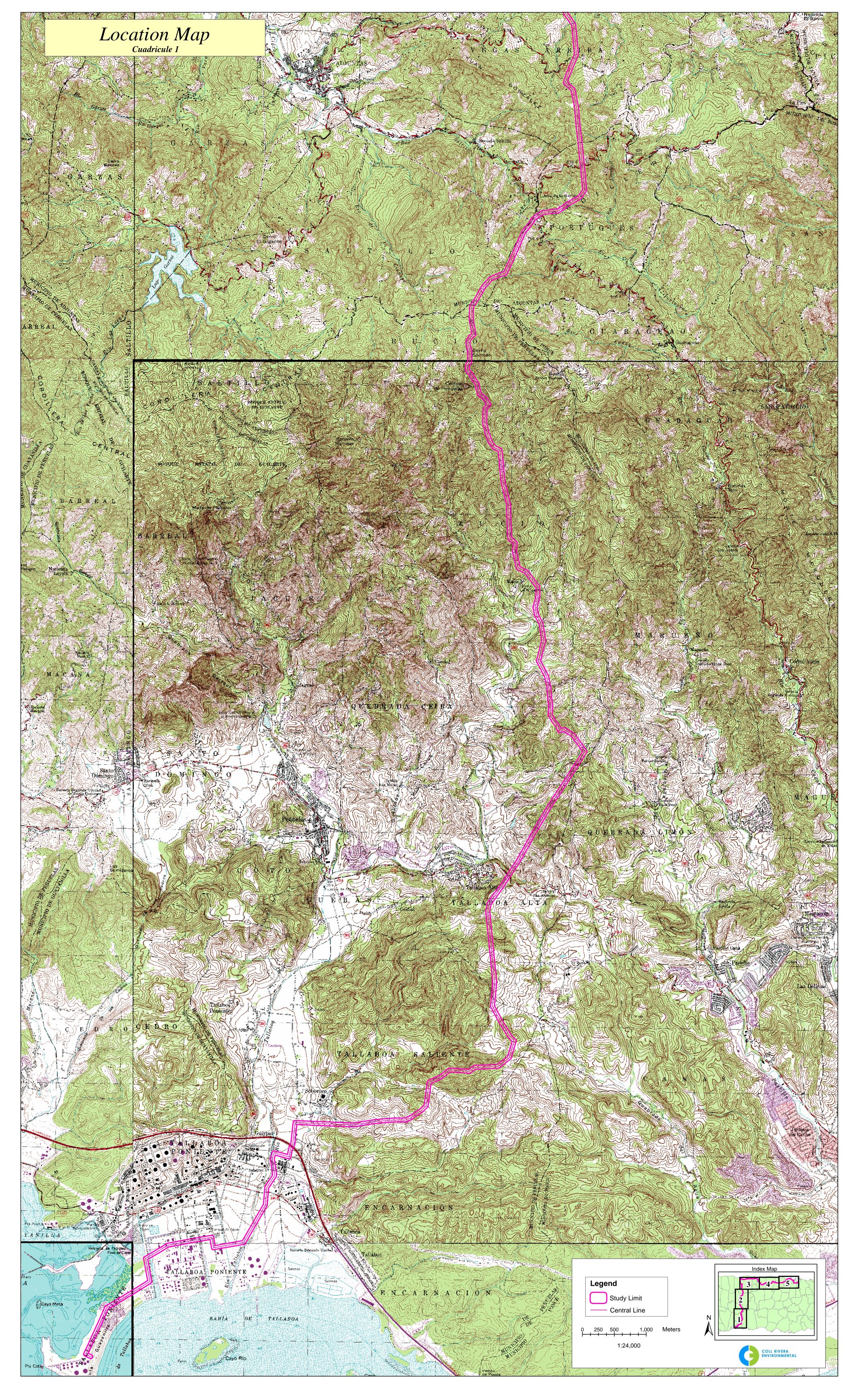
References

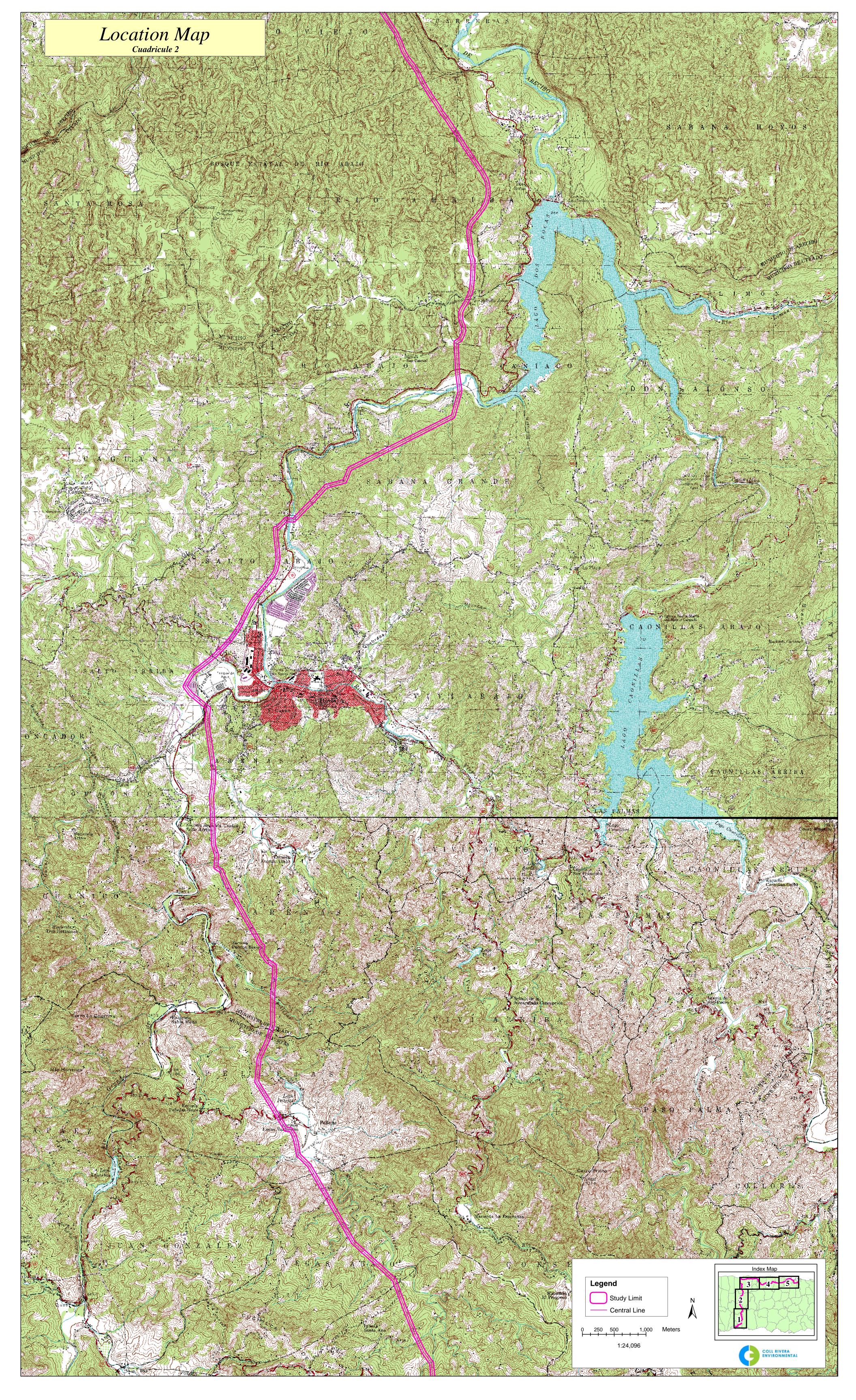
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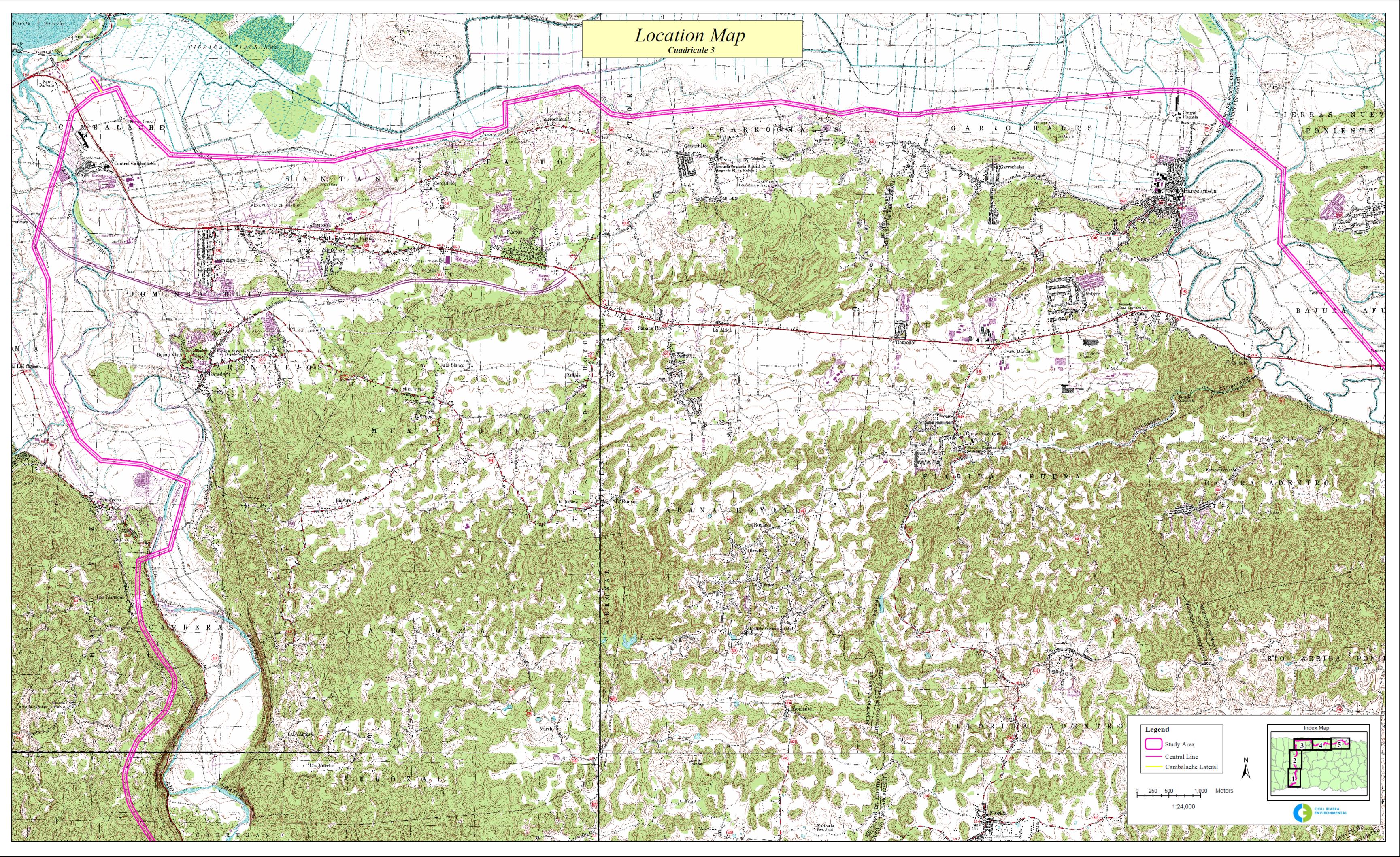
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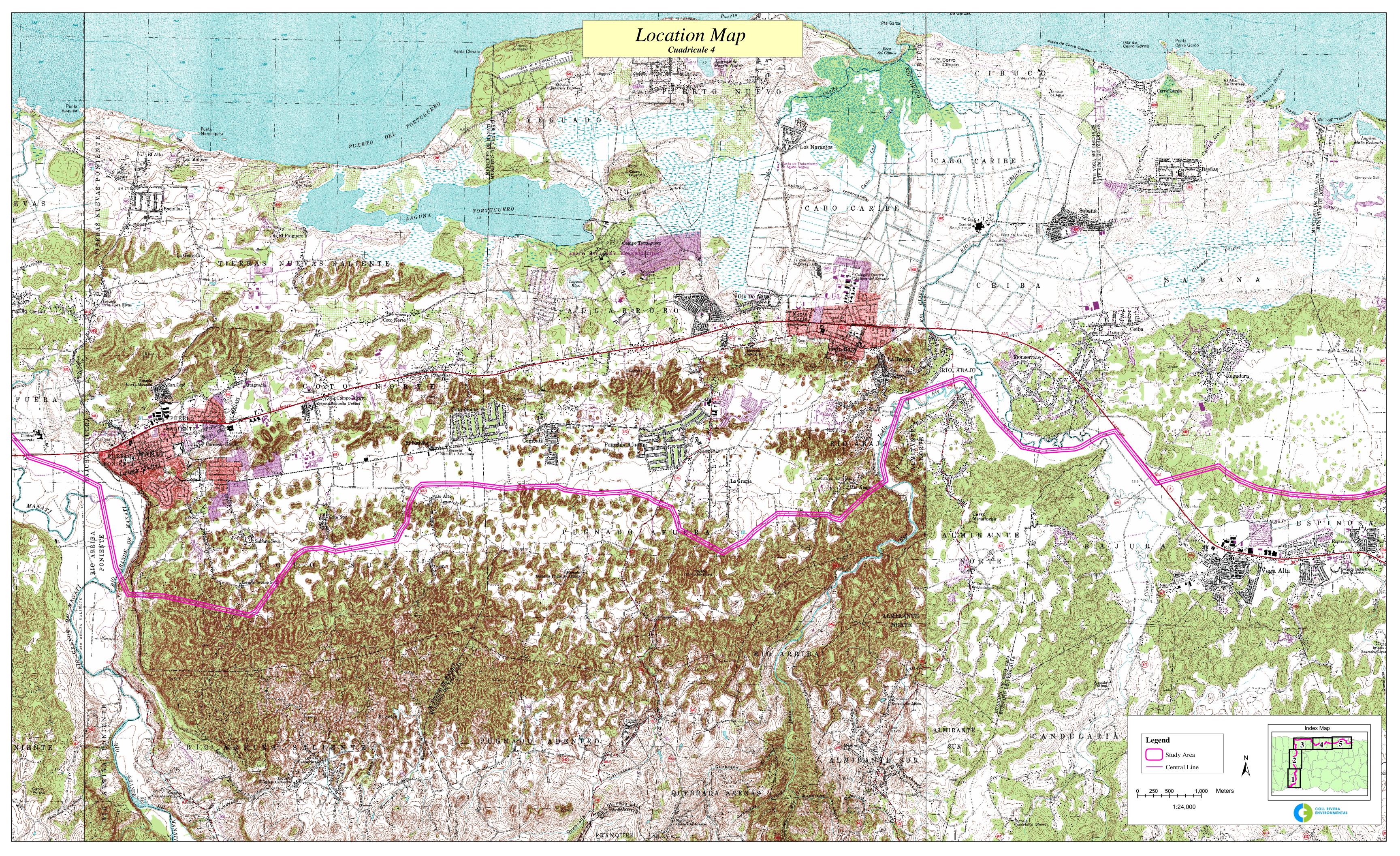
Appendix A: Figures

Figure 1: Site Location Map









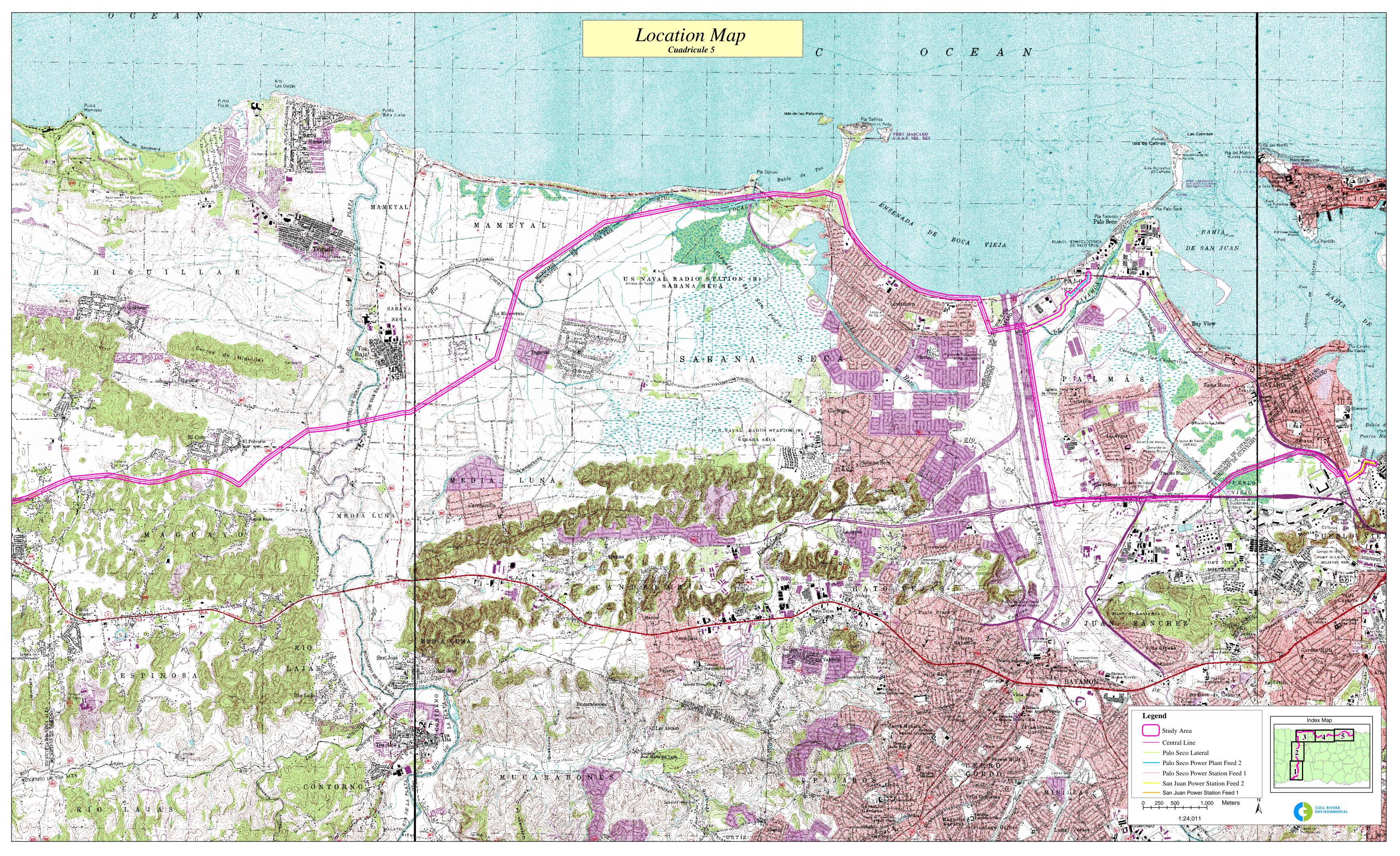


Figure 2: Aerial Photograph



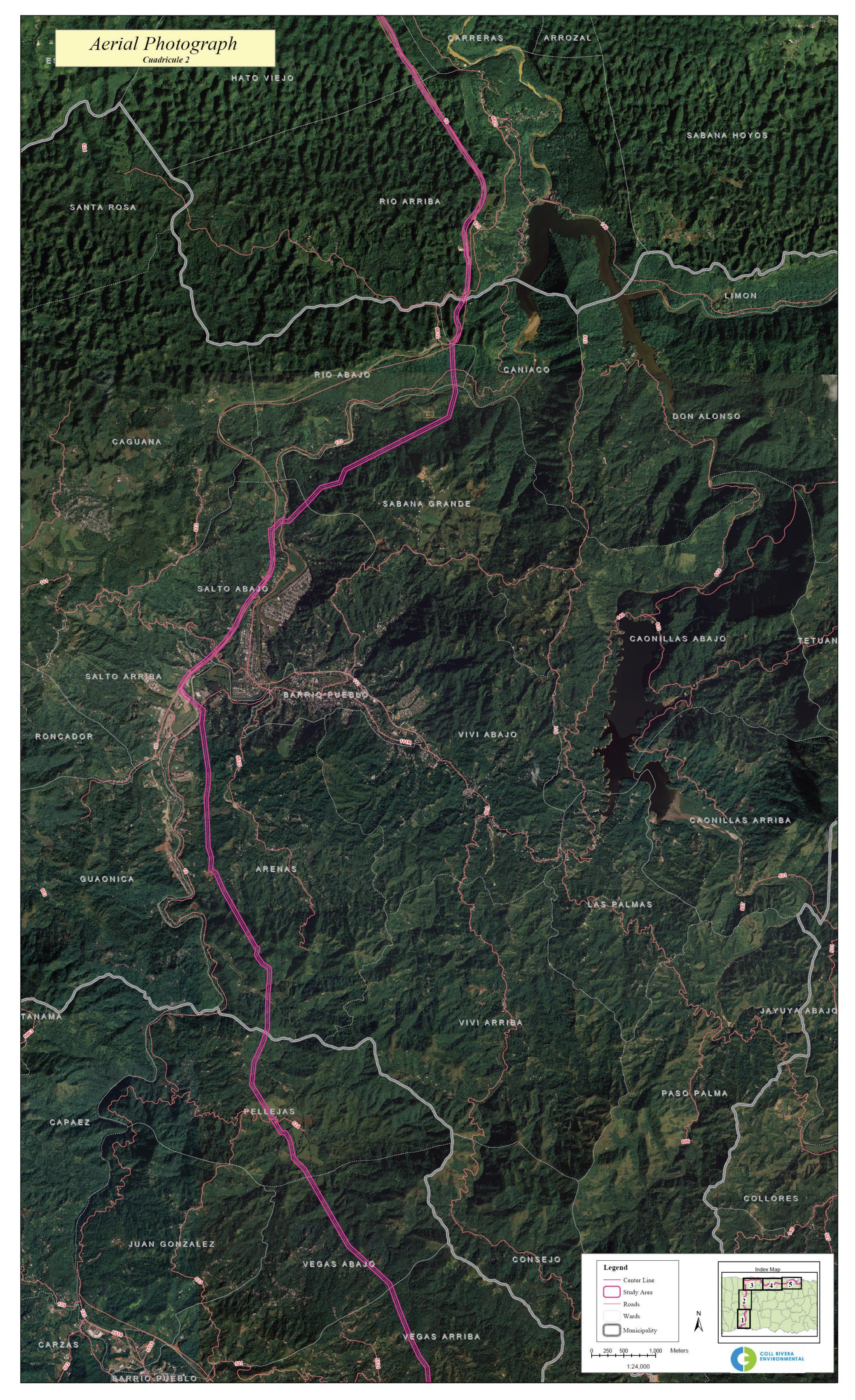








Figure 3: Hydrography Map





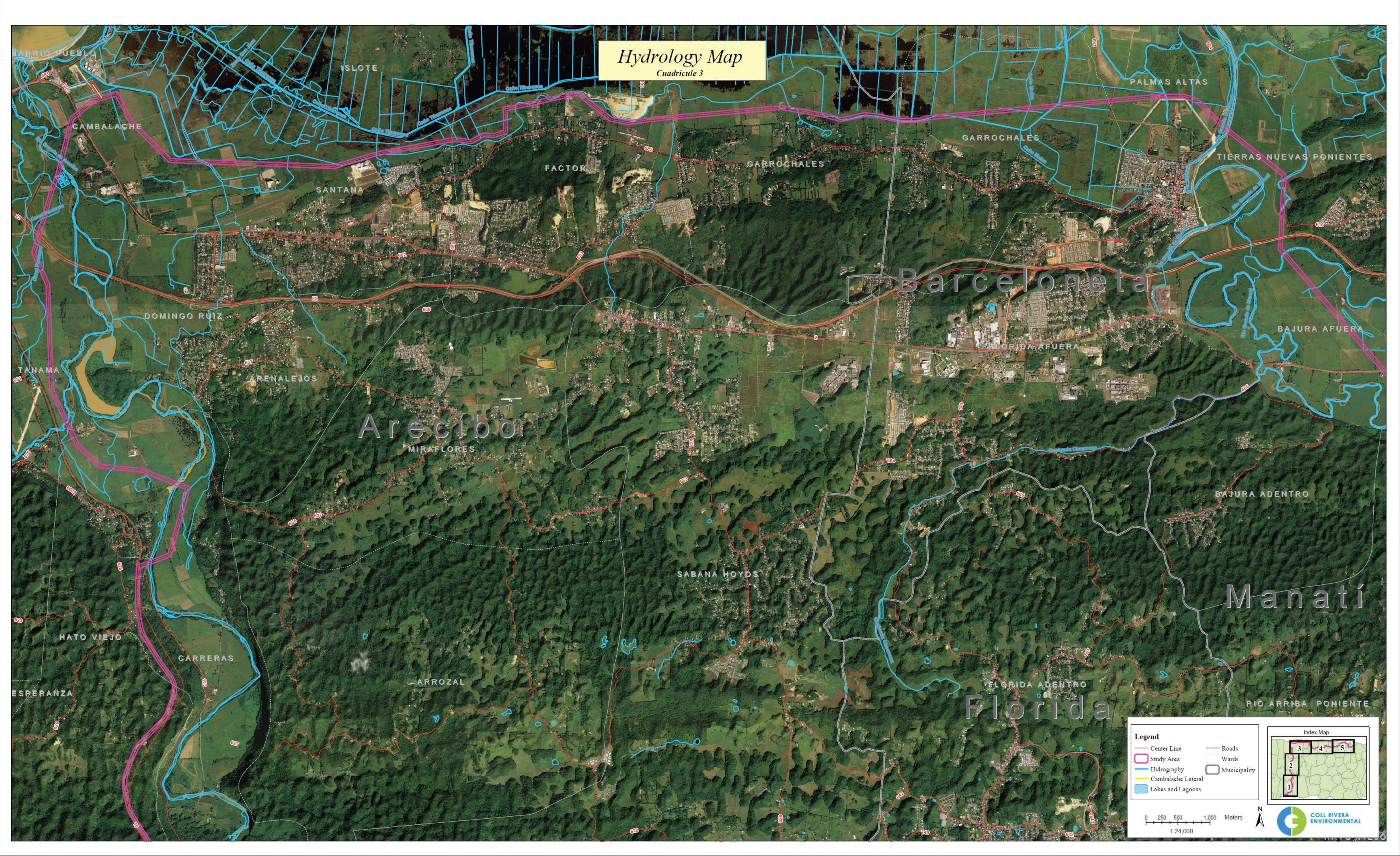
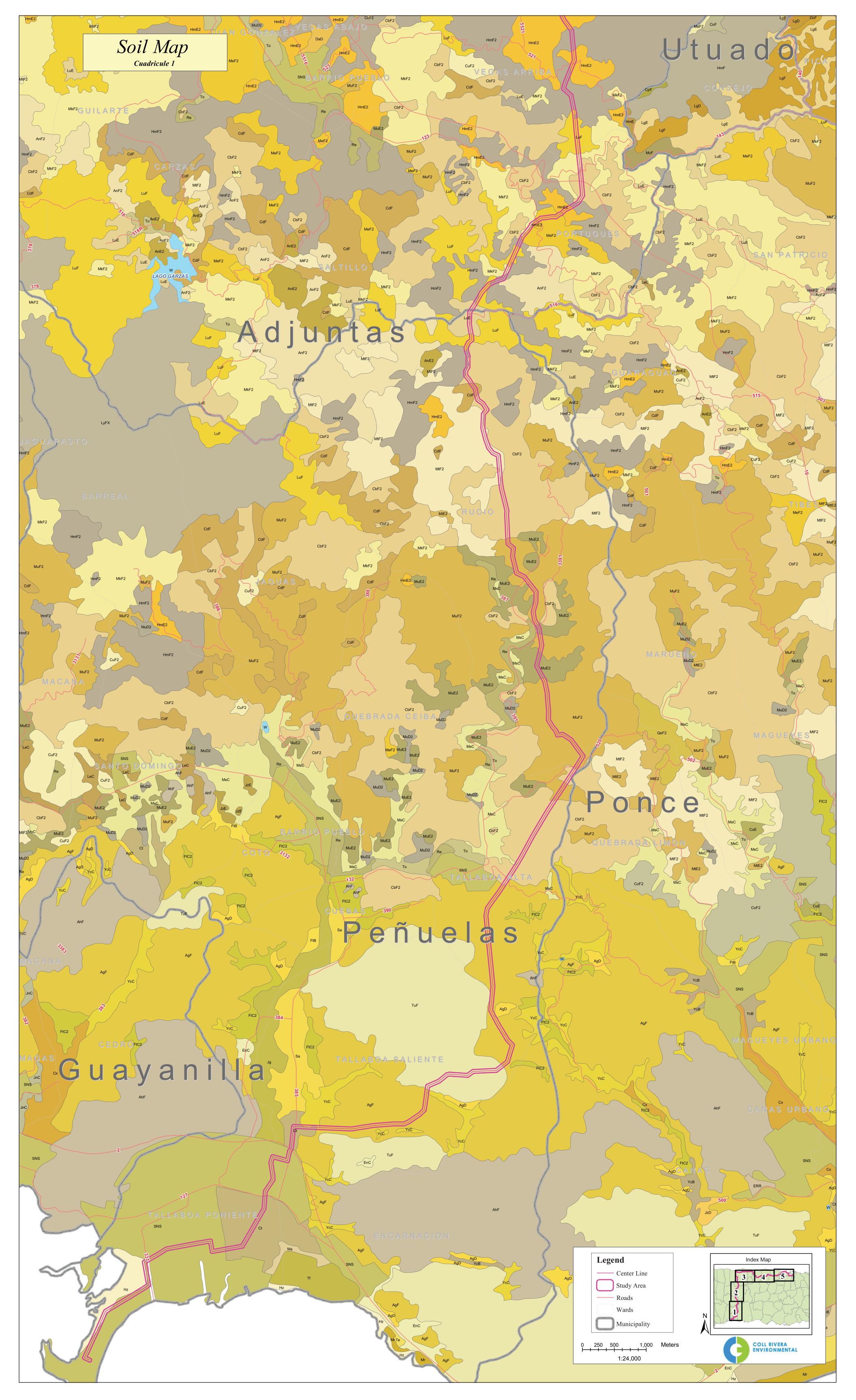
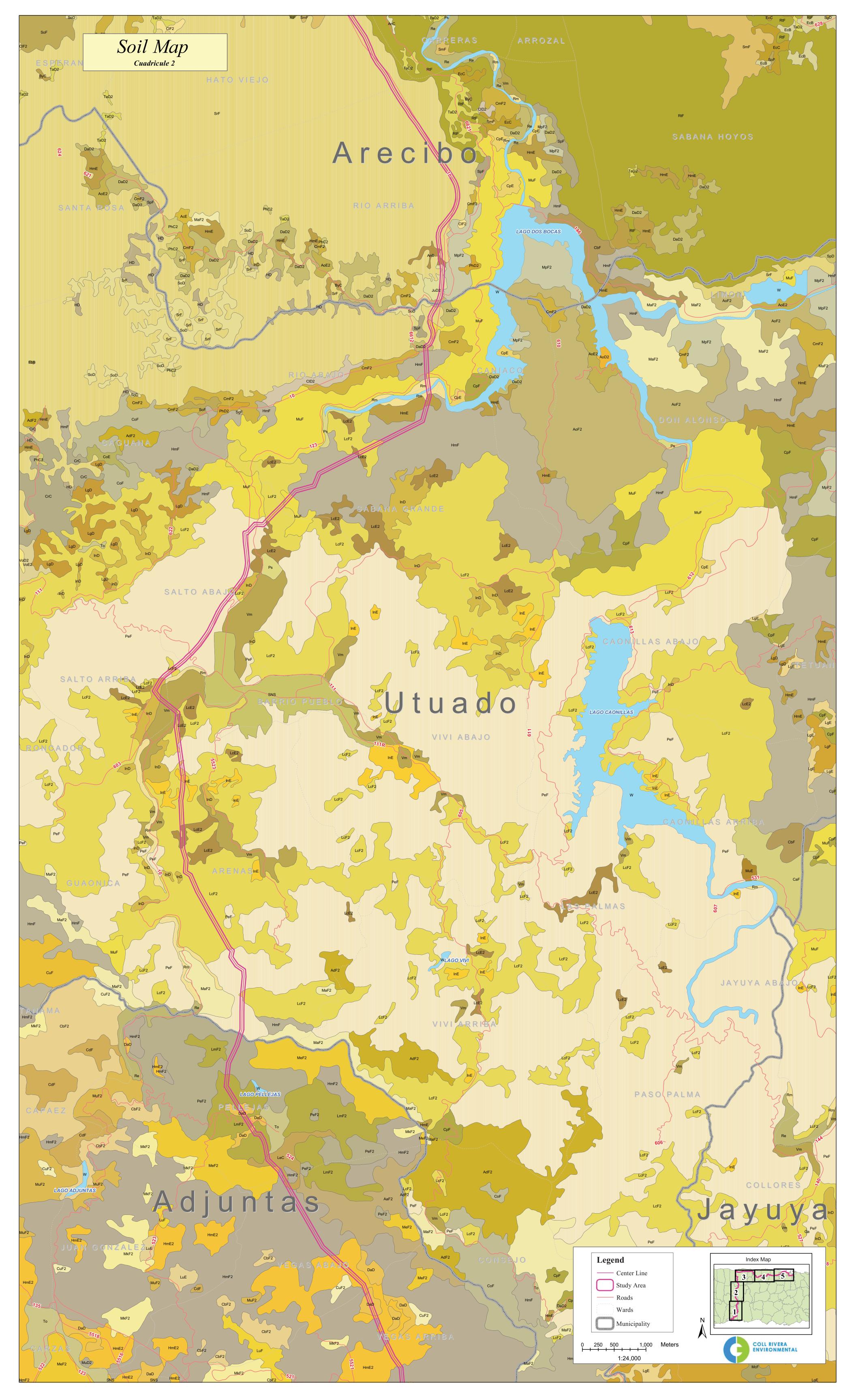


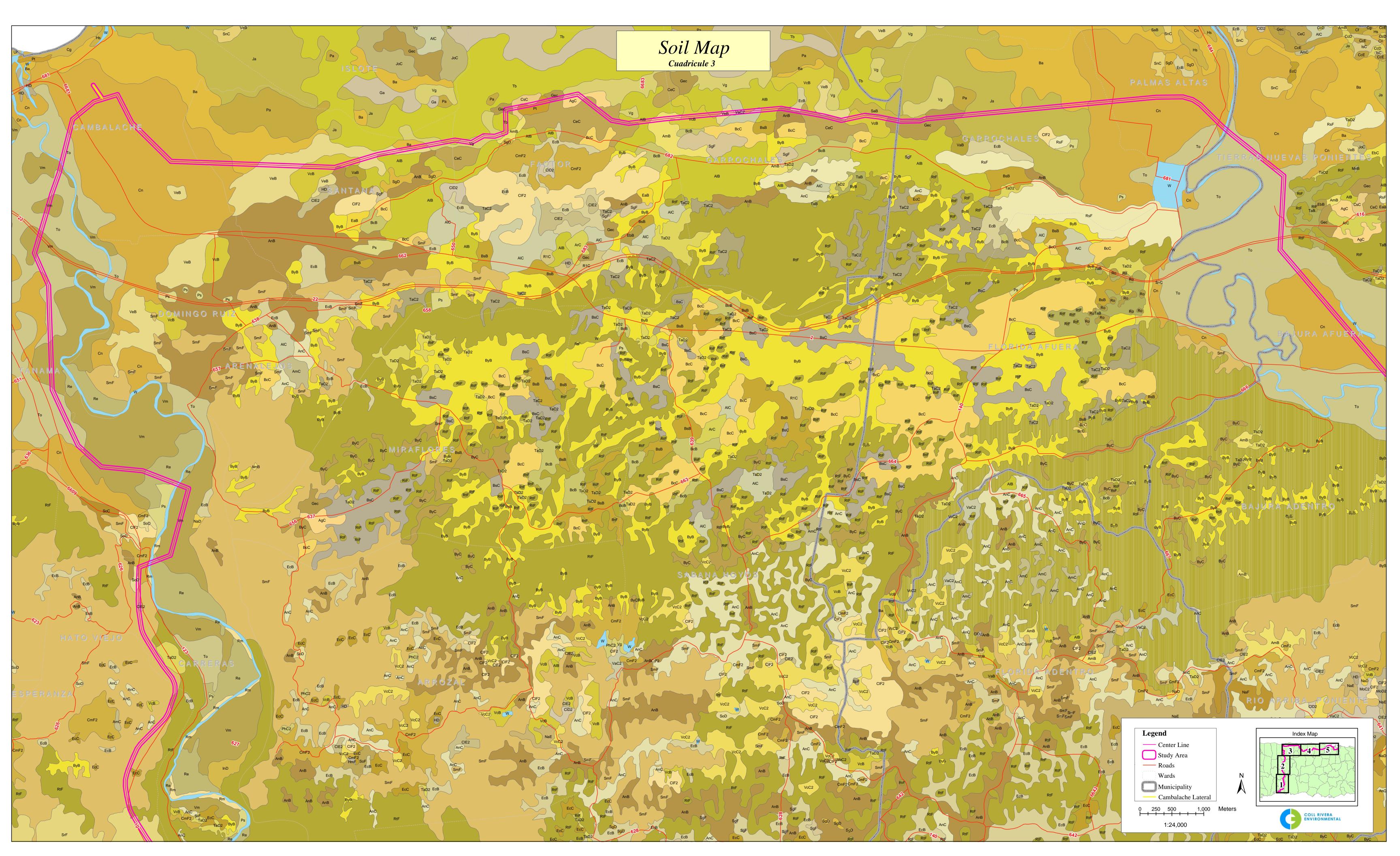


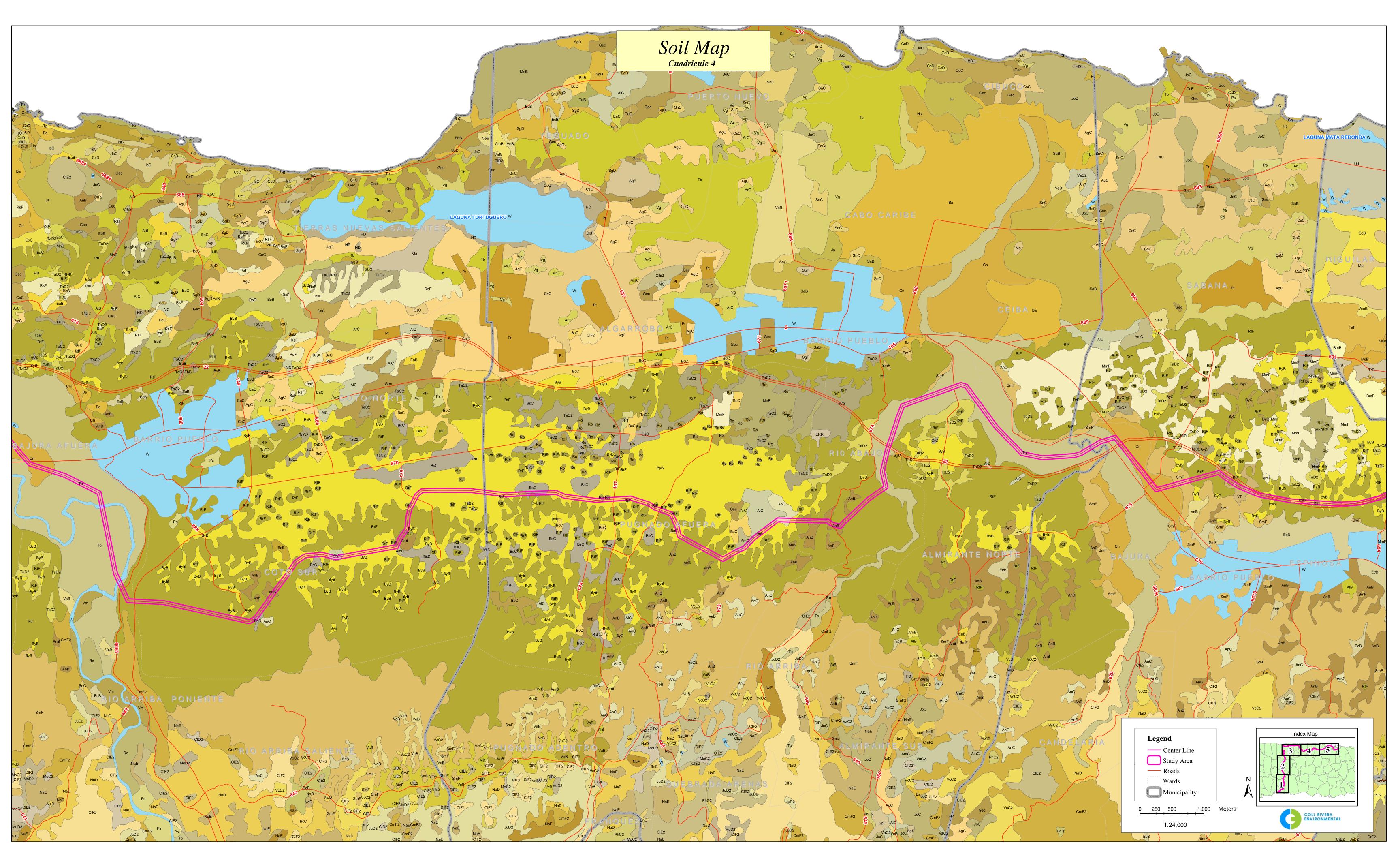


Figure 4: Soil Map









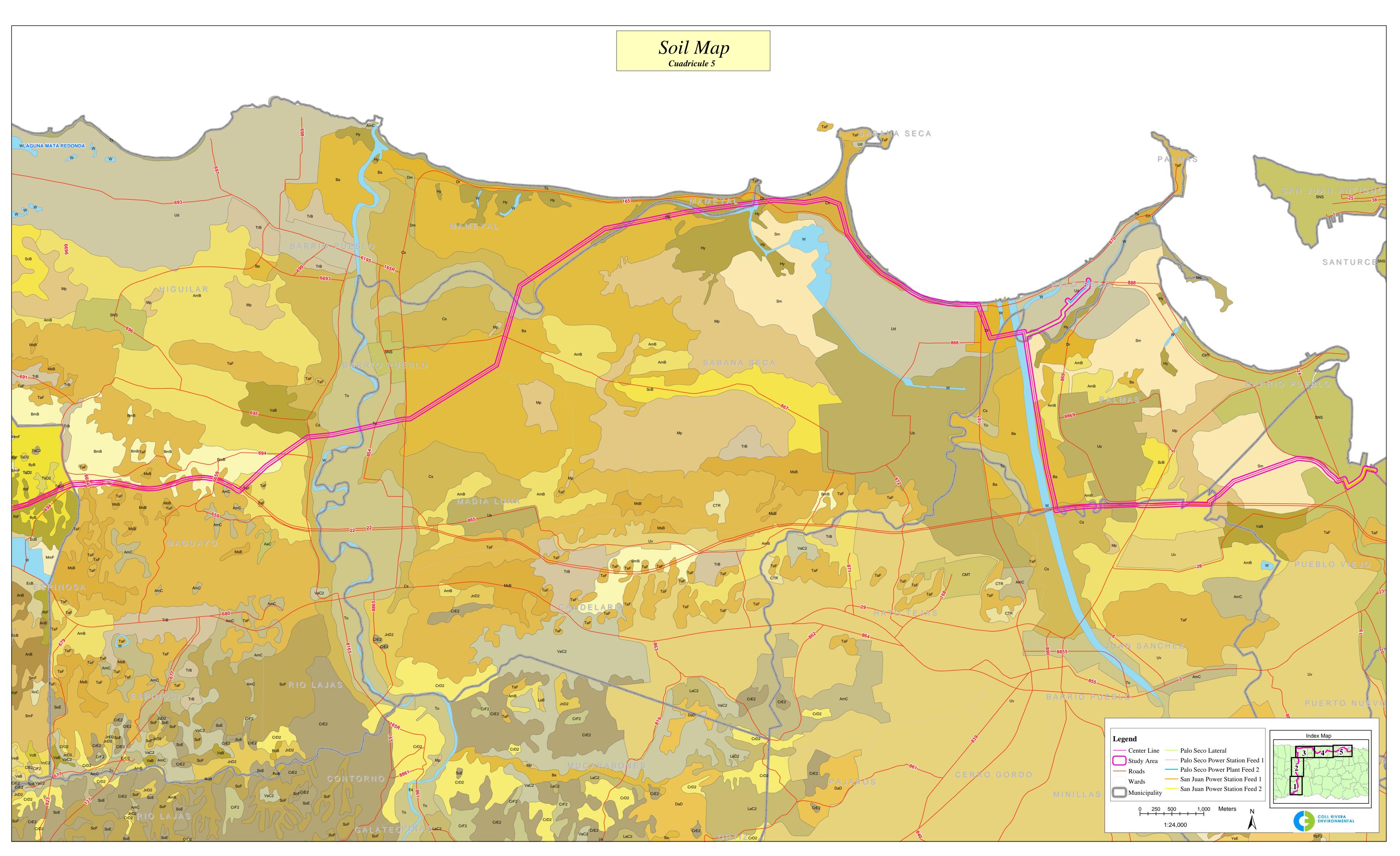


Figure 5: National Wetland Inventory Map

