RÍO PUERTO NUEVO
COMPENSATORY WETLAND
MITIGATION PROJECT
THIRD QUARTERLY REPORT

Submitted to:

U.S. Army Corps of Engineers
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I. Project Overview

1. Project Name: Río Puerto Nuevo Compensatory Wetland Mitigation Project
Federal Agency: U. S. Army Corps of Engineers (USACE)
Local Sponsor: Puerto Rico Department of Natural and Environmental Resources

2. Reforesta, Inc. was contracted by Dragados USA to implement and maintain for a period of two years the Puerto Nuevo River compensatory wetland mitigation project. Permanent monitoring plots were established on July 3 and 14, 2014. Data for the third quarterly report was collected on April 16, 2015.

3. The purpose of the Río Puerto Nuevo (RPN) flood control project is to protect lives and property. The project provides 11.2 miles of channel improvements to the river and five major tributaries (Quebradas Margarita, Josefina, Doña Ana, Buena Vista, and Guracanal). Finally, the RPN project was authorized by the Water Resources Development Act of 1986 and construction of the main channel began in 1995.

Figure 1. Black-necked stilts on water edge.

The revised Environmental Impact Statement dated July 1985, stated that the authorized project would directly impact 33.3 acres of mangroves and mud flats near the Kennedy Avenue Bridge. However, changes to the project's footprint reduced impacts to wetlands by 13.3 acres to a total of 20 acres. USACE identified approximately 28 acres within the project right-of-way to compensate the overall impact to wetland areas. The initial mitigation plan contemplated planting a mix of white (*Laguncularia racemosa*) and black (*Avicennia germinans*) at a density of approximately 4,000 seedlings/saplings per acre. The plan was amended to include red mangrove (*Rhizophora mangle*) and freshwater forested species such as *Pterocarpus, Annona,* and *Machaerium*.

4. The site is located on both sides of the newly extended Puerto Nuevo Channel (18º25'17.69 º N, 66.04'58.08º W. The planting areas are: 1)NORTH side between STA 79+00 to STA M 47+00 and 2) SOUTH side between STA M 5+60 to STA M 41+80 (Figure 3 and 4). Total planted acreage equals 27.53 acres excluding Puerto Rico Power

Authority right of ways. The northern half of the project can be accessed through the closed San Juan landfill, while the southern part can be easily reached from PR-22, right across the Nemesio Canales housing project. Although the project perimeter was not fenced, the mitigation terraces can be identified by changes in slopes and bordering established mangrove patches.

5. The mitigation project planting phase began on April 22, 2013 and concluded on May 16, 2014.

6. Plant establishment has been very successful as indicated by the rapid growth observed throughout the site. Mangrove trees continue to flower and white mangrove fruits have become available. Pneumatophores and prop roots are also evident. Reestablishing planting elevations was critical (the plan proposed a planting terrace elevation of 0 ft mean sea level). Elevation data from adjacent mangrove stands (+1.12 ft to +1.65ft above msl) indicated that the originally proposed planting elevation would have been too deep. Some areas that were already graded to 0 ft msl and subsequently planted, have had high mortality because these areas never become dry.

Figure 2. View of both sides of the planting terraces showing PREPA right of way with some recruitment.

7. Recent maintenance activities since project completion include removal of garbage and algae around seedlings, weeding and herbicide application (only in areas planted with freshwater tree species), and minimal plant replacement. The constant movement of the tides limits herbaceous ground cover in most planting areas.

8. Corrective and remedial actions during the coming months shall include herbaceous vegetation control, replanting, and staking. Replanting in low lying areas close to 0 ft msl is not recommended because trees cannot tolerate being completely submerged for long periods.

II. Requirements

Monitoring reports shall be prepared quarterly after the completion of the planting phase (May 16, 2014) for a period of two years. According to the mitigation plan prepared by USACE, a minimum of 80 % survival of planted species is required for the same monitoring time period. The time-zero report is dated July 18, 2014

III. Summary Data

On April 16, 2015 the eight 5 x 5 m permanent monitoring plots were surveyed (see Figure 4 for plot location). The purpose of the monitoring plots is to document the establishment and cover of the planted species and the presence of any unwanted species.

Within each plot all trees were identified and counted. In addition, the previously tagged individuals (n=80) were re-measured (DBH only measured for those trees over 1.3 m in height). All plots were photographed using the same stations as in the time-zero report (provided in the next pages).

Data for tagged individuals are presented on Table 1. All tagged individuals survived. Average height (grouping all species) has increased from 1.37 m during the last monitoring event to 1.67 m (21.9 % increase). Even though the majority of the trees are under the 1.3 m DBH threshold, average diameter for all species has increased from 1.39 cm to 1.62 between the last two surveys (n= 36 for the second quarterly event and n= 41 for the third quarterly period). Finally, total number of seedlings and trees were estimated for each of the plots in order to estimate densities. The table below presents the findings:

Plot number	Mangrove seedlings or trees	Freshwater forested species	Total	Density (trees per square meter)
1	76	0	76	3.0
2	4	19	23	0.9
3	52	0	56	2.1
4	65	0	65	2.6
5	51	0	51	2.0
6	29	0	29	1.2
7	121	0	121	4.8
8	77	0	77	3.1
			AVG.	**2.5**

Photo stations with accompanying information are presented below:

Photo sampling point #1 (Date taken: April 16, 2015)
Location: Plot #1-North side of channel
GPS coordinates: 18º25'27.22 º N, 66.4'57.54º W (NAD 83)
Orientation: East

Photo sampling point #2 (Date taken: April 16, 2015)
Location: Plot #2-North side of channel
GPS coordinates: 18º25'21.41 º N, 66.5'3.27º W (NAD 83)
Orientation: Southwest

Photo sampling point #3 (Date taken: April 16, 2015)
Location: Plot #3-North side of channel
GPS coordinates: 18º25'20.17 º N, 66.5'1.97º W (NAD 83)
Orientation: South

Photo sampling point #4 (Date taken: April 16, 2015)
Location: Plot #4-North side of channel
GPS coordinates: 18º25'10.88 º N, 66.5'26.79º W (NAD 83)
Orientation: South

Photo sampling point #5 (Date taken: April 16, 2015)
Location: Plot #5-South side of channel
GPS coordinates: 18º25'15.88 º N, 66.5'1.52º W (NAD 83)
Orientation: Southeast

Photo sampling point #6 (Date taken: April 16, 2015)
Location: Plot #6-South side of channel
GPS coordinates: 18º25'13.62 º N, 66.5'4.69º W (NAD 83)
Orientation: Northeast

Photo sampling point #7 (Date taken: April 16, 2015)
Location: Plot #7-South side of channel
GPS coordinates: 18º25'11.52 º N, 66.5'10.35º W (NAD 83)
Orientation: North

Photo sampling point #8 (Date taken: April 16, 2015)
Location: Plot #8-South side of channel
GPS coordinates: 18º25'8.18 º N, 66.5'20.11º W (NAD 83)
Orientation: West

IV. Maps and Plans

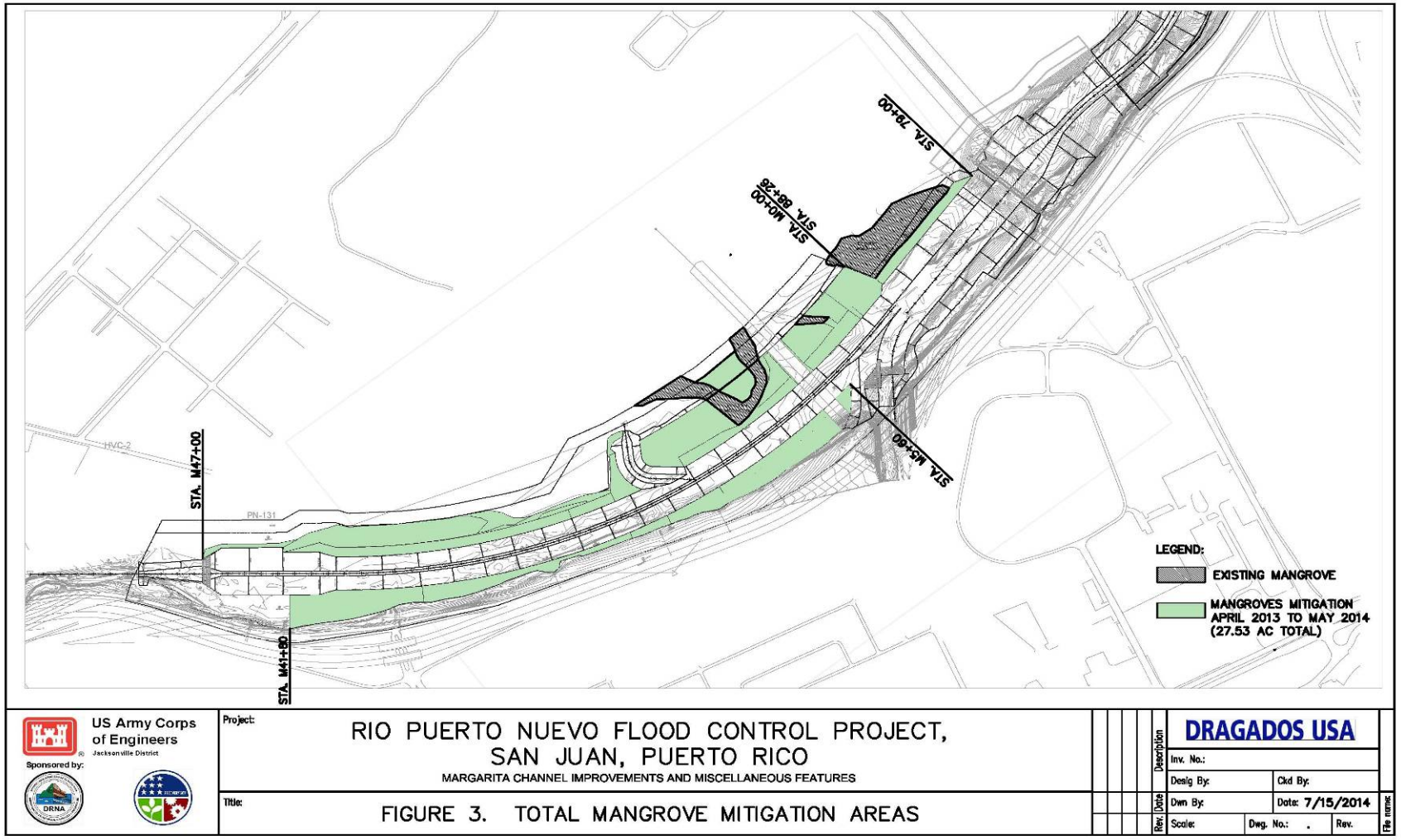

Figure 3. Location of mitigation areas.

Figure 4. Aerial photo of finished project.

Figure 5. Location of sampling plots.

V. Conclusions

The plantings at the mitigation site are thriving. The most recent data for survivorship found that 100 % of the monitoring trees have survived and seedling density is 2.4 plants per square meter. Growth data shows that the trees are well established and developing structures typical of mangrove trees such as prop roots and pneumatophores. Some mortality has been observed in areas close to the channel at elevations close to 0 msl. The mitigation site is meeting success criteria and with continued maintenance and monitoring should continue to do so. Minor remedial actions will include removal of tangling debris, plant replacement and herbaceous vegetation control specially in areas outside tidal influence.

Table 1. Sampling plot data

Plot Number	Tree Number	Species	Height (cm)	DBH (cm)
1	1	*Laguncularia racemosa*	165	1
1	2	*Laguncularia racemosa*	244	1.4
1	3	*Avicennia germinans*	213	0.8
1	4	*Laguncularia racemosa*	229	1.1
1	5	*Rhizophora mangle*	71	0
1	6	*Avicennia germinans*	140	0.3
1	7	*Laguncularia racemosa*	198	0.9
1	8	*Laguncularia racemosa*	244	1.9
1	9	*Rhizophora mangle*	61	0
1	10	*Laguncularia racemosa*	137	0.3
2	1	*Machaerium lunatum*	411	3.4
2	2	*Pterocarpus officinalis*	396	4.5
2	3	*Annona glabra*	411	3.6
2	4	*Machaerium lunatum*	411	3.1
2	5	*Pterocarpus officinalis*	168	0.6
2	6	*Machaerium lunatum*	295	1.4
2	7	*Pterocarpus officinalis*	274	1.4
2	8	*Annona glabra*	396	3.8
2	9	*Machaerium lunatum*	447	4.9
2	10	*Annona glabra*	244	2.2
3	1	*Laguncularia racemosa*	107	0
3	2	*Rhizophora mangle*	76	0
3	3	*Avicennia germinans*	91	0
3	4	*Rhizophora mangle*	76	0
3	5	*Avicennia germinans*	91	0
3	6	*Rhizophora mangle*	91	0
3	7	*Rhizophora mangle*	71	0
3	8	*Avicennia germinans*	81	0
3	9	*Rhizophora mangle*	64	0
3	10	*Rhizophora mangle*	61	0
4	1	*Laguncularia racemosa*	366	2.3
4	2	*Avicennia germinans*	274	1.4
4	3	*Laguncularia racemosa*	335	2.4
4	4	*Rhizophora mangle*	168	0.6
4	5	*Rhizophora mangle*	213	1
4	6	*Rhizophora mangle*	213	1.1
4	7	*Rhizophora mangle*	183	0.8
4	8	*Rhizophora mangle*	198	1.1
4	9	*Rhizophora mangle*	173	0.6

Plot Number	Tree Number	Species	Height (cm)	DBH (cm)
4	10	*Rhizophora mangle*	213	1.1
5	1	*Avicennia germinans*	76	0
5	2	*Rhizophora mangle*	107	0
5	3	*Laguncularia racemosa*	305	2.6
5	4	*Rhizophora mangle*	122	0
5	5	*Rhizophora mangle*	97	0
5	6	*Rhizophora mangle*	99	0
5	7	*Rhizophora mangle*	76	0
5	8	*Rhizophora mangle*	122	0
5	9	*Rhizophora mangle*	91	0
5	10	*Avicennia germinans*	91	0
6	1	*Rhizophora mangle*	109	0
6	2	*Rhizophora mangle*	152	0.9
6	3	*Laguncularia racemosa*	244	2.1
6	4	*Rhizophora mangle*	157	0.8
6	5	*Laguncularia racemosa*	244	2.2
6	6	*Rhizophora mangle*	157	0.8
6	7	*Laguncularia racemosa*	274	1.6
6	8	*Rhizophora mangle*	183	1.1
6	9	*Rhizophora mangle*	168	0.8
6	10	*Laguncularia racemosa*	290	2.3
7	1	*Rhizophora mangle*	99	0
7	2	*Rhizophora mangle*	61	0
7	3	*Rhizophora mangle*	91	0
7	4	*Rhizophora mangle*	61	0
7	5	*Rhizophora mangle*	61	0
7	6	*Rhizophora mangle*	61	0
7	7	*Rhizophora mangle*	46	0
7	8	*Rhizophora mangle*	61	0
7	9	*Rhizophora mangle*	107	0
7	10	*Rhizophora mangle*	43	0
8	1	*Rhizophora mangle*	122	0
8	2	*Rhizophora mangle*	112	0
8	3	*Avicennia germinans*	122	0
8	4	*Rhizophora mangle*	140	0.5
8	5	*Avicennia germinans*	76	0
8	6	*Avicennia germinans*	69	0
8	7	*Laguncularia racemosa*	198	0.8
8	8	*Rhizophora mangle*	132	0
8	9	*Avicennia germinans*	76	0
8	10	*Laguncularia racemosa*	183	1