DRAFT

Status Survey of *Linum arenicola* and *Linum carteri* var. *carteri* in South Florida

DRAFT REPORT
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Introduction

Both sand flax (*Linum arenicola* (Small) H.J.P. Windler) and Carter's flax (*Linum carteri* Small var. *carteri*) are small perennial herbs belonging to the flax family (Linaceae). Sand flax is endemic to Miami-Dade County and the Florida Keys portion of Monroe County where it occurs in pine rockland habitats as well as dry disturbed soils. Carter's flax is endemic to Miami-Dade County and occurs in pine rocklands and dry disturbed soils. Both species were petitioned as candidates for listing under the United States Endangered Species Act in 2007 (72 FR 69034 69106).

Over time, due to habitat destruction, fire suppression, and other human modifications, both taxa have become increasingly rare (Bradley and Gann, 1999). Human induced habitat destruction and alteration are continuing threats for populations of both taxa, particularly fire suppression and exotic pest plant invasions. Long-term habitat modifications such as sea-level rise are also threats, particularly to sand flax in the Florida Keys, as they will likely reduce necessary habitat (Bradley and Saha, 2009).

Three previous status surveys had been conducted for sand flax. One, conducted in 1980 (Austin et al., 1980) provided data for known stations throughout its range, although no populations were known in Miami-Dade County at the time. In 1996 a status survey was conducted for Miami-Dade County (Kernan and Bradley, 1996) who reported seven populations, representing about 1,000 plants. In 2006 a status survey was conducted in Monroe County in the Florida Keys (Hodges and Bradley, 2006). With the 2006 surveys, data for the Florida Keys populations are more recent and uptodate; however, no formal surveys in Miami-Dade County had occurred since 1996. There was a need for new sand flax range data because some populations have been lost and new ones have been found.

One previous status survey had been conducted for Carter's flax (Austin et al., 1980). This survey provided data for known stations throughout its range and included 17 stations, but it is not clear how many of those stations were believed extant at that time. Several of those occurrences represented plants that were misidentified as either *L. arenicola* or *L. carteri* var. *smallii*. Bradley and Gann (1999) provided a status summary based on observations of populations at that time, but no formal status surveys had been conducted for over thirty years.

This study was conducted to determine the status of sand flax in Miami-Dade County and of Carter's flax throughout its historic range. This included surveys of previously reported populations, and surveys of habitats where the species could occur.

Methods

Existing plant data in Gann et al. (2012) and other in-house data records collected by IRC staff were used to determine locations of extant and historical populations. Herbarium records from Everglades National Park Herbarium (ENP), Fairchild Tropical Botanic

Garden Herbarium (FTG), Florida Atlantic University Herbarium (FAU), New York Botanical Garden (NY), University of Florida Herbarium (FLAS), and the University of South Florida Herbarium (USF) were checked. In addition, previous status surveys and recovery plans were consulted and land managers and biologists were sought for specific, local, and up to date information.

Surveys for both taxa began with extant stations, then historic locations, followed by new survey stations. Because a comprehensive survey of all pine rockland habitat was conducted in 2004-2005 by IRC, this habitat was excluded from new surveys. Canals within urban Miami-Dade County that intersected with the pine rockland soils of the Miami Rock Ridge were surveyed. Additional disturbed sites with remnant native vegetation in close proximity to existing sites were also identified for surveys. Photos of all survey stations were created to facilitate field surveys. When surveying for new populations, aerial photographs, habitats, and associated plant taxa were compared with extant stations and IRC databases.

Occurrences were classified as extant if plants were found. Occurrences were classified as Historical if no plants were found but were observed within the past ten years and there is reason to believe that they could reappear, since their habitat is still extant. A population was considered Extirpated if no plants were observed during surveys, they had not been observed in over 20 years, or if the habitat at the station had been destroyed.

When a population was found to be extant, suitable habitat at the site was traversed, plants were counted, and plant populations were mapped. Mapping devices included either a Garmin GPSMap 60csx with accuracy to within three meters, or a Thales MobileMapper CE with ArcPad software with sub meter accuracy. A centroid of each population was taken. When measuring larger populations, polygon boundaries were recorded using the same devices and population sizes were estimated. Exact numbers were recorded for populations containing ten or fewer individuals,. For populations containing fewer than 100 individuals, plants were recorded in increments of ten (e.g. 11-20). Larger populations possessing fewer than 1,000 individuals plants, were recorded in increments of 100 (e.g. 101-200). Because of the high population density of sand flax on lands adjacent to the Homestead Air Reserve Base, a more systematic approach to sampling was needed. The boundaries of this population were first mapped. One hundred randomsampling stations were generated in ArcGIS using Hawth's Analysis Tools. At each of these stations individual plants were counted in a 1 x 1 m plot.

Results

Sand flax was found at six (6) locations, containing an estimated total of 107,060 plants. Populations ranged in size from 23 plants to 74,000 plants, with a median population size of approximately 4,500. Three populations are associated with the Homestead Air Reserve Base and properties decommissioned adjacent to the base. These three stations contain nearly 100,000 plants in total. Sand flax is considered to be Historical at three stations where it was not found in the present study but could reappear. All known sand flax populations occur on public lands, although none of these are managed for conservation of natural resources. Results for sand flax are presented in Table 1.

Carter's flax was found at seven (7) locations containing approximately 1,313 individuals. Populations ranged in size from a single plant to 700 plants, with a median of 18 plants. It was also found to be Historical at one station where it was not found in the current surveys but may reappear there. It is also recently extirpated from three stations. Two of the seven stations are on private lands. Of the five populations on public lands only three are managed for the conservation of natural resources. Results for Carter's flax are presented in Table 2.

Population Accounts – *Linum arenicola*

Allapatah Drive and Old Cutler Road

Status: Extirpated

Location: Old Cutler Road and Allapatah Drive (SW 112 Ave.)

Owner: Private

Historical Account: Sand flax was discovered here by Keith Bradley in 1994. Kernan and Bradley (1996) reported 256 plants. At the time this site consisted of a drained marl prairie dominated by native plant species. The site was developed in the mid to late 1990s, eliminating all habitat for the species.

Bauer Drive

Status: Extirpated

Location: Bauer Drive (SW 264 St.), 0.3 km east of Krome Avenue (SW 177 Ave.)

Owner: Miami-Dade County

Historical Account: Sand flax was discovered here by Keith Bradley and Debbie Duvall in 1992. The colony occurred along the south edge of Bauer Drive on the northern border of a pine rockland owned by Miami-Dade County. The property is not a managed preserve, but is occupied by a communications tower. Kernan and Bradley (1996) reported eight (8) plants. At the time (1992 through 1996) the road shoulder was dominated by native grasses. Since then native canopy hardwoods have invaded the site

and eliminated the sunny conditions required by sand flax. It has not been seen despite multiple surveys between 1997 and 2012 and is considered to be extirpated.

C-102N Canal, Goulds

Status: Extant (Figure 3)

Location: C102N Canal between SW 248 St. and US1

Owner: State of Florida, South Florida Water Management District

Historical Account: Sand flax was discovered at this station by Keith Bradley around 2005.

Survey Results: The C-102N canal was surveyed from the Florida Turnpike to US1. Plants were found only in the segment to the north of SW 248 St. Plants occurred on rocky banks of the canal, often on bare rock ledges, and mowed areas adjacent to the canal. Between 1,000 and 10,000 are estimated to be present here. This canal is adjacent to IRCs George Avery Pineland, where the species formerly occurred.

Threats: Changes in mowing regime could impact this population. Periodic mowing maintains an open canopy here, benefiting the species. Use of herbicides for weed control on the canal bank or mechanical clearing would be detrimental to this occurrence.

Management Recommendations: Control native hardwoods and exotic pest plant populations that could shade the population. Continue mowing the colony to maintain open, sunny conditions, preferably after plants are allowed to flower and set seed. Eliminate the use of herbicides on the canal bank.

Camp Owaissa Bauer

Status: Extirpated

Owner: Miami-Dade County (managed as conservation land)

Location: 17001 SW 184 St.

Historical Account: Sand flax was discovered here by George N. Avery in 1983. He found ten plants in pine rockland habitat. Since that time the pine rockland habitat where he found the plants the park suffered extremely heavy hardwood recruitment due to fire suppression. Despite periodic searches in 1989, 1990, 1991, 1994, 1995, 1996, 2003, and 2012 by Keith Bradley, George Gann, Roger Hammer, Steve Woodmansee, Jennifer Possley, and others, no plants have been relocated, despite hardwood control and reintroduction of fire. It is considered to be extirpated.

Cocoplum Development

Status: Extirpated

Location: 2587 Vistalmar Street, Coral Gables

Owner: Private

Historical Account: Sand flax was discovered here by Keith Bradley and Debbie Duvall in 1996. It occurred with a colony of Carter's flax. Kernan and Bradley (1996) reported

seventy-five (75) plants. This property was cleared in 2005 and a house constructed on the site, eliminating the population.

Everglades Archery Range (Camp Owaissa Bauer)

Status: Extant (Figure 4)

Location: 17415 Southwest 264th Street

Owner: Miami-Dade County

Historical Account: Sand flax was discovered at the Everglades Archery Range, a property owned and managed by Miami-Dade County as part of Camp Owaissa Bauer, by Keith Bradley and Roger Hammer in 1996 who found 19 plants. This station was directly across Bauer Drive from a previously known location that is now considered to be extirpated (see account for Bauer Drive, above).

Survey Results: This population was surveyed multiple times during this study before it was rediscovered in March 2012. Twenty-three (23) plants were found inside the property on the north side of the perimeter fence line, west of the facility entrance gate. All were growing along the edges of the unimproved perimeter road that is regularly mowed.

Threats: Changes in mowing regime could impact this population. Periodic mowing maintains an open canopy here, benefiting the species. Use of herbicides for weed control or mechanical clearing would be detrimental to this occurrence.

Management Recommendations: Control native hardwoods and exotic pest plant populations that could shade the population. Continue mowing the colony to maintain open, sunny conditions, preferably after plants are allowed to flower and set seed.

George Avery Pineland

Status: Historical

Location: East side of SW 125 Ave. at theoretical 238 Street

Owner: The Institute for Regional Conservation (managed as conservation land)

Historical Account: Sand flax was discovered here by Steve Green after the property was acquired by IRC. A small colony was periodically observed along a powerline easement at the base of a utility pole adjacent to pine rockland habitat. The colony was last seen in 2002. The reasons for its disappearance are unknown since no obvious changes in its habitat occurred. In 2009 the pine rockland was burned, but the species was not observed to recolonize the site. In 2010 a new utility pole was installed by Florida Power & Light on top of the original location, disturbing the substrate. The species does exist very close to the property on the bank of the C-102N canal and it is therefore feasible it could recolonize the property.

Homestead Air Force Base (decommissioned), Miami-Dade County-owned

Status: Extant, with one extirpated population (Figure 5)

Locations: 1) South side of St. Nazaire Blvd., between SW 125 Ave. and Mississippi Ave.; 2) East side of SW 127 Ave. at Community Partnership Drive

Owner: Miami-Dade County/USA

Historical Account: Sand flax was discovered at this station by Keith Bradley in 1992. Kernan and Bradley (1996) reported 600 plants.

Survey Results: A large colony was found to persist to the south of St. Nazaire Blvd. Because of the large population size at this location densities were estimated as described in the methods section. A density of 1.79 plants/m^2 was found, and plants occupied a 1.4 ha area. There is an estimated 24,000 plants in this colony. Plants occur in a grassy fields dominated either by native grasses and herbs in unmowed areas. Clusters of trees also occur here shading many areas. Typical hardwood species found at this site include the natives *Lysiloma latisiliquum* and *Sideroxylon salicifolium*, and exotic species such as *Schinus terebinthifolius.* In regularly mowed areas around a tennis court the ground cover is dominated by the exotic grass *Zoysia tenuifolia*, and there are no canopy trees or shrubs. Plants occur both on lands owned by Miami-Dade County and the Federal government. Federal lands include the mowed lawn around the tennis court, and county lands are unmowed, to the east of the tennis court.

In addition to the population described above, an additional population recently existed in a separate portion of this large county/federal-owned complex of properties. This was originally indicated in FNAI records as an occurrence of *Linum carteri* var. *carteri.* A survey of the station in 2010 by Keith Bradley resulted in the finding of *L. arenicola*, indicating that the FNAI report was based on a misidentification. This population occurred in an open mowed field adjacent to a small ditch. The area was on the east side of SW 127 Ave. at what is now Community Partnership Drive on federally-owned land. This population was developed in 2011 and all plants destroyed.

Threats: Changes in mowing regime could impact this population. Periodic mowing maintains an open canopy here, benefiting the species. In unmowed areas hardwoods are becoming dense and are most likely eliminating habitat for sand flax. Use of herbicides for weed control or mechanical clearing would be detrimental to this occurrence.

Management Recommendations: Control native hardwoods and exotic pest plant populations that could shade the population. Continue mowing the colony to maintain open, sunny conditions, preferably after plants are allowed to flower and set seed.

Homestead Air Reserve Base

Status: Extant (Figure 6)

Location: 29050 Coral Sea Boulevard, on south side of SW 288 St. and theoretical SW 132 Ave.

Owner: United States Department of Defense

Historical Account: Sand flax was discovered within the current boundaries of the Homestead Air Reserve Base in October 2011 by Keith Bradley. Other populations formerly reported from the Base in Kernan and Bradley (1996) are on lands that are now

owned by Miami-Dade County (see accounts for SOCSOUTH and Homestead Air Force Base).

Survey Results: This population occurred around the perimeter of a small pine rockland fragment at the northwest corner of the base on SW 288 St. and 132 Ave. Thirty-seven (37) plants were found. All plants were associated with native herb and grass species typical of pine rockland habitats in mowed areas adjacent to the pine rockland.

Threats: Changes in mowing regime could impact this population. Periodic mowing maintains an open canopy here, benefiting the species. Use of herbicides for weed control or mechanical clearing would be detrimental to this occurrence.

Management Recommendations: Burn pine rockland habitat adjacent to this colony every three to seven years. Control exotic pest plant populations within the pine rockland and in the vicinity of plants. Continue mowing the perimeter of the pine rockland to maintain open, sunny conditions, preferably after plants are allowed to flower and set seed.

L-31E Canal

Status: Extant (Figure 7)

Location: L-31E canal, approximately parallel to the shore of Biscayne Bay, from SW 328 St. to Card Sound Road

Owner: State of Florida, South Florida Water Management District

Historical Account: Sand flax was discovered at this station by Keith Bradley in approximately 2000.

Survey Results: Plants were found to occur along 14 km of canal levee, from just east of Card Sound Road at the southern terminus of the L-31E canal, north to almost SW 328 Street. Though plants occur on the edges of the levee at a variety of elevations they were not found to occur near the bottom of the levee which is prone to periodic flooding. The dominant plant species associated with sand flax on the levee are the native grasses *Schizachyrium gracile* and *S. sanguineum.*

Threats: Use of herbicides, while not observed, would be a threat to populations. Some sand flax was lost on the levee close to Card Sound Road due to the installation of Bahia grass sod in recent years, an activity associated with the installation of new culverts. If similar projects are planned other erosion control measures should be investigated that do not pose a threat to sand flax.

Management Recommendations: Continue regular mowing of the levee to maintain open sunny conditions.

Martinez Pineland

Status: Historical

Location: East side of SW 137 Ave., between SW 176 St. and SW 168 St.

Owner: Miami-Dade County (managed as conservation land)

Historical Account: Sand flax was discovered here by Jennifer Possley in 2005, when she observed 11-100 plants in drained marl prairie. A survey in December 2011 failed to relocate these plants. Jennifer Possley reports that it has been at least 4 years since she observed these plants (personal communication, July 18, 2012). Because of a lack of fires on this property the vegetation has become extremely dense, limiting habitat for the species. It may be rediscovered on the site, especially after a fire.

Palmetto Bay Village Center

Status: Extirpated

Location: 18001 Old Cutler Road

Owner: Private

Historical Account: Sand flax was discovered here by George Gann in 1988. Kernan and Bradley (1996) reported twelve (12) plants. Following the transfer of the property from the Burger King Corporation to Palmetto Bay Village Center, large portions of the natural areas on the property were mechanically cleared. The clearing created extensive damage to the soils. Detailed surveys of the property in 2009 by Keith Bradley failed to reveal any plants. It is presumed to be extirpated.

Silver Green Cemetery

Status: Historical

Location: North side of SW 240 St. on east side of theoretical SW 137 Ave.

Owner: Private

Historical Account: Sand flax was discovered here by Keith Bradley and Debbie Duvall in 1993. Kernan and Bradley (1996) reported 47 plants. At the time this site was heavily overgrown and unmaintained, but did have open sunny areas consisting of ground cover native to pine rocklands on exposed limestone. The property was cleared in the mid to late 1990s. All canopy trees were removed and the site is now mowed very frequently. Sod was planted on a small portion of the site. This site was surveyed five times in 2011 but no plants were found. There is suitable habitat, but the property is mowed so often that if plants are present they may not have been visible, lacking the opportunity to grow and flower.

SOCSOUTH Property, former Homestead Air Force Base

Status: Extant (Figure 8)

Location: Complex of lands along Flight Line Road, adjacent to runway at Homestead Air Reserve Base

Owner: Miami-Dade County, leased to United States

Historical Account: Sand flax was discovered at this station by Keith Bradley in 1992 when it was within the boundaries of the Homestead Air Force Base. Kernan and Bradley (1996) reported 20 plants. The property is being leased to the United States for

the development of a Special Operations center of the U.S. Southern Command (SOCSOUTH).

Survey Results: This population was surveyed in detail in 2009 (Bradley, 2009). Sand flax was found to occur at densities up to 4.5 plants/m^2 in some habitats and 74,000 plants were estimated to occur there. In 2013 surveys at SOCSOUTH by Craig van der Heiden, showed sand flax is persisting in this area. Habitat for sand flax on this property includes former lawns dominated by the exotic grass *Zoysia tenuifolia*, as well as relictual, formerly cleared pine rockland habitat dominated by native plant species.

Threats: Development of portions of this property by SOCSOUTH will eliminate some colonies. Conservation plans do account for management of the population, including setting aside the densest colonies for conservation and long-term management. conservation plans have been implemented and this population should continue to thrive.

Management Recommendations: Control native hardwoods and exotic pest plant populations that could shade the population. Continue mowing the colony to maintain open, sunny conditions, preferably after plants are allowed to flower and set seed. Habitats should be restored through the use of prescribed fire.

Population Accounts – *Linum carteri* var. *carteri*

C-103 Canal

Status: Extant (Figure 9)

Location: C-103 Canal at theoretical 277 St., between Krome Avenue (SW 177 Ave.) and SW 182 Ave.

Owner: State of Florida, South Florida Water Management District

Historical Account: This colony was discovered during this status survey, in March 2012.

Survey Results: A single plant was discovered on the west bank of the C-103 Canal between Krome Avenue (SW 177 Ave.) and SW 182 Ave. The plant was growing on exposed rocky soil in an area otherwise dominated by weedy herbaceous species.

Threats: Changes in mowing regime could impact this population. Periodic mowing maintains an open canopy here, benefiting the species. Use of herbicides for weed control on the canal bank or mechanical clearing would be detrimental to this occurrence.

Management Recommendations: Control native hardwoods and exotic pest plant populations that could shade the population. Continue mowing the colony to maintain open, sunny conditions, preferably after plants are allowed to flower and set seed. Eliminate the use of herbicides on the canal bank.

Camp Owaissa Bauer Addition

Status: Extant (

Figure **10**)

Location: Southeast corner of SW 264 St. and Krome Avenue (SW 177 Ave.)

Owner: Miami-Dade County (managed as conservation land)

Historical Account: This colony was discovered by Keith Bradley in 1994. Surveys conducted by URS Corporation in March 2006 found 30+ plants. In a follow up survey in November 2010 by URS no plants were found. Plants were also mapped by Fairchild Tropical Botanic Garden in December 2010.

Survey Results: Two colonies of plants were observed on the property. Three (3) plants were found along Krome Avenue on the edge of fire suppressed pine rockland habitat. This previously known station was found only after multiple survey attempts. Ten (10) plants were found in pine rockland habitat at the northeast corner of the preserve.

Threats: Expansion of Krome Avenue threatens this taxon on the western edge of the preserve and pine rockland habitat. While the project to widen this road has been dormant since 2010, it will certainly be a threat at some point in the future. Disturbances along this edge are also common and can have impacts to the population. It is a common place for "yard sales" and parking to sell used cars. These impacts are usually away from the plants, but sometimes encroach on the edge of the natural area. Shading by canopy trees is a threat for both colonies, particularly by wild tamarind (*Lysiloma latisiliquum*).

Management Recommendations: Control native hardwoods and exotic pest plant populations that could shade the population. Continue mowing the Krome Avenue colony to maintain open, sunny conditions, preferably after plants are allowed to flower and set seed.

Chapman Field, USDA Subtropical Horticultural Research Station

Status: Extant (Figure 11)

Location: 13601 Old Cutler Road

Owner: United States Department of Agriculture

Historical Account: This colony was discovered Keith Bradley in 1996. Surveys were conducted by Jennifer Possley in approximately 2002, but plants were not counted. She found that plants existed in five colonies.

Survey Results: Approximately 700 plants were found in four general areas on the station. One of these was newly discovered, and one colony mapped by Jennifer Possley could not be located. All plants were found to occur in disturbed soils. Three of the colonies are adjacent to pine rockland fragments, but no plants occur within the pine rockland habitat, except for a fire break that runs through one of them. Most of these pine rockland fragments are extremely dense due to decades of fire suppression. Three of the colonies are very large. Because plants occur mainly in open fields, populations are regularly mowed. This mowing serves to maintain open sunny conditions and benefit the taxon.

Threats: Expansion of agricultural activities could potentially threaten this taxon, but to date no colonies have been known to have been impacted on the site due to such activities. Use of herbicides could potentially be a threat.

Management Recommendations: Control native hardwoods and exotic pest plant populations that could shade the population. Continue mowing to maintain open, sunny conditions, preferably after plants are allowed to flower and set seed.

Charles Deering Estate at Cutler

Status: Extirpated

Location: 16701 SW 72 Avenue

Owner: Miami-Dade County (managed as conservation land)

Historical Account: Carters' flax was discovered here Rob Line in the 1980s. He observed one small colony of plants in a firebreak at the northern end of the property. He reported that this colony later disappeared. Surveys of this location throughout the 1990s, and many botanical surveys of the Deering Estate, have failed to rediscovery the taxon in this area.

Cocoplum Development

Status: Extirpated

Location: 2587 Vistalmar Street, Coral Gables

Owner: Private

Historical Account: Carter's flax was discovered here by Keith Bradley and Debbie Duvall in 1996. It occurred with a colony of sand flax. This property was cleared in 2005 and a house constructed on the site, eliminating the population.

Gifford Arboretum Pineland

Status: Historical

Location: Intersection of Campo Sano Avenue and San Amaro Court, Coral Gables

Owner: Private

Historical Account: Carter's flax was discovered here by Debbie Duvall in the 1980s. This private property is across Campo Sano Avenue from the Gifford Arboretum at University of Miami. It was observed here repeatedly throughout the 1990s. While the site remains, two surveys in September 2011 and March 2012 failed to relocate the taxon. The site has developed a denser canopy due to encroachment and growth of native and exotic hardwoods. It is possible that the species could still be located on the site in some of the canopy caps that remain on the property.

Montgomery Botanical Center

Status: Extant (Figure 12)

Location: 5957 Montgomery Drive (SW 120 St) – approximately

Owner: Private

Historical Account: This colony was observed in 1991 by Keith Bradley, but was misidentified at the time as *Linum carteri* var. *smallii*. It was later identified as Carter's

flax by Joyce Maschinski of Fairchild Tropical Botanic Garden. This property is isolated from the Montgomery Botanical Center's main property, to the east. This small property is the location of a pumping station that provides water to the Center.

Survey Results: Twelve plants were observed in the southeast corner of the property in a fire break. The firebreak provides open, sunny habitat on bare rock. Most of the property is pine rockland habitat, but this has an extremely dense subcanopy with no habitat for this taxon. All other firebreaks were surveyed on the property. While suitable habitat existed, plants were found only in the single colony.

Threats: Shading is the largest threat to this species. No suitable conditions remain for the taxon in the pine rockland on the property because of fire suppression. Growth of canopy species over the fire break where the taxon persists could eliminate the colony.

Management Recommendations: Control native hardwoods and exotic pest plant populations that could shade the population. Continue mowing the fire break to maintain open, sunny conditions, preferably after plants are allowed to flower and set seed.

Old Dixie Pineland

Status: Extant (Figure 13)

Location: West side of US1 at theoretical SW 275 Street

Owner: Private

Historical Account: This colony was discovered in 1992 by Keith Bradley, when plants were observed in the right-of-way of the former FEC Railway line.

Survey Results: Despite the recent destruction of most of this site, a small colony of plants was located. Plants were found adjacent to US1 in recently disturbed pine rockland, all within 25 m of the highway. A total of eighteen (18) plants were found. The FEC Railway right-of-way was developed into the South Miami-Dade Busway in 2007 and this colony was completely destroyed.

Threats: Development is the largest threat to this species. This property is privately owned and has already been partially cleared. This pine rockland was formerly much larger, but individual owners have been rapidly developing their properties in this area, leaving only this small vulnerable site behind. In addition to development, encroachment by hardwoods and other plant species is a threat. Post-disturbance succession may eliminate habitat for this species.

Management Recommendations: Acquire the property for preservation. Utilize prescribed fire to maintain suitable conditions for Carter's flax.

Ponce & Riviera Pineland

Status: Extirpated

Location: North side of Ponce de Leon Blvd. on east side of Riviera Drive, Coral Gables

Owner: Private

Historical Account: Carter's flax was discovered here by George Avery in 1978 (Avery 1903 FAU, US). It was known from this site until 2004 when an apartment complex was constructed on the site, eliminating the population.

R. Hardy Matheson Preserve

Status: Extant (Figure 14)

Historical Account: This colony was recorded by Fairchild Tropical Botanic Garden in 1990. Plants were mapped by Jennifer Possley in approximately 2002.

Location: East side of Old Cutler Road on north side of Snapper Creek Canal, south of Destacada Ave., Coral Gables

Owner: State of Florida, leased to Miami-Dade County (managed as conservation land)

Survey Results: Three hundred and seventy four (374) plants were observed in pine rockland habitat near the northern border of the preserve. All plants occurred in open canopy gaps where bare rock substrate was exposed. All plants occurred in an area where vegetation had been mechanically cleared decades ago.

Threats: Shading is the largest threat to this species. Hardwood encroachment at this site is a serious issue and could eventually eliminate the population.

Management Recommendations: Control native hardwoods and exotic pest plant populations that could shade the population.

Rockdale Pineland

Status: Extant (Figure 15)

Location: West side of US1, between SW 144 and SW 152 Streets

Owner: Miami-Dade County (managed as conservation land)

Historical Account: This colony was discovered by Keith Bradley in 1999.

Survey Results: One hundred and ninety five (195) plants were observed along the edges of the abandoned FEC Railroad tracks, adjacent to pine rockland habitat. The population has two colonies at the north and south ends of the site, with no plants in the middle. While there was no historical data to quantify it, there was an observable decline at the southern end of the property. Plants formerly grew south of a small gate near the south end of the railroad tracks. Plants are now almost completely gone from this area due to shading by cultivated trees.

Threats: Shading is the largest threat to this species and has caused losses at the southernmost portion of the property. Plants have also been trampled by parking vehicles and machinery along the edges of the railroad right-of-way.

Management Recommendations: Control native hardwoods and exotic pest plant populations that could shade the population. Eliminate parking of vehicles on populations. Continue mowing the right-of-way to maintain open sunny conditions, preferable mowing after plants flower and set seed.

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Table 1: Sand flax (*Linum arenicola*) Survey Results

Site Name	Results	Estimated Population Size
Allapatah Drive and Old Cutler Road	Extirpated	0
Bauer Drive	Extirpated	0
C-102N Canal, Goulds	Extant	1,000-10,000
Camp Owaissa Bauer	Extirpated	0
Cocoplum Development	Extirpated	0
Everglades Archery Range (Camp Owaissa Bauer)	Extant	23
George Avery Pineland	Historical	0
Homestead Air Force Base (decommissioned, County-owned)	Extant	24,000
Homestead Air Reserve Base	Extant	37
L-31E Canal	Extant	1,000-10,000
Martinez Pineland	Historical	0
Palmetto Bay Village Center	Extirpated	0
Silver Green Cemetery	Historical	0
SOCSOUTH (former Homestead Air Force Base)	Extant	74,000

Table 2: Carter's flax (*Linum carteri* var. *carteri*) Survey Results

Site Name	Results	Estimated Population Size
C-103 Canal	Extant	1
Camp Owaissa Bauer Addition	Extant	13
Chapman Field, USDA Subtropical Horticultural Research Station	Extant	700
Charles Deering Estate at Cutler	Extirpated	0
Cocoplum Development	Extirpated	0
Gifford Arboretum Pineland	Historical	0
Montgomery Botanical Center	Extant	12
Old Dixie Pineland	Extant	18
Ponce & Riviera Pineland	Extirpated	0
R. Hardy Matheson Preserve	Extant	374
Rockdale Pineland	Extant	195

Figures

Figure 1: Sand flax (*Linum arenicola*) survey results

Figure 2: Carter's flax (*Linum carteri* var. *carteri*) survey results

Figure 3: Sand flax, C-102N Canal

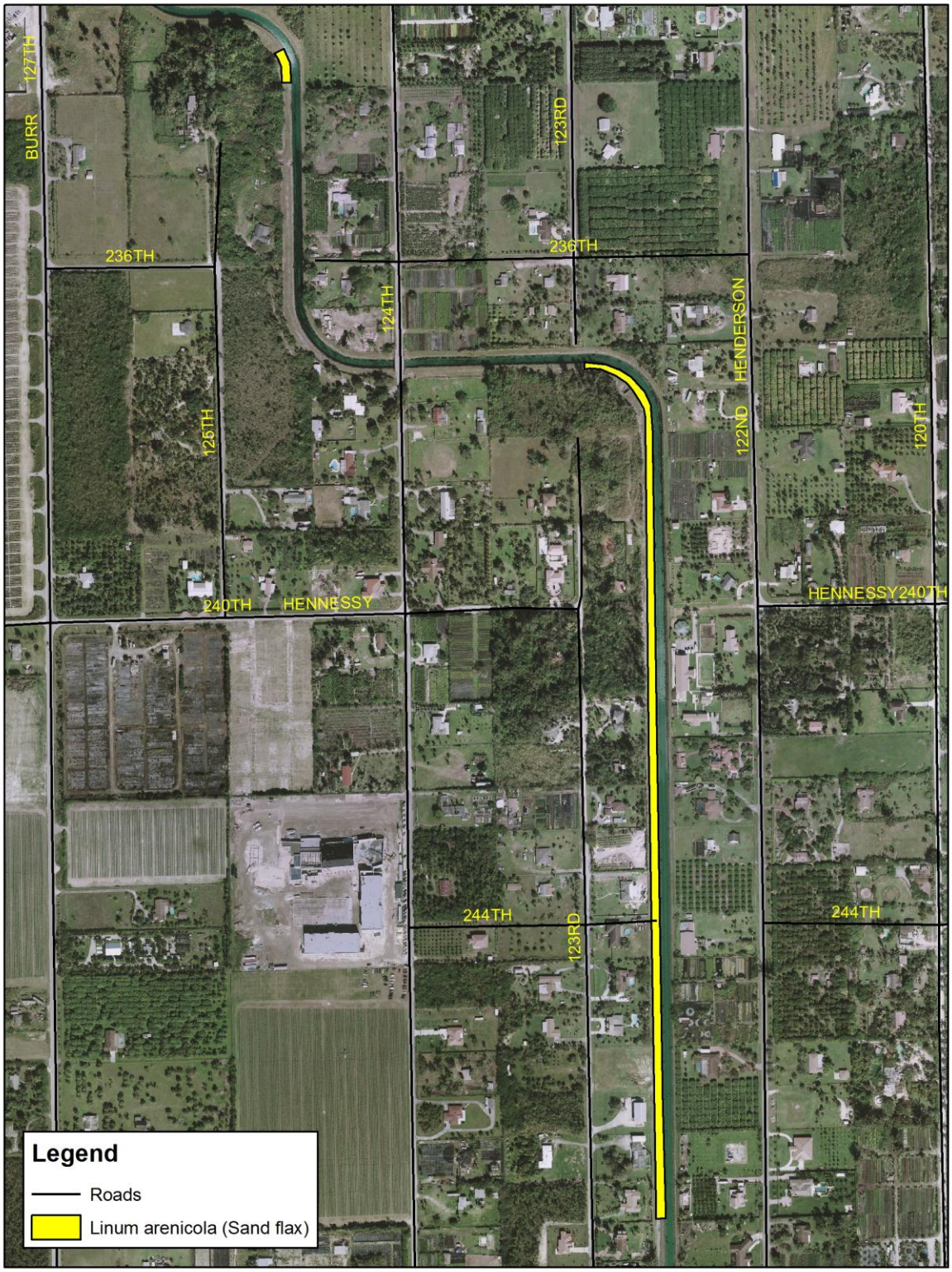

Figure 4: Sand flax, Everglades Archery Range

Figure 5: Sand flax, Homestead Air Force Base (decommissioned), Miami-Dade County-owned

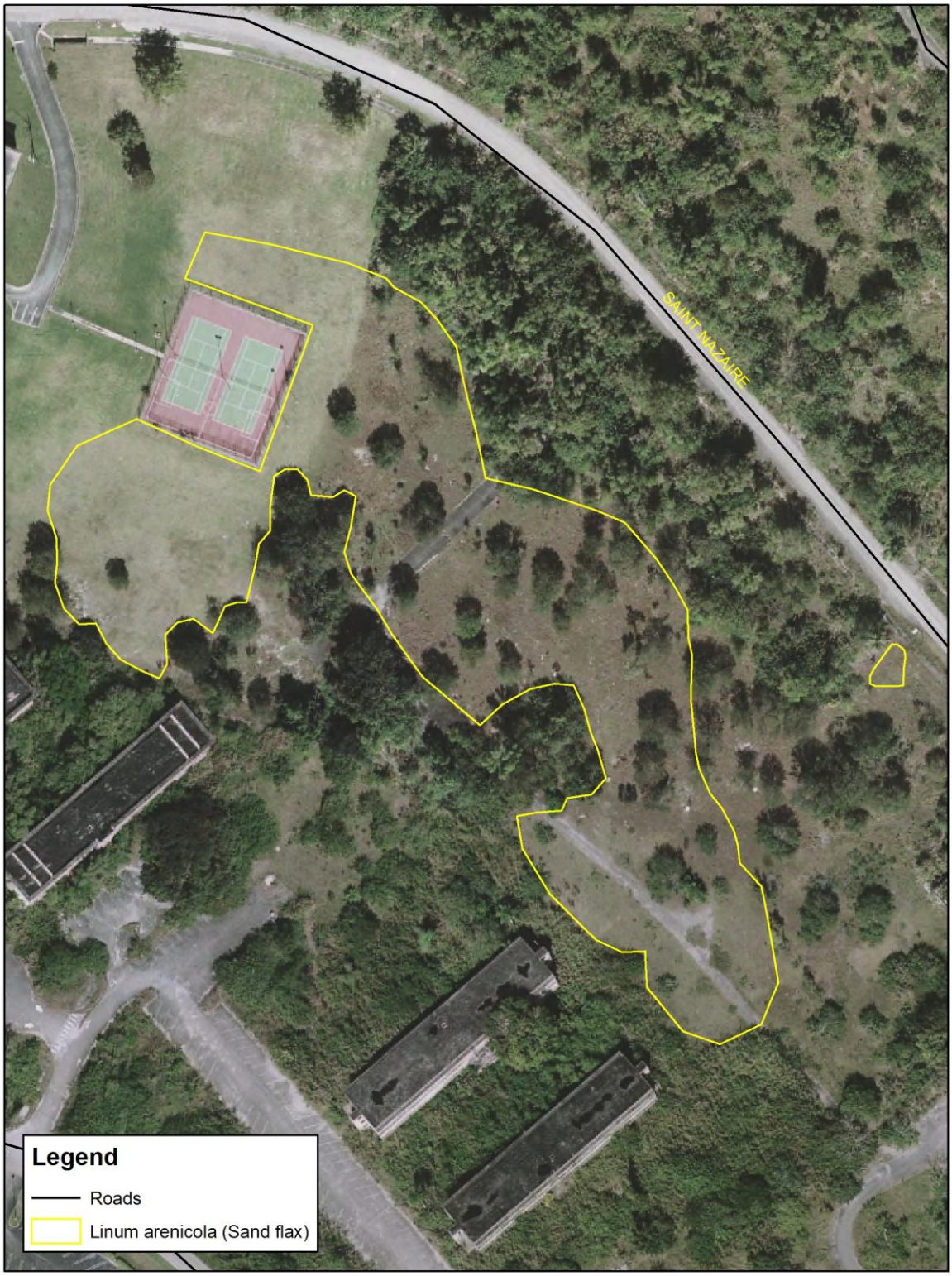

Figure 6: Sand flax, Homestead Air Reserve Base

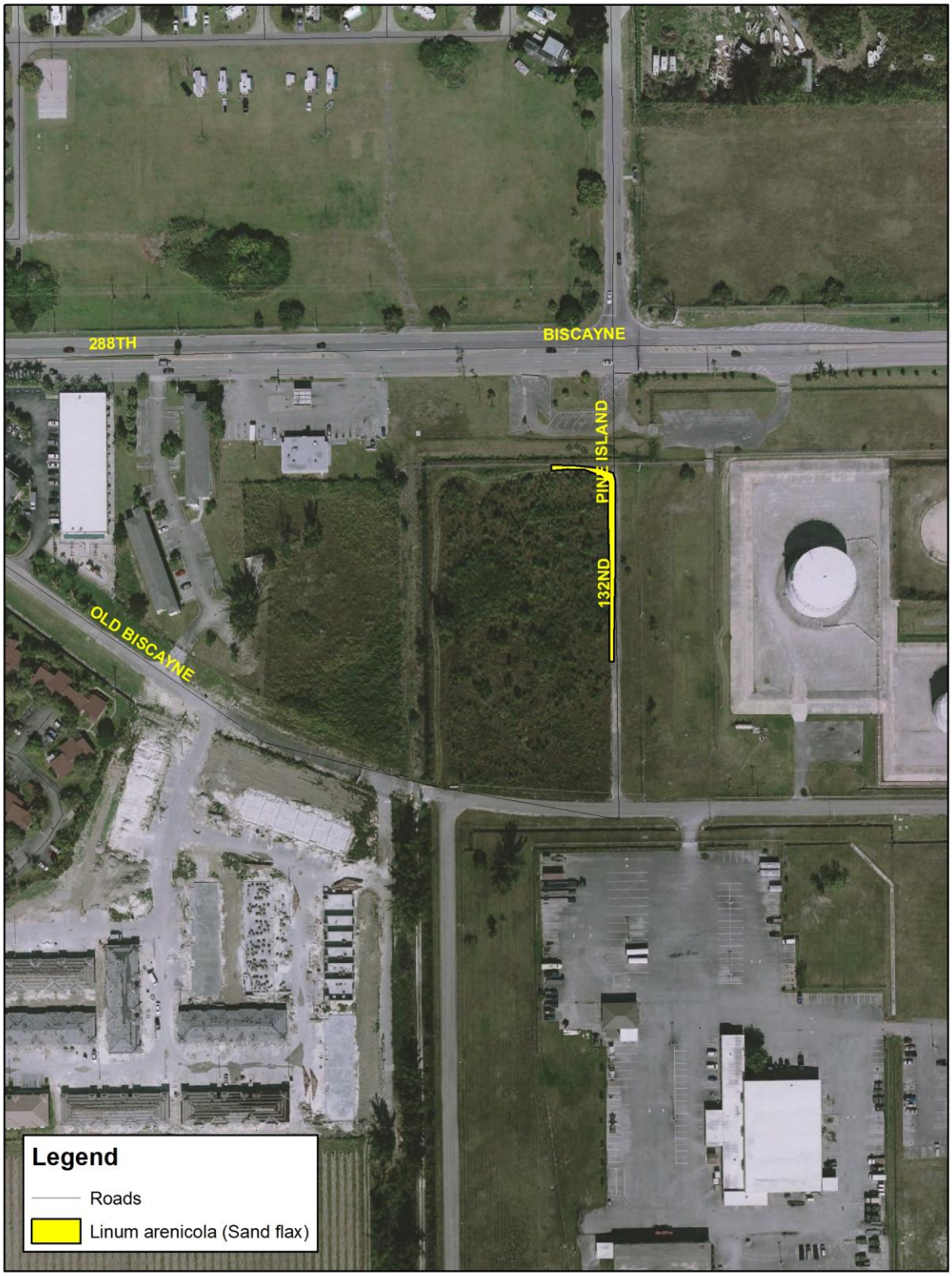

Figure 7: Sand flax, L-31E Canal

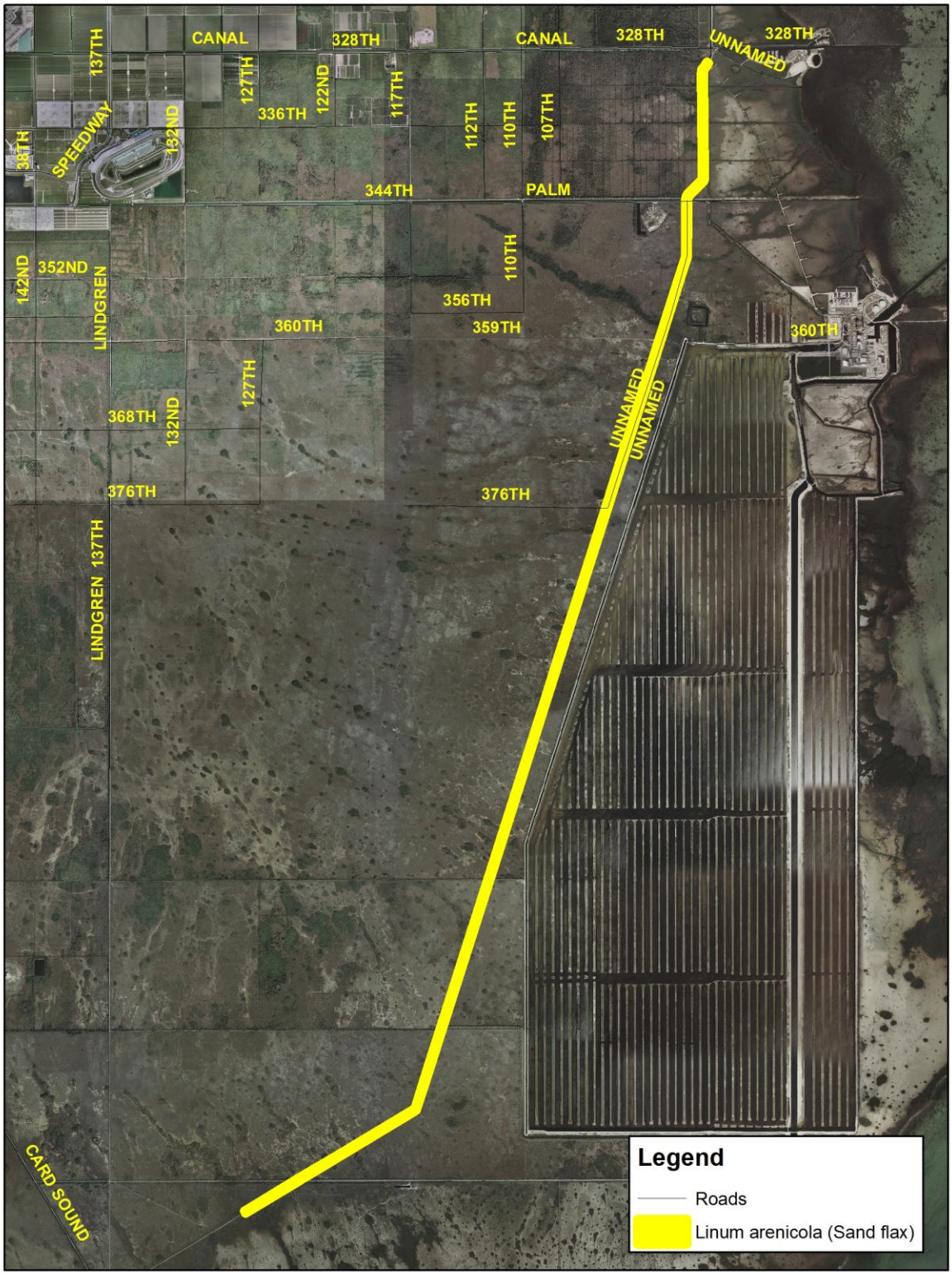

Figure 8: Sand flax, SOCSOUTH Property, former Homestead Air Force Base

Figure 9: Carter's flax, C-103 Canal

Figure 10: Carter's flax, Camp Owaissa Bauer Addition

Figure 11: Carter's flax, Chapman Field, USDA Subtropical Horticultural Research Station

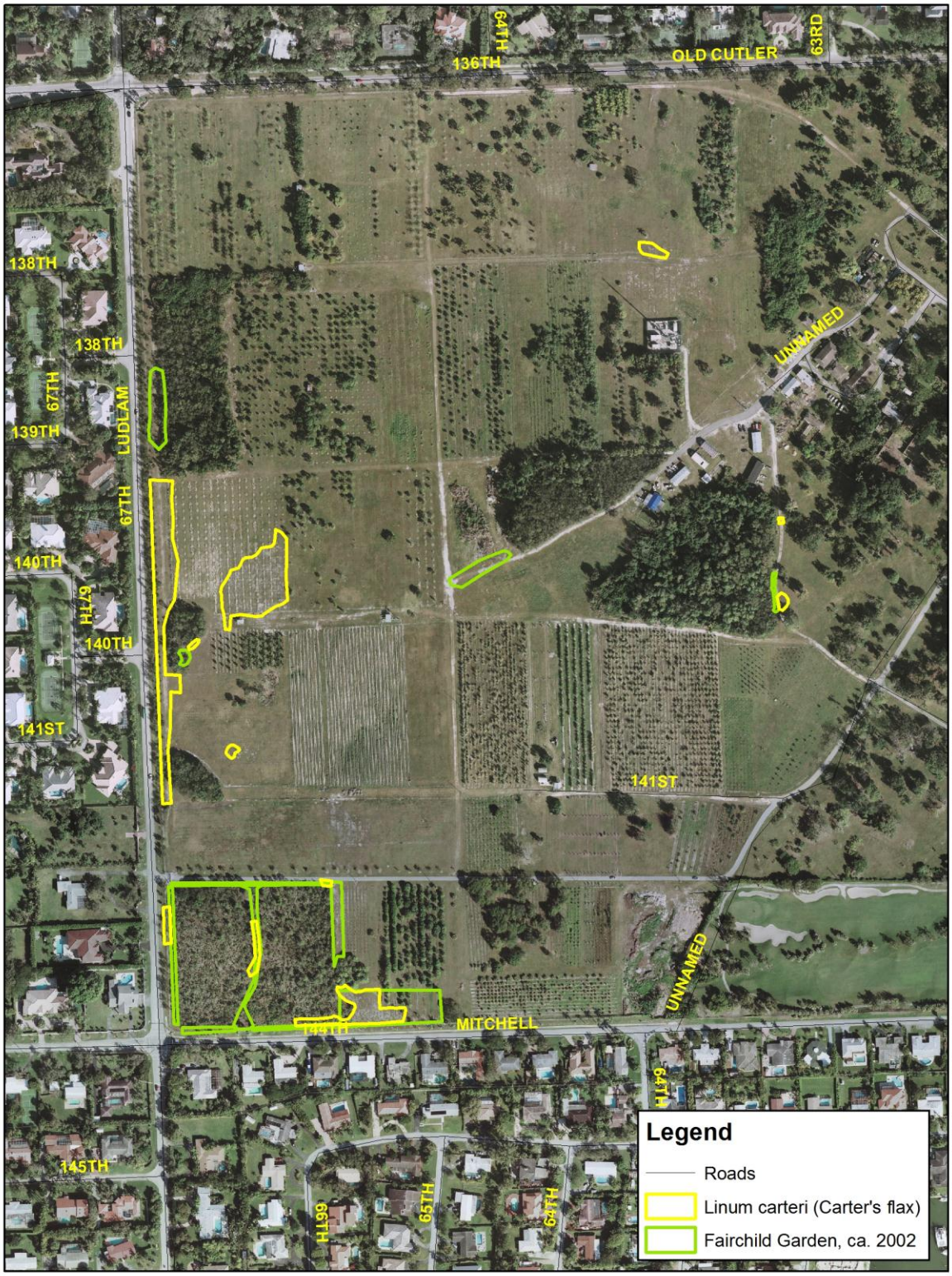

Figure 12: Carter's flax, Montgomery Botanical Center

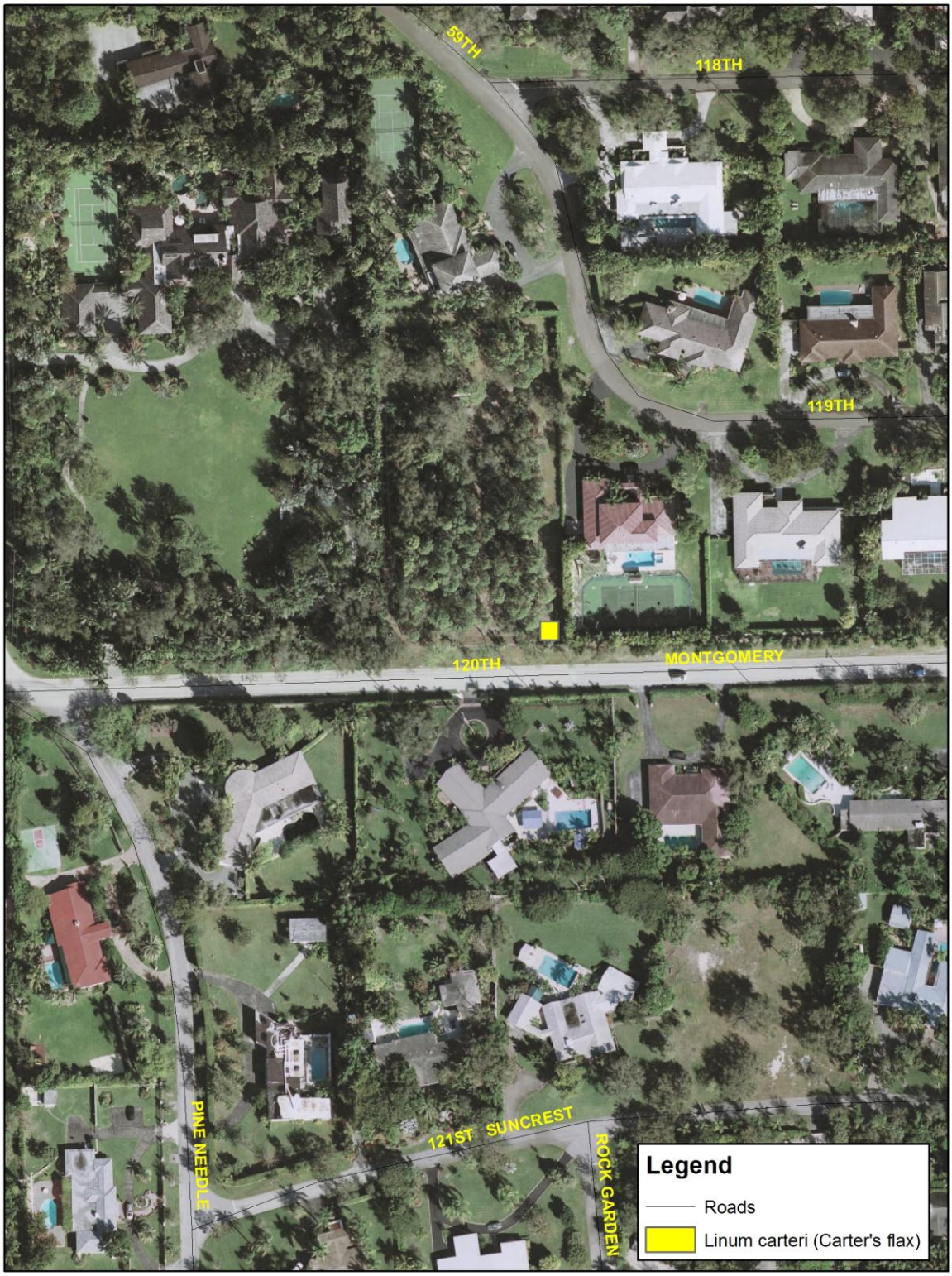

Figure 13: Carter's flax, Old Dixie Pineland

Figure 14: Carter's flax, R. Hardy Matheson Preserve

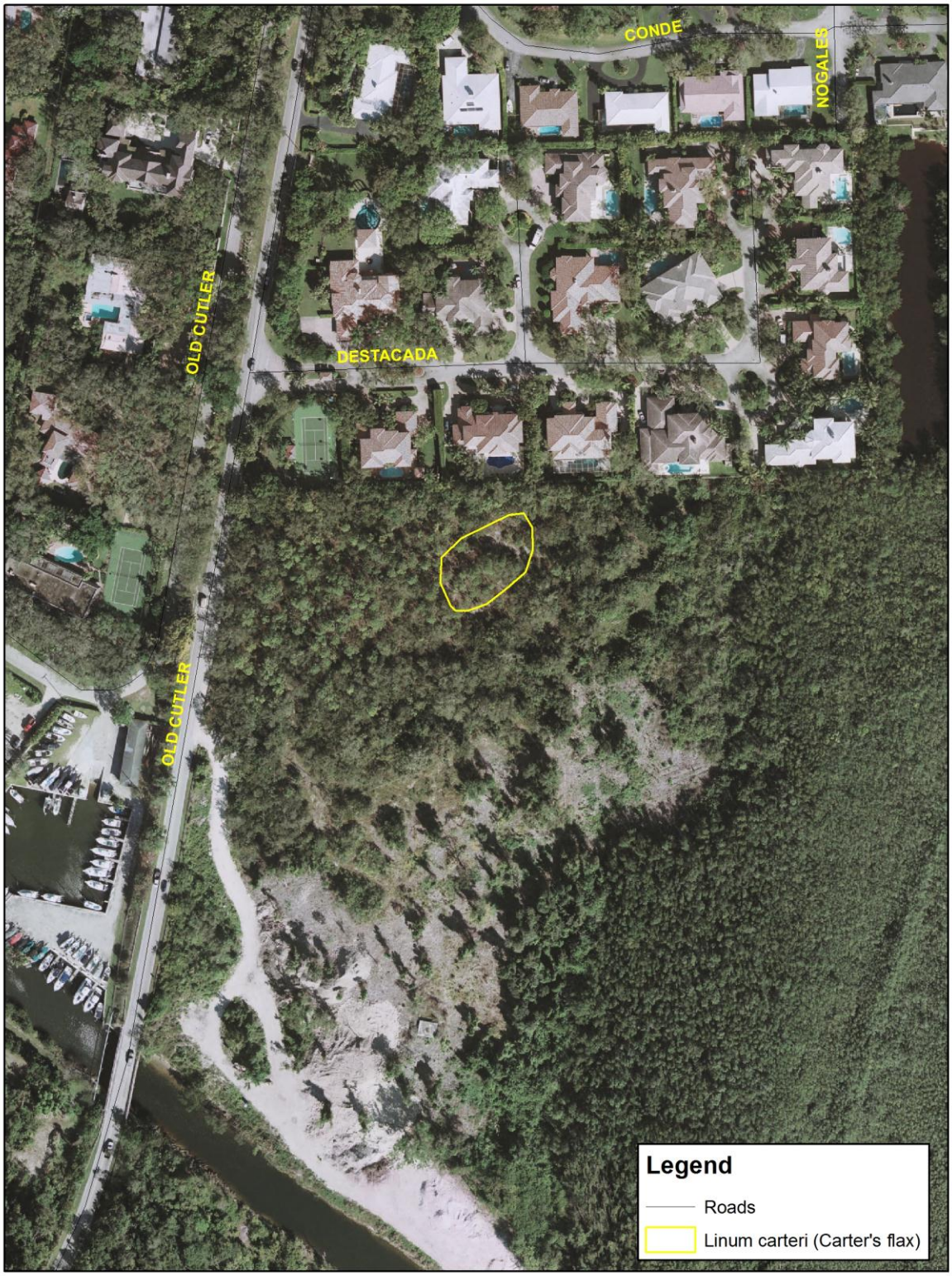

Figure 15: Carter's flax, Rockdale Pineland