THE EFFECTIVENESS OF VEGETATED FLOATING MATS IN SEQUESTERING NUTRIENTS IN A STRUCTURALLY CONTROLLED WATERBODY

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EXECUTIVE SUMMARY

Lee County (County) installed three (3) floating plant mats comprised of closed-cell foam mat with suspended hydrophytic plant species on a structurally controlled portion of Mulloch Creek during the 2008 growing season. The purpose of using the floating mats (BeeMats) was to sequester nitrogen and phosphorous as accumulated plant biomass from the creek. At the end of the growing season the plant biomass (roots plus shoots) and the associated stored nutrients was harvested and disposed of at an upland location.

Because of the perceived success of the floating mats in hydroponically sequestering both nitrogen and phosphorous as a result of the apparent biomass accumulation on the mats, the County planned on replanting these mats for the 2009 growing season following the completion of the installation of a new water control structure on Mulloch Creek. During this growing season the County planned on quantifying the storage of both phosphorous and nitrogen from biomass accumulation on the mats.

The objective of this study was to document the effectiveness of the floating plant mats in sequestering nutrients from a structurally controlled portion of Mulloch Creek during a portion of a typical Lee County growing season (May through October, 2009). The design of this study included the installation of three 6-ft X 6-ft planted floating sample mats paired with the replanting of each of the 22-ft by 20-ft Existing mats. Baseline conditions were established and sampling for roots and shoots biomass was conducted during Sample Events 1, 2 and 3 where a single sample mat was pulled, roots and shoots weighed and triplicate samples analyzed for total nitrogen and phosphorous.

Water quality monitoring was also conducted on a monthly basis beginning in May 2009 through November 2009 to document the concentrations of both organic and inorganic forms of nitrogen and phosphorous at two (2) upgradient and one downgradient location. While these results did not display trends in nitrogen and phosphorous reduction from the upgradient to downgradient sample location, they did show that the water quality in the creek (nitrogen and phosphorous) were below the values that are typical of water quality values for Florida's lakes and streams. In addition the water quality monitoring showed that the inorganic fraction of the total nitrogen and ortho-phosphate that are the plant available forms of these nutrients occurred at relatively low levels particularly from a plant nutrient standpoint through the study period.

The storage of total nitrogen (roots and shoots) of both the planted and recruited species on the Sample Mat varied by the rate, amount, and location (i.e., roots or shoots) of the storage. The general trend of the total nitrogen storage for each species was an increase in nitrogen during the three growth periods with a notable exception of *Pontederia cordata* that showed a decline in total nitrogen during the final growth period (Sample Events 2 through 3). *Agrostis alba* stored the most total nitrogen during the growth period (May through October) analyzed followed by *Canna flaccida*, *Juncus effusus* and *Pontederia cordata* largely due to the increases in biomass.

The recruitment of measurable levels of nitrogen from *Ludwigia* spp. and Other Species began between the Sample Events 1 and 2 growth period. These recruitment species had a substantial contribution to the total nitrogen storage stored on the Sample Mats over the growth period analyzed.

Agrostis alba stored the highest levels of root nitrogen on the Sample Mats, followed by *Canna flaccida*, *Juncus effusus*, and *Pontederia cordata*. Nitrogen storage in the Sample Mat shoots was also highest, followed by *Juncus effusus* and *Canna flaccida*. *Pontederia cordata* shoots lost nitrogen during the growth period analyzed.

Total nitrogen storage (roots plus shoots) normalized to a per plant basis was highest in *Agrostis alba*, followed by *Canna flaccida*, *Juncus effusus*, and *Pontederia cordata*. The roots of *Canna flaccida* stored the most nitrogen on a per plant basis which was followed by *Agrostis alba*, soft rush and *Pontederia cordata*. Conversely the shoots of *Agrostis alba* on a per plant basis stored the highest levels of nitrogen, followed by *Juncus effusus* and *Canna flaccida*.

Based on the quantities of the nursery grown plant species installed and recruited on the Existing Mats and the associated total nitrogen storage on a per plant basis for these species, a total of 1,292 grams on a dry weight basis of nitrogen was stored on each Existing Mat. *Agrostis alba* accounted for the highest nitrogen storage (698.8 gm) followed by *Canna flaccida* (248.6 gm), *Juncus effusus* 173.1 gm, Ludwigia species (126.4 gm), *Pontederia cordata* (36.9 gm) and other recruitment species (9.2 gm).

The general trend of phosphorous storage in the roots plus shoots for each installed species was an increase in phosphorous during the three growth periods except for *Pontederia cordata* that showed a net loss during the Sample Event 2 and 3 (final growth period). Also contributing to Sample Mat nitrogen storage in the roots plus shoots over the growth period analyzed were the recruitment of *Ludwigia* spp. and Other Species.

The highest levels of phosphorous stored in Sample Mats roots occurred in *Agrostis alba* followed by *Canna flaccida* and *Juncus effusus*. *Pontederia cordata* roots did not store phosphorous on the Sample Mats. Phosphorous storage in the Sample Mat shoots was also highest in *Agrostis alba* followed by *Juncus effusus*. Both *Pontederia cordata* and *Canna flaccida* shoots did not store phosphorous during the growing season (May through October).

Total phosphorous storage (roots plus shoots) normalized to a per plant basis was highest in *Agrostis alba*, followed by *Canna flaccida*, *Juncus effusus*, Ludwigia spp. and Other Species. The roots of *Canna flaccida* stored the most phosphorous on a per plant basis which was followed by *Agrostis alba*, *Juncus effusus* and *Pontederia cordata*. Conversely, the shoots of *Agrostis alba* on a per plant basis stored the highest levels of

phosphorous followed by *Juncus effusus*. Neither *Pontederia cordata* nor *Canna flaccida* shoots on a per plant basis stored phosphorous during the growing season.

Based on the quantities of the nursery grown plant species installed and recruited on the Existing Mats and the associated total phosphorous storage (roots plus shoots) on a per plant basis for these species, a total of 83.11 grams on a dry weight basis of phosphorous was stored on each Existing Mat. *Agrostis alba* accounted for the highest phosphorous storage (46.52 gm) followed by *Canna flaccida* (15.84 gm), *Juncus effusus* (11.27 gm), Ludwigia species (10.75 gm), and other recruitment species (0.52 gm).

The sampling data for total nitrogen and phosphorous storage (roots plus shoots) during the growth period analyzed (May through October) generally support that the harvest of the plant material from the Existing Mats should occur near the end of a typical Lee County growing season due to the overall increase of stored phosphorous and nitrogen from Sample Event to Sample Event. The exact timing of the fall harvest is likely to vary from year to year depending on local conditions (e.g., heavy frost or possible freezes) and other management decisions.

The sample data of shoot growth during the growth period analyzed do not support the harvesting a crop of shoots of any of the species installed on the Existing Mat for several reasons. Both *Agrostis alba* and *Juncus effusus* steadily increased in the amount of stored nitrogen and phosphorous in its shoots on a per plant basis during each of the three (3) growth periods measured. *Canna flaccida* shoots had successive increases in stored nitrogen and phosphorous between the Baseline through Sample Event 2 growth period and showed a slight decline between Sample Event 2 through 3 but not appreciable enough to warrant harvesting. *Pontederia cordata* shoots on a per plant basis show virtually no increase in stored nitrogen or phosphorous analyzed during the growth period analyzed.

Nearly all management decisions or practices strive to maximize the cost to benefit. In the case of this study, the cost was considered to be the unit cost of the installation of each of the nursery-grown plants (plant plus installation) versus the nitrogen and phosphorous stored on a per plant basis. Because the price per installed plant was the same for each of the species ($0.60), the species that stored the most nitrogen and phosphorous on a per plant basis were obviously the most cost effective.

Based on the total nitrogen storage on a per plant basis and the cost of each plant ($0.60 per plant installed), *Agrostis alba* cost $0.39 per a gram of nitrogen stored on a dry weight basis, followed by *Canna flaccida* at $0.48 per gram, *Juncus effusus* at $1.80 per gram and *Pontederia cordata* at $6.18 per gram (see **Table 55**). Phosphorous storage on a per gram basis among the species evaluated was most cost effective with *Agrostis alba* costing $5.93 per gram followed by *Canna flaccida* at $7.58 and *Juncus effusus* at $27.68 per gram (see **Table 56**). Because *Pontederia cordata* did not store phosphorous, no costs were calculated.

Another way of considering the management implication and future deployment of the mats as a management practice is to relate the storage of nitrogen and phosphorus on the Existing Mats as gallons of water treated at prescribed nitrogen and phosphorus reduction target levels. As an example, the examination of stored nitrogen on the Existing Mats (N=3) was estimated to be 3,878.8 grams that on a parts per million basis is equivalent to 3.9 million mg for a one liter volume.

The levels of inorganic nitrogen (i.e., plant available nitrogen) analyzed between May and November, 2009 ranged from <0.076 mg/L in May to a high of 0.695 mg/L in August. Using a treatment reduction goal of 0.25 mg/L and the aforementioned storage of nitrogen on the Sample Mats during the growth period analyzed, the equivalent volume of water treated at this rate of plant uptake would be equivalent to 15.5 million liters or 4.1 million gallons. Based on the cost analysis results of **Table 55**, the cost of treatment at the 0.25 mg/L rate is 0.08 cents per gallon or 0.02 cents per liter.

Based on the cost of storage of either nitrogen or phosphorous on a per plant basis, altering the plant quantities to favor both *Agrostis alba* and *Canna flaccida* and to a lesser extent *Juncus effusus* can result in substantially greater amounts of nitrogen and phosphorous stored on the Existing Mats in a more cost effective manner.

While a substantial level of insight into the use of vegetated floating mats was gained by this study, further study with regards to providing recommendations for the implementation of vegetated floating mats for the sequestration of nutrients under a wide range of water quality conditions is needed.

1.0 STUDY BACKGROUND

During the 2008 growing season, Lee County (County) installed three (3) floating plant mats comprised of closed-cell foam mat with suspended hydrophytic plant species on a structurally controlled portion of Mulloch Creek. The purpose of using the floating mats (BeeMats) during the 2008 growing season was to sequester nitrogen and phosphorous as plant biomass from the creek. At the end of the growing season the plant biomass (roots and shoots) and the associated stored nutrients was harvested and disposed of at an upland location.

The vegetation composition of this structurally controlled section of Mulloch Creek is comprised of combinations of emergent and floating aquatic plant species including Nuphar luteum, *Pistia stratiotes, Panicum repens*, *Panicum hemitomon*, and *Cyperus* spp.

Combinations of Industrial and commercial landuses predominate the impounded portion of the Mulloch Creek watershed (i.e., east of the aforementioned weir structure located at U.S. Highway 41). To the west of U.S. Highway 41, Mullock Creek is free flowing to it confluence with Estero Bay. Landuse in this portion of Mullock Creek is comprised of residential and commercial development and conservation lands.

Because of the perceived success of the floating mats in hydroponically sequestering both nitrogen and phosphorous as a result of the apparent biomass accumulation on the mats, the County planned on replanting these mats for the 2009 growing season following the completion of the installation of a new water control structure on Mulloch Creek. During this growing season the County planned on quantifying the storage of both phosphorous and nitrogen from biomass accumulation on the mats.

The objective of this study is to document of the effectiveness of the floating plant mats in sequestering nutrients from a structurally controlled portion of Mulloch Creek (see **Figure 1**) for a portion of a typical Lee County growing season (May through October, 2009). The design of this study included the installation of three 6-ft X 6-ft planted floating sample mats (Sample Mats) paired with the replanting of each of the 22-ft by 20-ft existing mats (Existing Mats). Baseline conditions were established and sampling for roots and shoots biomass was conducted during three successive events (Sampling Events 1, 2, and 3) where a single Sample Mat was pulled, roots and shoots weighed and triplicate samples analyzed for total nitrogen and nitrogen. The data collected from the Sample Mats was normalized and used to estimate the phosphorous and nitrogen storage on the Existing Mats.

This report is presented in five sections including: 1) Study Background; 2) Materials and Methods; 3) Results; 4) Analysis of Results; and, 5) Conclusions. The Materials and Methods section describes materials and installation of the sample mats, water quality sampling method, and the procedures for plant tissue sampling and analysis. The results of the results water quality sampling and the biomass and nutrient storage on the

Sample Mats is presented in the third section. The fourth section presents analysis of the Sample Mat data including the normalization of root and shoot nutrient storage on a per individual plant basis; estimates of the amount of nutrient storage on the Existing Mats based on normalized nutrient storage on a per plant basis; discussion of the management implications for the future use of the floating plant mats as a best management practice and recommendations of future studies and analysis to further understand the most effective use of the mats for nutrient sequestration. The final section provides an overview of the study results along with recommendations for future deployment of the mats within the County.

Figure 1 - Project Location Map

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2.0 MATERIALS AND METHODS

2.1 Plant Materials

Four plant species were selected for installation on both the Existing and Sample Mats. Each of these species was grown at Beeman's Nursery located in New Smyrna Beach, Florida. The four species selected for this study included Agrostis alba, Pontederia cordata, Juncus effusus and Canna flaccida. Each of these species is briefly described below.

Agrostis alba is a creeping perennial cool season grass, related to the bentgrasses. Although native to Europe, it occurs throughout the northern and western halves of the United States, and along the southern border of Canada. The stems are slender with narrow leaves, about 1/4 inch wide. The panicle is loose and pyramidal in shape; its reddish color gives the grass its common name of redtop. It grows in a variety of habitat types ranging from moist to relatively dry soils, along river banks and rolling hills. It is most abundant in well-drained medium to fine-textured soils and is somewhat tolerant to alkali soils, moderate levels of droughts, and long, wet periods.

Juncus effusus is a perennial wetland plant that occurs in freshwater wetlands on all continents. *Juncus effusus* normally grows in areas that are only periodically flooded but it also can withstand periods of drying out, and it can tolerate continued submergence in up to 3 inches of water. It grows in clumps, spreads vigorously via rhizomes, and prefers heavy, wet acidic soils in mild climates where it rarely freezes. The stems are typical near 3 feet in height, without nodes, cylindrical, smooth to slightly striated, and taper to a bristle. The flowers and fruits are borne in compact clusters that appear to emerge laterally a few inches below the tip of the flowering stem.

Pontederia cordata is a herbaceous, aquatic perennial with a cluster of erect arrowhead-shaped leaves arising from a single basal clump. It most commonly grows up to 3 ft tall on fleshy petioles (leaf stems) in acidic, freshwater marshes ranging from Minnesota and Nova Scotia, southward to Texas and Florida, the West Indies and to Argentina. It spreads by creeping rhizomes (underground stems) just beneath the soil surface. Throughout late spring and summer, *Pontederia cordata* produces showy spires of violet-blue flowers standing on stalks 2-3 feet in height.

Canna flaccida is an herbaceous perennial that grows up to 4 ft tall in freshwater marshes, savannas, and on the edges of ponds and lakes. It spreads in these habitats through rhizomes (underground stems). The natural range of *Canna flaccida* is the southeastern coastal plain from South Carolina to Florida and east to Texas. The leaves are upright and succulent with prominent longitudinal veins. The flowers are bright yellow and born on a terminal cluster. Canna flacida prefers moist and fertile soils.

2.2 Floating Mat Installation

The installation of three (3) 6-ft x 6-ft floating mats (Sample Mats) and the replanting of three (3) 20-ft x 22 ft insitu floating mats (Existing Mat) on an impounded portion of Mulloch Creek was conducted on May 14, 2009. Each of the Sample Mats were planted with the aforementioned nursery grown plant species in the quantities specified in **Table 1**. The planting of the Sample Mats cells followed a specific pattern that included *Agrostis alba* on the mat perimeter followed by *Pontederia cordata, Juncus effusus* and *Canna flaccida*) on the interior. The Sample Mats were floated and anchored into place at the locations specified in **Figure 2**.

Table 1: The Quantity the Nursery Grown Plant Species Installed on each of the Sample Mats and Existing Mats

Common Name	Genus/ Species	Number of Mat Cells Planted	
		Sample Mat	Existing Mat
Redtop	*Agrostis alba*	28	460
Pickerelweed	*Pontederia cordata*	27	380
Canna lily	*Canna flaccida*	10	200
Softrush	*Juncus effusus*	25	520
Total =		**90**	**1,560**

The three (3) Existing Mats were floated to a near shore location where the plant material detritus from the previous growing season was removed. These mats were then planted with the same nursery grown plant species as specified in **Table 1**. The planting of the Existing Mat followed the same pattern as the Sample Mat including Agrostis alba on the mat perimeter followed by *Pontederia cordata*, *Juncus effusus*, and *Canna flaccida* on the interior. The Existing Mats were individually floated and anchored into place adjacent to the each of the Sample Mats locations specified in **Figure 2**.

Figures 3 and **4** show the final placement of a Sample Mat and an Existing Mat shortly after their installation was completed.

Figure 2 - Location of Paired Sample and Existing Mats

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Figure 3: Completed Sample Mat Placement in Mulloch Creek

Figure 4: Completed Existing Mat Placement in Mulloch Creek

2.3 Water Quality Monitoring

Water quality monitoring within in the Mulloch Creek Impoundment was conducted on a monthly basis at the two inflow points and at the downstream water level control structure beginning in April 2009 through November 2009 (see **Figure 5**). Samples were collected and submitted to Sun Laboratories, Inc. for chemical analysis. The chemical parameters and associated laboratory testing methods are presented in **Table 2**.

Table 2: Mulloch Creek Impoundment Water Quality Parameters and Associated Laboratory Testing Methods

Parameter	EPA Method
Nitrate (NO_3)	300.0
Nitrogen Ammonia (NH_3, NH_4)	350.2
Total Kjeldahl Nitrogen	351.2
Ortho-Phosphate	300.0
Total Phosphorous	6010

Field measurement of dissolved oxygen (DO), pH, and specific conductivity was conducted during the monthly collection of water quality samples. All monthly samples and measurements were collected and, as appropriate, submitted to Sun Laboratories, Inc. for analysis pursuant to applicable Florida Department of Environmental Protection Standard Operating Procedures and in accordance with the National Environmental Laboratory Accreditation Conference (NELAC) protocols.

2.4 Vegetation Sampling and Analysis

Baseline Sampling Event

A composite sample composed of ten (10) individuals of each of the nursery grown plant species installed on the Sample Mats and Existing Mats was collected on April 29, 2009 during the mat installation. The roots and shoots of each plant were separated and when necessary washed free of nursery growing media. A composite of the roots and shoots for each plant species was packaged and submitted to Thornton Laboratories, Incorporated (Thornton). Thornton measured the wet weight biomass of the roots and shoots of each composite sample and dried the tissue samples in an air circulating, humidity controlled oven at 68° C for up to 14 days. Following the oven drying, the composite root and shoot samples were again measured to determine the root and shoot biomass on a dry weight basis (dwb) for each plant species.

Figure 5 - Water Quality Sampling Location Map

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The oven dried root and shoot samples for each species were ground to <80 sieve. Samples of the ground roots and shoots of each species were then analyzed by the laboratory for total nitrogen, total phosphorous and total potassium as a percentage of the oven-dried biomass. The data collected during the baseline sampling event provided the foundation for the determination of the sequestration of the accumulation of nitrogen and phosphorous by biomass accumulated on the sample mats.

Growing Season Sampling Events

The biomass and total nitrogen, phosphorus and potassium of the roots and shoots of the planted and recruited plant species occurring on the Samples Mats were analyzed during three separate sampling events. The dates of these sampling events along with the aforementioned baseline event are presented in **Table 3.**

Table 3: Sampling Dates for Baseline and Sample Mat Sampling Events

Sample Event	Sample Date
Baseline	April 20, 2009
Event 1	June 30, 2009
Event 2	August 27, 2009
Event 3	October 29, 2009

During each sampling event, the roots and shoots of each plant species were individually collected from one (1) of the three (3) Sample Mats. The roots of each species were washed free of nursery growing media. The wet weight of the roots and shoots of the planted and recruited species were weighed with a digital scale in the field to the nearest 0.1 gram. The roots and shoots of each species were individually packaged and delivered to the laboratory. As a quality control measure, the wet weight of the roots and shoots of each plant species were re-weighed and the roots and shoots dried in an air circulating, humidity controlled oven at 68° C for 14 days. Following oven drying, the root and shoot of each species were again weighed and the root and shoot biomass on a dry weight basis (dwb) for each plant species were then determined.

The oven dried root and shoot samples for each species were ground to <80 sieve. Triplicate samples of the ground roots and shoots of each species were then analyzed for total nitrogen, total phosphorous and total potassium as a percentage of the oven-dried biomass.

During each sampling event, the total cover and relative cover of planted and recruited species on the respective Sample Mat sampled were visually estimated. The mortality or loss of planted species was also determined on a per species basis for the specific Sample Mat sampled during each sample event.

3.0 RESULTS

3.1 Water Quality

Water quality in the Mulloch Creek Impoundment was analyzed on a monthly basis at two stormwater infall locations and near its discharge located downstream at a newly constructed water control structure. The insitu monthly measurements for temperature, pH, Specific Conductivity and Dissolved Oxygen are presented in **Table 4**.

Table 4: Insitu Water Quality Measurements at the Mulloch Creek Impoundment

Sample Date	Sample Location	Temperature (C°)	pH	Specific Conductivity (S/cm)	Dissolved Oxygen (mg/L)
4/30/2009	Infall 1	29.7	6.79	751	6.66
	Infall 2	27.6	7.35	762	5.15
	Weir Outfall	28.6	8.25	775	6.86
5/12/2009	Infall 1	31.7	6.89	795	6.01
	Infall 2	29.9	7.48	842	7.21
	Weir Outfall	31.4	8.96	757	5.48
6/30/2009	Infall 1	28.0	7.61	835	6.80
	Infall 2	29.0	7.60	972	3.20
	Weir Outfall	29.2	7.88	817	5.05
7/30/2009	Infall 1	30.6	7.11	789	6.10
	Infall 2	32.0	7.09	811	7.33
	Weir Outfall	32.1	7.98	791	5.99
8/31/2009	Infall 1	28.1	7.53	811	6.03
	Infall 2	29.5	7.53	968	7.14
	Weir Outfall	28.4	7.51	813	5.42
10/20/2009	SW Infall 1	24.1	7.74	830	5.65
	SW Infall 2	22.1	7.52	922	6.79
	Weir Outfall	23.9	7.59	840	5.35
11/16/2009	Infall 1	23.8	7.42	810	4.82
	Infall 2	21.9	7.53	878	6.40
	Weir Outfall	23.4	7.39	817	5.84

Table 5 presents the analytical results of the water quality sampling conducted at the three sample locations at the Mulloch Creek Impoundment. The data show that total phosphorous and ortho-phosphate occur at levels lower than a value of 0.11 mg/L, which is typical of water quality values for Florida's lakes and streams[1]. The highest levels of phosphorous were sampled at Infall-1 sample location on April 3, 2009 (0.043 mg/L), May 12, 2009 (0.067 mg/L), and October 20, 2009 (0.043 mg/L).

Both the inorganic and organic concentrations of nitrogen were sampled at the Mulloch Creek Impoundment are presented in **Table 5**. Total nitrogen in the impoundment ranged from a low of 0.167 mg/L at south weir outfall on April 30, 2009 to a high of 1.302 mg/L at the weir outfall on August 31, 2009. With the exception the aforementioned high value measured at weir outfall, all of the total nitrogen values measured were below the 1.2 mg/L that is typical of water quality values for Florida's lakes and streams.

Kjeldahl Nitrogen (organic nitrogen) accounted for the major portion of the total nitrogen sample during each monthly sampling event. The inorganic fraction (plant available nitrogen) of the total nitrogen that was sampled monthly at each sampling location was relatively low particularly from a plant nutrient standpoint.

The laboratory results of the water quality monitoring are presented in **Appendix A**.

3.2 Vegetation Cover on Sample Mats

Just prior to each of the Sample Mat Sampling Events (Sample Events 1, 2 and 3) a visual estimate of the percent cover of each of the species that were planted and over time recruited on the mats was conducted. **Table 6** presents the results of the estimation of the percent cover of the planted *Pontederia cordata*, Agrostis alba, *Juncus effusus* and *Canna flaccida* and the recruited *Ludwigia peruviana* and *Ludwigia octavalis (Ludwigia* spp.) and "other species" that were composed of cattails (*Typha* spp.), spikerush (*Elleocharis* spp.), bluestem (*Andropogon* spp.) and other unidentified dicot species.

Figures 6, 7 and **8** present the total cover of the installed and recruited plant species that occur on the Sample Mats just prior to plant biomass sampling.

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[1] Friedemann, M. and J. Hand. 1992. *Typical water quality values for Florida's lakes, streams, and estuaries.* Standards and Monitoring Section, Bureau of Surface Water Management, Florida Dept. of Environmental Regulation.

Table 5: Water Quality Sampling Results[2]								
Sample Date	Sample Location	Nitrate (mg/L)	Nitrogen Ammonia (mg/L)	Plant Available Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Calculated Total Nitrogen (mg/L)	Ortho-phospate (mg/L)	Total Phosporous (mg/L)
4/30/2009	SW Infall 1	0.014,U	0.081	< 0.095	0.743	< 0.838	< 0.022, U	0.043, I
	SW Infall 2	0.014,U	0.354	<0.368	0.688	<1.056	< 0.022, U	0.028, I
	SW Weir Outfall	0.06	0.052	0.112	0.055	0.167	< 0.022, U	< 0.015, U
5/12/2009	SW Infall 1	0.014, U	0.062	< 0.076	0.599	< 0.675	< 0.022, U	0.067
	SW Infall 2	0.014, U	0.086	< 0.100	0.742	< 0.842	< 0.022, U	0.037, I
	SW Weir Outfall	0.014, U	0.184	< 0.198	0.571	< 0.769	< 0.022, U	< 0.015, U
6/30/2009	SW Infall 1	0.21	0.056	0.266	0.454	0.720	< 0.022, U	< 0.015, U
	SW Infall 2	0.014, U	0.040	< 0.054	0.655	< 0.709	< 0.022, U	< 0.015, U
	SW Weir Outfall	0.24	0.072	0.312	0.381	0.693	< 0.022, U	< 0.015, U
7/30/2009	SW Infall 1	0.29	0.162	0.452	0.445	0.897	< 0.022, U	< 0.015, U
	SW Infall 2	0.12	0.042	0.162	0.587	0.749	< 0.022, U	< 0.015, U
	SW Weir Outfall	0.27	0.031	0.301	0.444	0.745	< 0.022, U	< 0.015, U
8/31/2009	SW Infall 1	0.28	0.130	0.410	0.646	1.056	< 0.022, U	0.043, I
	SW Infall 2	0.014, U	0.083, I	< 0.097	0.771	< 0.868	< 0.022, U	< 0.015, U
	SW Weir Outfall	0.21	0.485	0.695	0.607	1.302	< 0.022, U	0.019, I
9/21/2009	SW Infall 1	0.27	0.094	0.364	0.649	1.013	< 0.022, U	< 0.015, U
	SW Infall 2	0.014	0.092	0.106	0.798	0.904	< 0.022, U	< 0.015, U
	SW Weir Outfall	0.27	0.070	0.340	0.566	0.906	< 0.022, U	< 0.015, U
10/20/2009	SW Infall 1	0.33	0.042	0.372	0.660	1.032	< 0.022, U	0.034, I
	SW Infall 2	0.12	0.046	0.166	0.794	0.960	< 0.022, U	< 0.015, U
	SW Weir Outfall	0.26	0.006, I	0.266	0.705	0.971	< 0.022, U	< 0.015, U
11/16/2009	SW Infall 1	0.36	0.054	0.414	0.500	0.914	< 0.022, U	< 0.015, U
	SW Infall 2	0.15	0.079	0.229	0.781	1.010	< 0.022, U	< 0.015, U
	SW Weir Outfall	0.33	0.052	0.382	0.525	0.907	< 0.022, U	0.027, I

[2] I = The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U = The compound was analyzed for but not detected.

These results show an increase in total cover for *Juncus effusus*, *Agrostis alba* for each successive sampling event. *Canna flaccida* cover increased between Sample Events 1 and 2 but declined between Sample Events 2 and 3. *Pontederia cordata* cover remained unchanged between Sample Events 1 and 2 and declined between Sample Events 2 and 3. During Sample Event 1 the first recruitment species, *Ludwigia peruviana*, was observed (<1% cover). This species along with *Ludwigia octavalis* rapidly spread on Sample Mats 2 and 3. Other species increasingly recruited on the Sample Mats between the Sample Events 1 through 3 growth period (see **Table 6**).

Table 6: Visual Estimate of the Percent Cover of the Planted and Recruited Species on Sample Mats during Sample Events 1, 2 and 3

Genus and Species	Percent Cover		
	Sample Event 1	Sample Event 2	Sample Event 3
Agrostis alba	10	15	20
Pontederia cordata	10	10	5
Canna flaccida	5	10	5
Juncus effusus	15	20	20
Ludwigia spp.	<1	20	30
Other Spp.	----	<1	<1
Total =	**>40**	**>65**	**>80**

Figure 6: Planted and Recruited Species Cover on Sample Mat 1 (Sample Event 1)

Figure 7: Planted and Recruited Species Cover on Sample Mat 2 (Sample Event 2)

Figure 8: Planted and Recruited Species Cover on Sample Mat 3 (Sample Event 3)

3.3 Biomass and Nutrient Storage on Sample Mats

Baseline Event

The baseline biomass and nutrient content (% dwb) of the roots and shoots of the nursery-grown plants sampled (N=10) prior to installation on the Sample Mats and Existing Mats are presented in **Tables 7** and **8**. **Appendix B** presents a summary of the laboratory results for the biomass (dwb) in each of the nursery grown plant species sampled (N = 10).

Total biomass of the sampled nursery grown plant materials was 90.8 grams composed of 54.9 grams of roots and 35.9 gm of shoots. The sampled baseline root biomass was highest for *Juncus effusus*, followed closely by *Canna flaccida*, and *Agrostis alba*. The *Pontederia cordata* root biomass was substantially less than the other sampled species. *Juncus effusus* also displayed the highest baseline shoot biomass followed by Agrostis alba, *Pontederia cordata* and *Canna flaccida* (see **Tables 7** and **8**).

Table 7: Total Root Biomass and Percent Moisture, Phosphorous, Nitrogen and Potassium of Nursery Grown Plant Species (N=10 of each species)

Genus Species	Dry Weight[1] (gm)	Moisture (%)	Nitrogen (%)	Phosphorous (%)	Potassium (%)
Agrostis alba	16.5	76.82	0.58	0.13	0.15
Pontederia cordata	2.8	90.43	1.74	0.29	1.72
Canna flaccida	16.9	87.53	0.53	0.20	1.41
Juncus effusus	18.6	70.16	0.68	0.16	0.54
Total =	**54.9**				

Table 8: Total Shoot Biomass and Percent Moisture, Phosphorous, Nitrogen and Potassium of Nursery Grown Plant Species (N=10 of each species)

Genus Species	Dry Weight (gm)	Moisture (%)	Nitrogen (%)	Phosphorous (%)	Potassium (%)
Agrostis alba	9.5	57.69	0.74	0.24	0.66
Pontederia cordata	8.8	90.18	3.16	0.48	5.29
Canna flaccida	5.1	89.53	0.73	0.65	4.17
Juncus effusus	12.5	58.29	0.78	0.17	0.84
Total =	**35.9**				

[1] Note, the dry weight of the roots and shoots of each plant species installed on the Floating and Sample Mats was calculated based on the field-weighed (digital scales) wet weights and the Thornton % moisture content of each species.

The percentage of nitrogen, phosphorous and potassium (dwb) in the nursery grown plant species roots and shoots varied by plant species. The percentage of nitrogen was highest in the roots and the shoots of *Pontederia cordata*, followed by *Juncus effusus*, Agrostis alba and *Canna flaccida* (see **Tables 7** and **8**). Total percent phosphorous in the roots of the nursery grown plant species was highest in *Pontederia cordata* followed by *Canna flaccida*, *Juncus effusus* and Agrostis alba. The percentage of phosphorous in the shoots displayed a different pattern with *Canna flaccida* being the highest followed by *Pontederia cordata*, Agrostis alba and *Juncus effusus* (see **Tables 7** and **8**). The laboratory results of the percent nitrogen, phosphorous, and potassium in the biomass are presented in **Appendix B**.

While not the focus of this study, potassium was analyzed as a general macronutrient indicator of potential plant nutrient deficiencies. The percentage of potassium was highest in both the roots and shoots of *Pontederia cordata*, followed by *Canna flaccida*, *Juncus effusus,* and Agrostis alba (see **Tables 7** and **8**).

The average nutrient content of the roots and shoots of each plant on a per species basis was determined from the number of nursery-grown plants of each species sampled (N=10), the root and shoot biomass and the percentage of nutrients stored (% dwb). These results are presented in **Tables 9**, **10** and **11** and the associated (paired) **Figures 6**, **7** and **8**.

Because the number of plants of each species sampled was constant (N=10), the results of the nutrient content on a per plant basis for each species is the function of the interaction between biomass and percent nutrient content of that biomass. The nitrogen content in the roots of the nursery grown plant species prior to installation on a per plant basis was highest in *Juncus effusus* followed by Agrostis alba, *Canna flaccida* and *Pontederia cordata* (see **Table 9** and **Figure 9**). The nitrogen content in the shoots was highest in *Pontederia cordata* followed by *Juncus effusus*, Agrostis alba and *Canna flaccida* (see paired **Table 10** and **Figure 10**). The nitrogen content of the each plant (roots plus shoots) for each nursery grown species on a per plant basis was highest in *Pontederia cordata* followed by *Juncus effusus*, Agrostis alba and *Canna flaccida* (see **Table 11** and **Figure 8**).

The phosphorous content in the roots of the nursery grown plant species prior to installation on a per plant basis was highest in *Juncus effusus* and *Canna flaccida* followed by Agrostis alba and *Pontederia cordata* (see **Table 9** and **Figure 9**). The phosphorous content in the shoots was highest in *Pontederia cordata* followed by *Canna flaccida* and *Juncus effusus* and Agrostis alba (see **Table 10** and **Figure 10**). The phosphorous content of the each plant (roots plus shoots) for each nursery grown species on a per plant basis was highest in *Canna flaccida* followed by *Juncus effusus* and *Pontederia cordata* and *Agrostis alba* (see **Table 11** and **Figure 11**).

Table 9: Average Total Phosphorous, Nitrogen and Potassium (gm dwb) in Nursery Grown Plant Roots on a Per Plant Basis			
Genus Species	**Total Nitrogen**	**Total Phosphorous**	**Total Potassium**
Agrostis alba	0.010	0.002	0.002
Pontederia cordata	0.005	0.001	0.005
Canna *flaccida*	0.009	0.003	0.024
Juncus effusus	0.013	0.003	0.010

Figure 9: Average Total Phosphorous, Nitrogen and Potassium in Nursery Grown Plant Roots on a Per Plant Basis

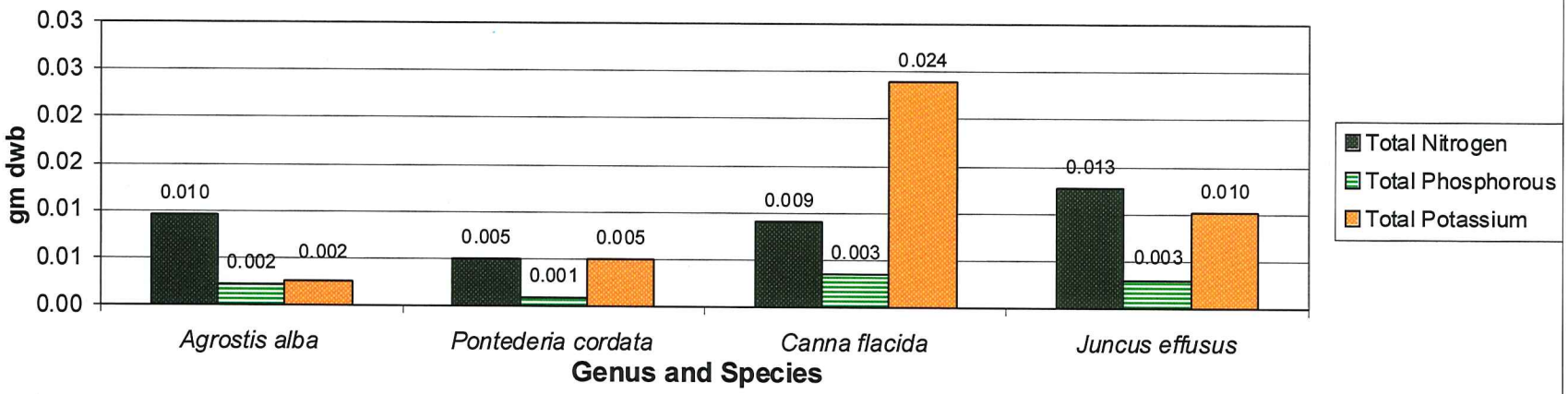


Table 10: Average Total Phosphorous, Nitrogen and Potassium in Nursery Grown Plant Shoots on a Per Plant Basis			
Genus Species	**Total Nitrogen**	**Total Phosphorous**	**Total Potassium**
Agrostis alba	0.007	0.002	0.006
Pontederia cordata	0.028	0.004	0.047
Canna *flaccida*	0.004	0.003	0.021
Juncus effusus	0.010	0.002	0.011

Figure 10: Average Total Phosphorous, Nitrogen and Potassium in Nursery Grown Plant Shoots on a Per Plant Basis

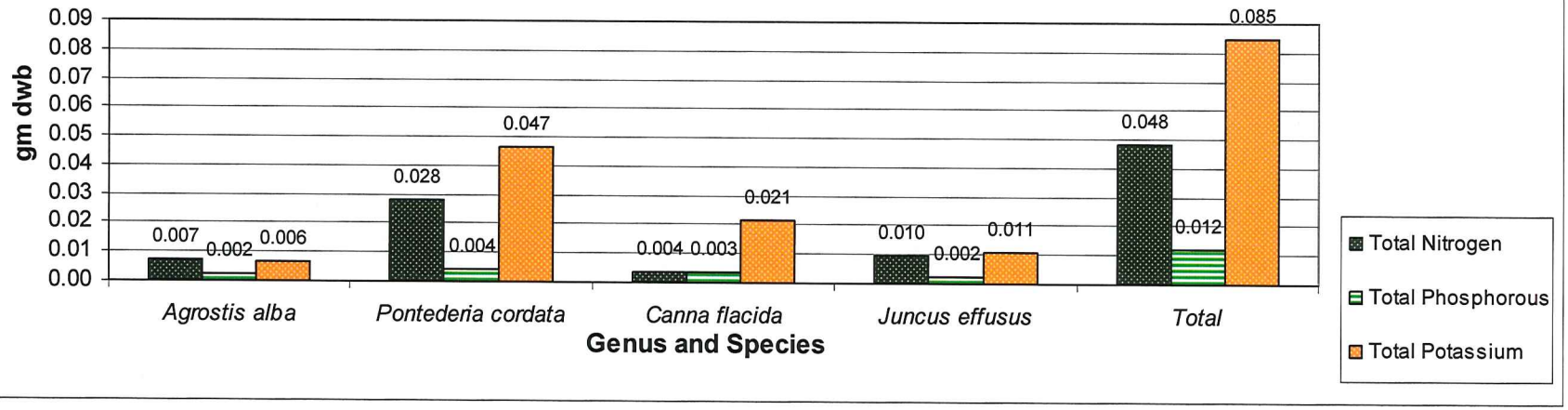
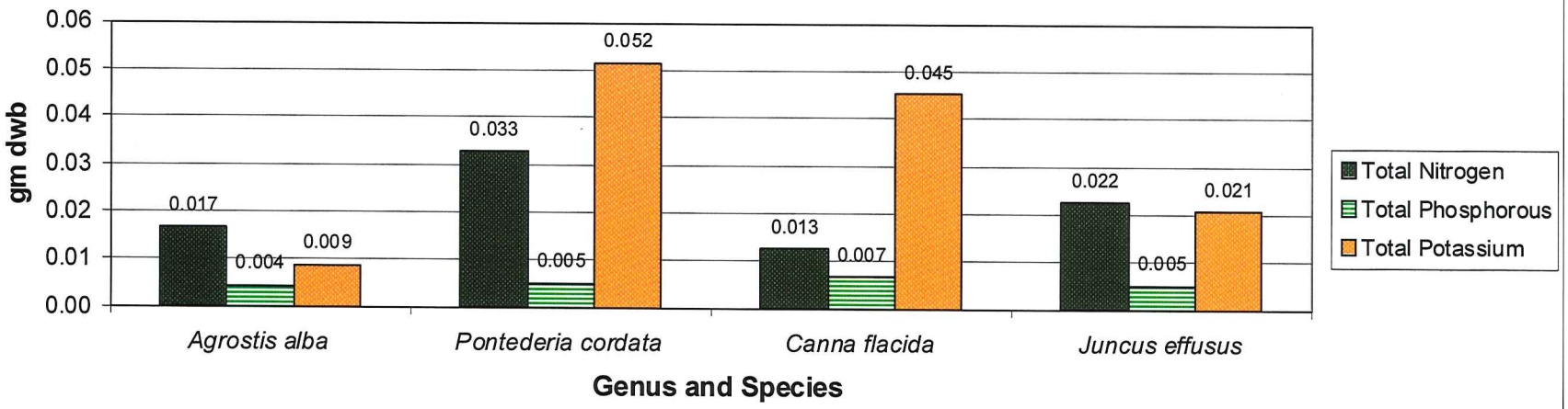


Table 11: Average Total Phosphorous, Nitrogen and Potassium (gm dwb) in Nursery Grown Plant Roots and Shoots on a Per Plant Basis			
Genus Species	**Total Nitrogen**	**Total Phosphorous**	**Total Potassium**
Agrostis alba	0.0166	0.0044	0.0088
Pontederia cordata	0.0328	0.0051	0.0515
Canna *flaccida*	0.0127	0.0067	0.0451
Juncus effusus	0.0224	0.0051	0.0206
Total	**0.084**	**0.021**	**0.126**

Figure 11: Average Total Phosphorous, Nitrogen and Potassium in Nursery Grown Plant Roots and Shoots on a Per Plant Basis



The average total nitrogen and phosphorous on a per plant basis (roots and shoots) of the nursery grown species prior to installation was used to estimate the amount of these nutrients that were planted on both the Sample Mats and the Existing Mats. The calculated amount of both nitrogen and phosphorous in the installed plant (roots and shoots) on the Sample Mats and Existing Mats was dependent on the nutrient content of each individual species (roots and shoots) planted and the number of each species planted. The amount of both nitrogen and phosphorous planted on a per species basis on both the Sample Mats and Existing Mats was used as the foundation for the analysis of the cumulative storage of these nutrients during Sample Events 1, 2 and 3.

Tables 12, **13** and **14** and **Figures 12**, **13** and **14** present the results of the estimated nitrogen and phosphorous levels (gm dwb) in the roots and shoots and roots plus sheets of the species planted on each of the three (3) Samples Mats. **Tables 15**, **16** and **17** and **Figures 15**, **16** and **17** present the results of the estimated nitrogen and phosphorous roots (gm dwb) planted on each of the three (3) Existing Mats.

Table 12: Estimated Total Nitrogen, Phosphorous and Potassium in Roots (gm dwb) Planted on Each Sample Mat				
Genus Species	**# Cells Planted**	**Total Nitrogen**	**Total Phosphorous**	**Total Potassium**
Agrostis alba	28	0.267	0.060	0.069
Pontederia cordata	27	0.133	0.022	0.132
Canna flaccida	10	0.090	0.034	0.239
Juncus effusus	25	0.317	0.074	0.251
Totals =	**90**	**0.807**	**0.190**	**0.691**

Figure 12: Estimated Total Nitrogen, Phosphorous and Potassium in Roots Planted on Each Sample Mat

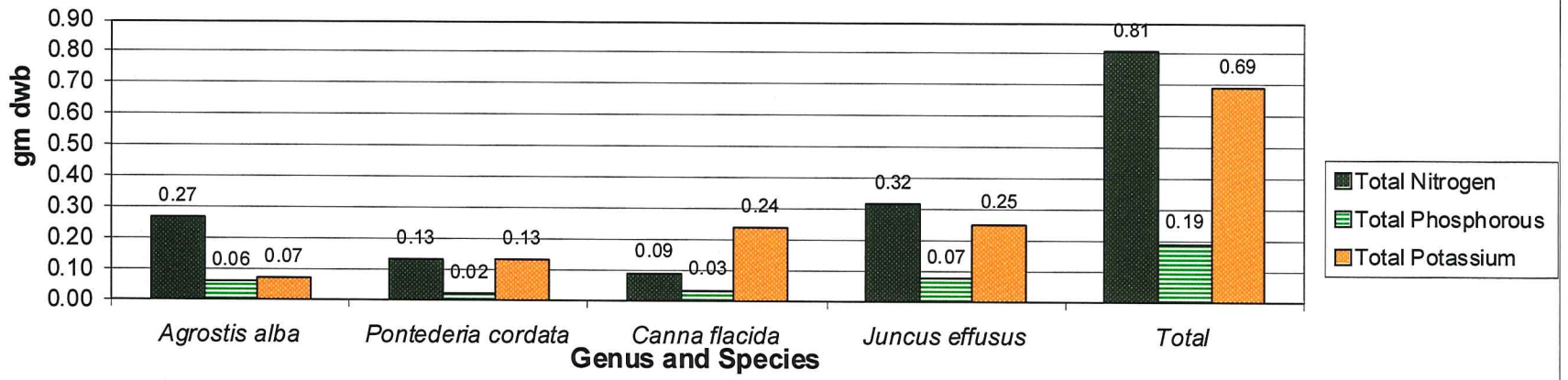


Table 13: Estimated Total Nitrogen, Phosphorous and Potassium in Shoots (gm dwb) Planted on Each Sample Mat				
Genus Species	**# Cells Planted**	**Total Nitrogen**	**Total Phosphorous**	**Total Potassium**
Agrostis alba	28	0.197	0.064	0.176
Pontederia cordata	27	0.752	0.114	1.260
Canna flaccida	10	0.037	0.033	0.212
Juncus effusus	25	0.244	0.053	0.263
Totals =	**90**	**1.231**	**0.264**	**1.910**

Figure 13: Estimated Total Nitrogen, Phosphorous and Potassium in Shoots Planted on Each Sample Mat

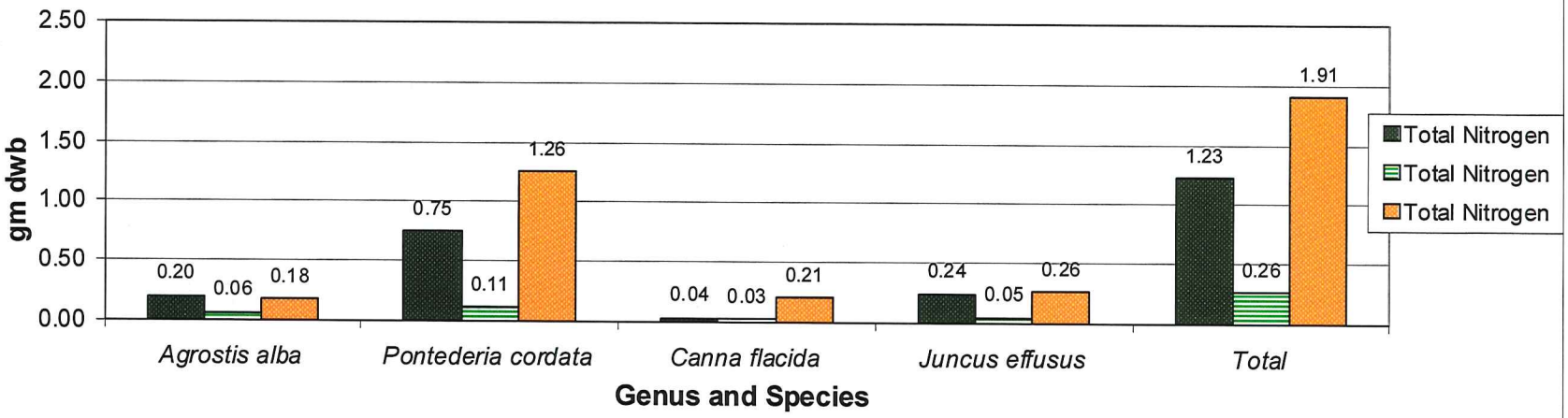


Table 14: Estimated Total Nitrogen, Phosphorous and Potassium in Roots and Shoots (gm dwb) Planted on Each Sample Mat				
Genus Species	**# Cells Planted**	**Total Nitrogen**	**Total Phosphorous**	**Total Potassium**
Agrostis alba	28	0.465	0.124	0.245
Pontederia cordata	27	0.885	0.136	1.391
Canna *flaccida*	10	0.127	0.067	0.451
Juncus effusus	25	0.561	0.128	0.514
Totals =	**90**	**2.037**	**0.455**	**2.601**

Figure 14: Estimated Total Nitrogen, Phosphorous and Potassium in Roots and Shoots Planted on Each Sample Mat

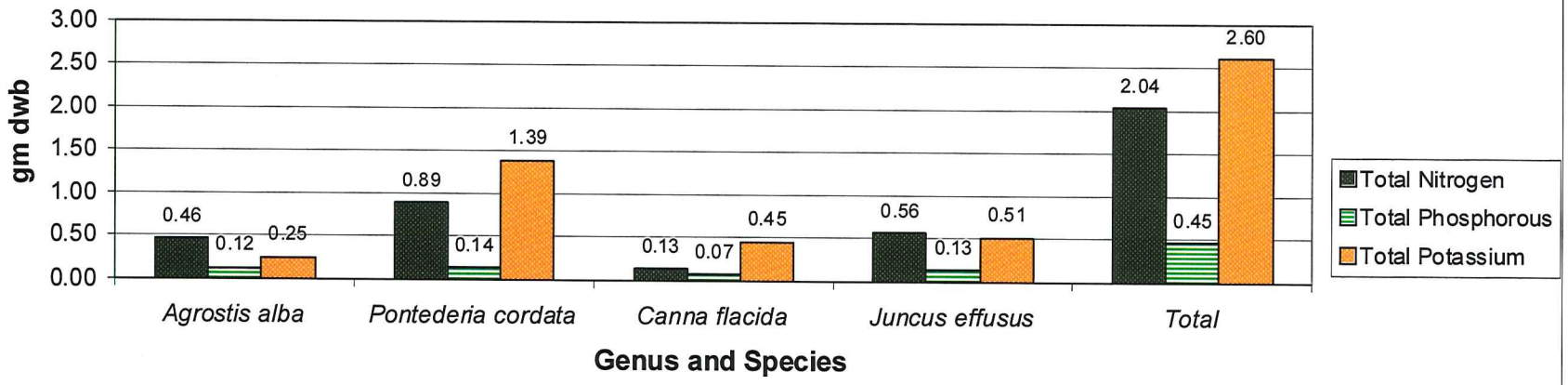


Table 15: Estimated Total Nitrogen, Phosphorous and Potassium in Roots (gm dwb) Planted on Each Existing Mat				
Genus Species	**# Cells Planted**	**Total Nitrogen**	**Total Phosphorous**	**Total Potassium**
Agrostis alba	460	4.39	0.98	1.14
Pontederia cordata	380	1.87	0.31	1.85
Canna flaccida	200	1.80	0.68	4.78
Juncus effusus	520	6.58	1.55	5.23
Totals =	**1,560**	**14.64**	**3.52**	**12.99**

Figure 15: Estimated Total Nitrogen, Phosphorous and Potassium in Roots Planted on Each Existing Mat

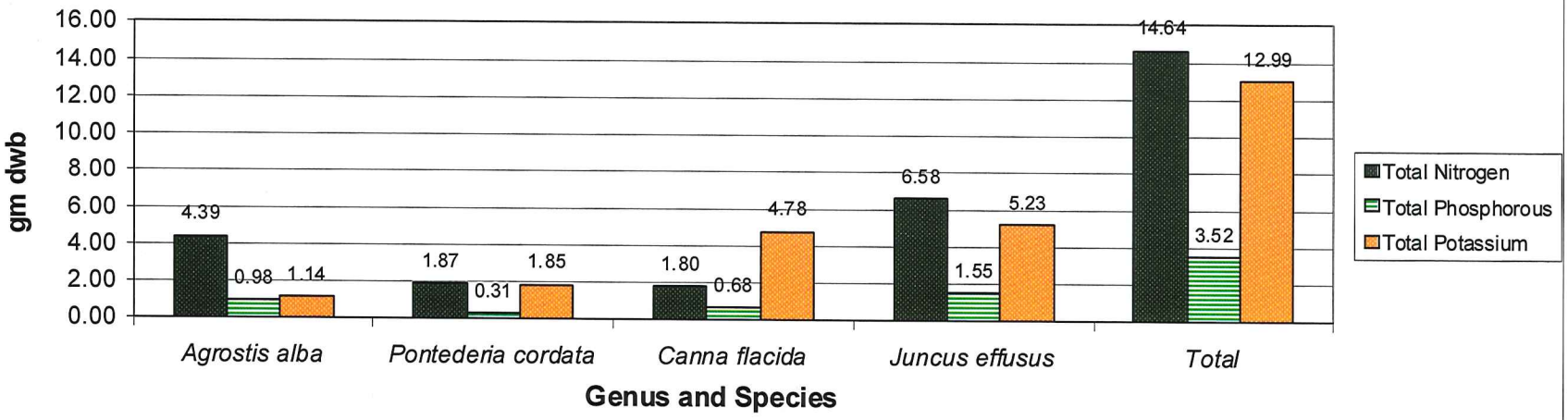


Table 16: Estimated Total Nitrogen, Phosphorous and Potassium in Shoots (gm dwb) Planted on Each Existing Mat				
Genus Species	**# Cells Planted**	**Total Nitrogen**	**Total Phosphorous**	**Total Potassium**
Agrostis alba	460	3.241	1.051	2.890
Pontederia cordata	380	10.589	1.608	17.727
Canna flaccida	200	0.741	0.660	4.235
Juncus effusus	520	5.075	1.106	5.466
Totals =	**1,560**	**19.646**	**4.426**	**30.318**

Figure 16: Estimated Total Nitrogen, Phosphorous and Potassium in Shoots Planted on Each Existing Mat

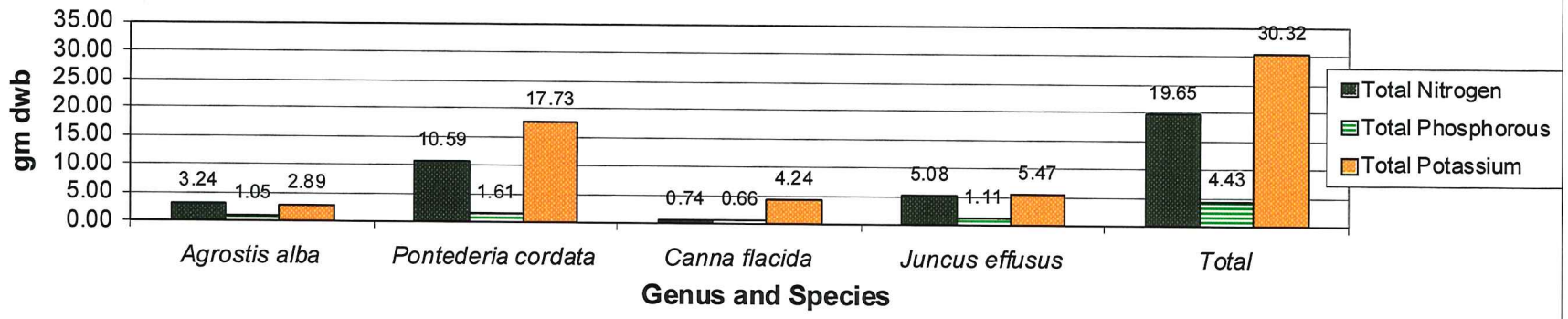
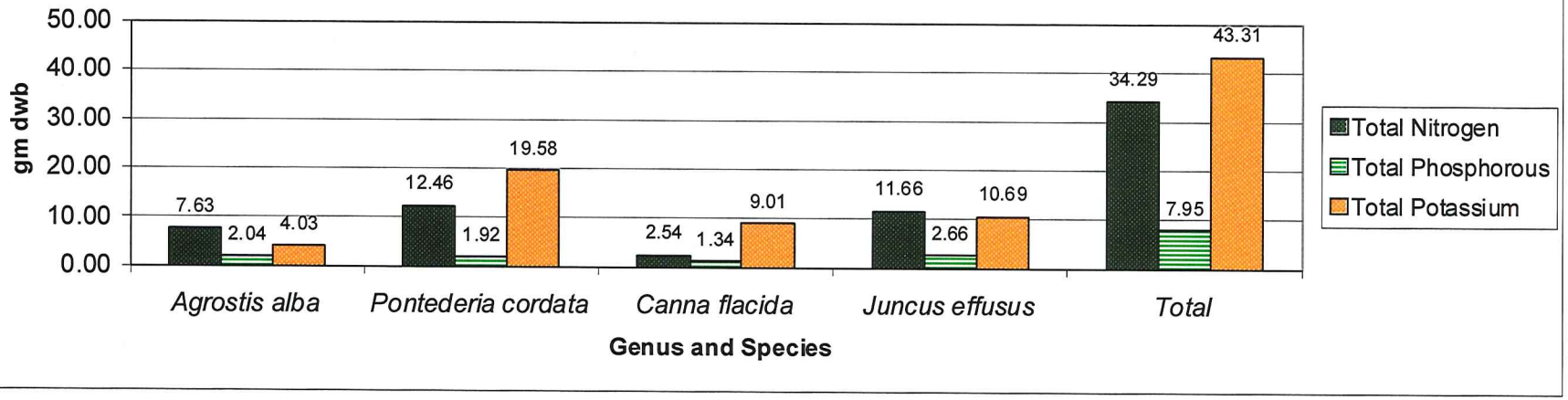


Table 17: Estimated Total Nitrogen, Phosphorous and Potassium in Roots and Shoots (gm dwb) Planted on Each Existing Mat				
Genus Species	**# Cells Planted**	**Total Nitrogen**	**Total Phosphorous**	**Total Potassium**
Agrostis alba	460	7.631	2.035	4.026
Pontederia cordata	380	12.462	1.921	19.578
Canna flaccida	200	2.538	1.338	9.014
Juncus effusus	520	11.659	2.655	10.694
Totals =	**1,560**	**34.291**	**7.949**	**43.312**

Figure 17: Estimated Total Nitrogen, Phosphorous and Potassium in Roots and Shoots Planted on Each Existing Mat



Sample Mats Biomass Production

This section presents cumulative storage of root and shoot biomass on Sample Mats during a portion of the 2009 growing season (May through October). The stored root and shoot biomass of each species (i.e., nursery grown and recruitment species) occurring on the Sample Mats was normalized to the average root and shoot biomass on a per plant basis for each of three (3) sample events. Normalizing the data allowed for measurement of net biomass production (i.e., increase in plant biomass above baseline conditions). This data was then used to estimate the root and shoot biomass that was stored on each of the three (3) Existing Mats during each sample event based on the numbers of nursery-grown plants installed.

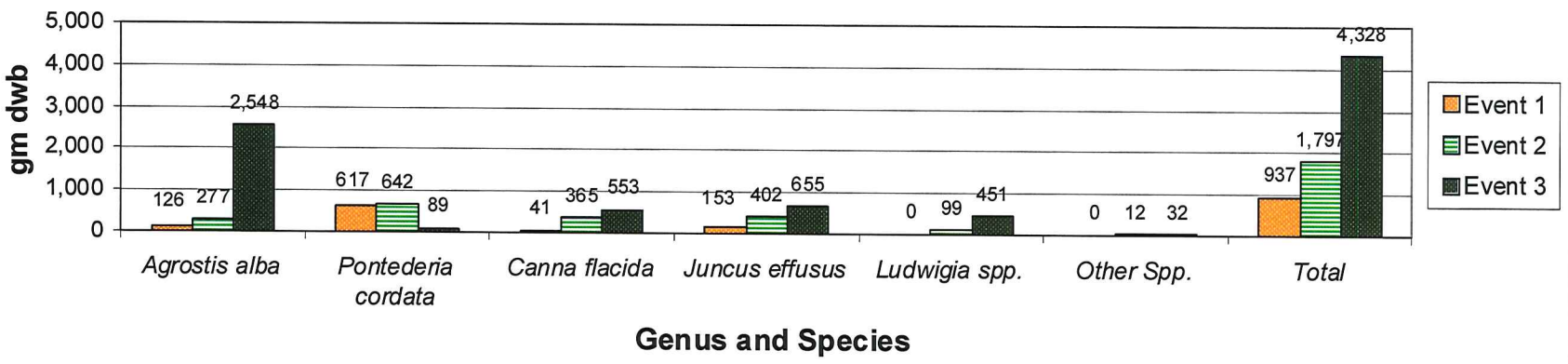
The results of the measured biomass production of the roots and shoots of the nursery-grown plants installed on the Sample Mats displayed a net increase in root, shoot and total plant biomass production. A significant portion of the nursery grown plant materials total biomass production was supplemented by the recruitment of *Ludwigia peruviana* and *Ludwigia octavalis (Ludwigia* spp.) and other species including cattails (*Typha* spp.), spikerush (*Elleocharis* spp.), bluestem (*Andropogon* spp.) and other unidentified dicot species (Other Species). The laboratory results for root and shoot biomass production are presented in **Appendix B**.

The measured total biomass (gm dwb) production of the plant species installed on the Sample Mat increased at differential rates between each of sample growth periods (i.e., Sampling Events 1, 2 and 3) with the exception of *Pontederia cordata* which displayed a decline in biomass production between Sampling Events 2 and 3 (See **Table 18** and **Figure 18**). *Pontederia cordata* had the highest measured biomass production during the growth period between the Baseline and Sample Event 1 followed by *Juncus effusus*, *Agrostis alba* and *Canna flaccida*. Between Sample Events 1 and 2 the total biomass among the nursery grown plant species shifted slightly with *Pontederia cordata* displaying the highest biomass production followed by *Juncus effusus*, *Canna flaccida* and *Agrostis alba*. It was during this sampling period that the recruitment of *Ludwigia* spp. and Other Species biomass occur at measurable levels (See **Table 18** and **Figure 18**).

During the growth period between sample Events 2 and 3, the most significant shifts in biomass production occurred among both the planted and recruited species. The measured *Agrostis alba* biomass (root plus shoots) exceeded all of the combined planted and recruitment species on the Sample Mat during this growth period. *Juncus effusus* had the next highest measured total biomass followed by *Canna flaccida*, *Ludwigia* spp., *Pontederia cordata* and Other Species during this growth period (See **Table 18** and **Figure 18**).

Table 18: Root and Shoot Biomass (gm dwb) Storage on Sample Mats			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	126.2	276.7	2,548.1
Pontederia cordata	616.6	641.9	88.7
Canna flaccida	40.7	365.4	552.7
Juncus effusus	153.2	402.0	655.2
Ludwigia spp.	----	99.4	451.1
Other Spp.	----	11.6	32.2
Total	**936.7**	**1,797.0**	**4,328.0**

Figure 18: Root and Shoot Biomass Storage on Sample Mats



The measured root biomass production of the plant species installed on the Sample Mats increased at differential rates between each of the successive sampling events (i.e., Sampling Events 1, 2 and 3) with the exception of *Pontederia cordata* that displayed a substantial decline in root biomass between Sampling Events 2 and 3 (see **Table 19** and **Figure 19**). Measured root biomass on the Sample Mat was highest in *Pontederia cordata* followed by *Agrostis alba*, *Juncus effusus* and *Canna flaccida* during the growth period between the Baseline and Sample Event 1. *Pontederia cordata* continued to display the highest root biomass measured during Sample Event 2 followed by *Canna flaccida*, *Juncus effusus* and *Agrostis alba* (see **Table 19** and **Figure 19**).

The root biomass production was most significant during the growth period between Sample Events 2 and 3. The total measured root biomass of *Agrostis alba* exceeded the combined total of the root biomass of all other planted species on the Sample Mat. *Canna flaccida* produced the next highest root biomass followed by *Juncus effusus* and *Pontederia cordata* (see **Table 19** and **Figure 19**).

Shoot biomass production of the species installed on the Sample Mats also displayed differential rates of both biomass accumulation and decline between each growth period. *Pontederia cordata*'s shoot biomass production increased between the Baseline and Sample Event 1 growth period but declined between Sample Events 1 through 2 Sample Events 3 growth period (see **Table 20** and **Figure 20**). During the growth period between Sample Events 2 and 3, *Pontederia cordata* actually declined to a level lower than the Baseline Event indicating a net overall loss of biomass. This biomass loss was due to declining growth rates of shoots and a plant mortality rate of 32 percent. The biomass of *Canna flaccida* displayed a successive increase in shoot production between the Baseline and Sample Events 1 and 2 but a decline between Sample Events 2 and 3 (see **Table 20** and **Figure 20**). Both *Agrostis alba* and *Juncus effusus* had positive biomass production during each of these growth periods (see **Table 20** and **Figure 20**)

Between the Baseline and Event 1 growth period, *Juncus effusus* had the highest biomass production. *Pontederia cordata* had the second highest stored shoot biomass during this growth period followed by *Agrostis alba* and then *Canna flaccida*. *Juncus effusus* continued to display the highest measured and stored shoot biomass on the Sample Mat associated with Sample Event 2. *Agrostis alba* displayed the second highest stored shoot biomass during this sampling event followed by *Canna flaccida* and *Pontederia cordata* (see **Table 20** and **Figure 20**).

Similar to root biomass production, during the final growth period, shoot biomass of *Agrostis alba* exceeded the combined total of the root biomass of all other planted species. *Juncus effusus* display the next highest, followed by *Canna flaccida* (see **Table 20** and **Figure 20**).

Table 19: Root Biomass (gm dwb) Storage on Sample Mats			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	94.1	230.9	1,858.5
Pontederia cordata	560.6	632.6	91.2
Canna flaccida	27.1	331.7	538.9
Juncus effusus	42.8	200.9	295.7
Total =	**724.6**	**1,396.1**	**2,784.3**

Figure 19: Root Biomass Storage on Sample Mats

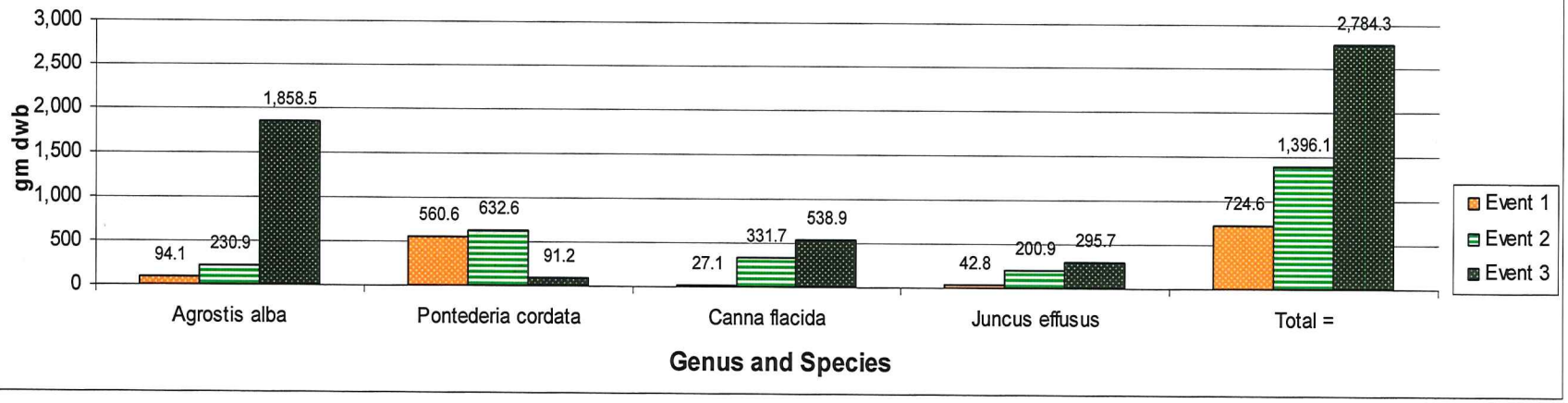
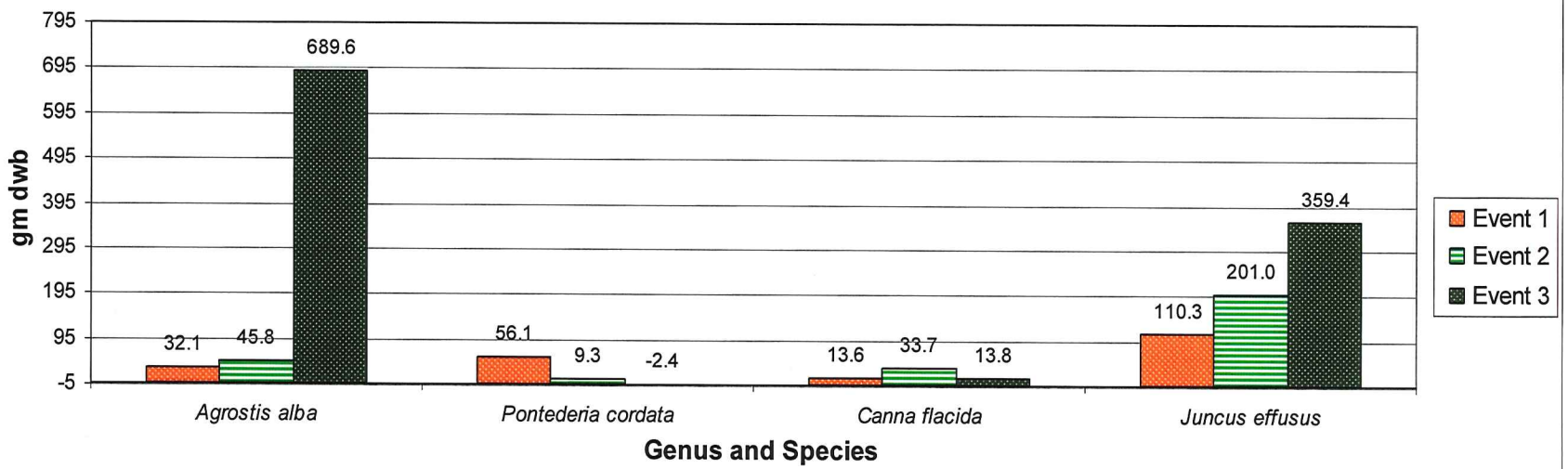


Table 20: Shoot Biomass (gm dwb) Storage on Sample Mats			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	32.1	45.8	689.6
Pontederia cordata	56.1	9.3	-2.4
Canna flaccida	13.6	33.7	13.8
Juncus effusus	110.3	201.0	359.4
Total =	**212.2**	**289.9**	**1,060.5**

Figure 20: Shoot Biomass Storage on Sample Mats



3.4 Percent Nitrogen and Total Nitrogen Storage in Sample Mat Roots and Shoots

Percent Nitrogen in Sample Mat Roots and Shoots

The total nitrogen content (% dwb) of the roots and shoots of the nursery grown plant species sampled during the baseline and Sampling Events 1, 2 and 3 are presented in **Tables 21** and **22** and paired with **Figures 21** and **22**. These results show that between the baseline and Sample Event 1, the total percent nitrogen in roots and shoots of *Agrostis alba*, *Canna flaccida*, and *Juncus effusus* increased. The total percent nitrogen in both the roots and shoots of *Pontederia cordata* declined during this growing period. **Appendix B** presents the laboratory results of the percent nitrogen in the Sample Mat Biomass on a per sample event basis.

The growth period between Sample Events 1 and 2, total nitrogen in the roots (% dwb) of *Pontederia cordata* and *Juncus effusus* increased while *Agrostis alba* and *Canna flaccida* displayed a decline (see **Table 21** and **Figure 21**). During this growth period, the percentage of total nitrogen in the shoots of *Agrostis alba*, *Pontederia cordata*, and *Canna flaccida* increased and the percentage of total nitrogen in the shoots of *Juncus effusus* declined (see **Table 22** and **Figure 22**).

During the growth period between Sample Events 2 and 3 the total percent nitrogen increased in the roots of *Agrostis alba*, *Canna flaccida*, and *Juncus effusus* and decreased in *Pontederia cordata* (See **Table 21** and **Figure 21**). The percentage of nitrogen in the shoots of *Agrostis alba*, *Pontederia cordata*, *Canna flaccida*, and *Juncus effusus* all increased during this growth period (see **Table 22** and **Figure 22**).

Appendix B presents a summary of analytical data for nitrogen.

Nitrogen Storage on Sample Mats

The estimated storage of nitrogen (gm dwb) in the Sample Mat roots plus shoots (total nitrogen) of both the planted and recruited species varied by the rate, amount, and location (i.e., roots or shoots) of the storage. **Table 23** and **Figure 23** present the results of the net storage (roots plus shoots) of nitrogen for each of the three (3) sampling events on a per species basis. The general trend of the total nitrogen storage for each species was an increase in nitrogen during the three growth periods with a notable exception of *Pontederia cordata* that showed a decline in total nitrogen between Sample Events 2 and 3.

Table 21: Percent Total Nitrogen (dwb) in Sample Mat Roots				
Genus/ Species	**Baseline**	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.58	1.36	1.15	1.40
Pontederia cordata	1.74	0.64	0.67	0.50
Canna flaccida	0.53	1.16	0.67	2.20
Juncus effusus	0.68	1.05	1.11	1.37

Figure 21: Percent Total Nitrogen in Sample Mat Roots

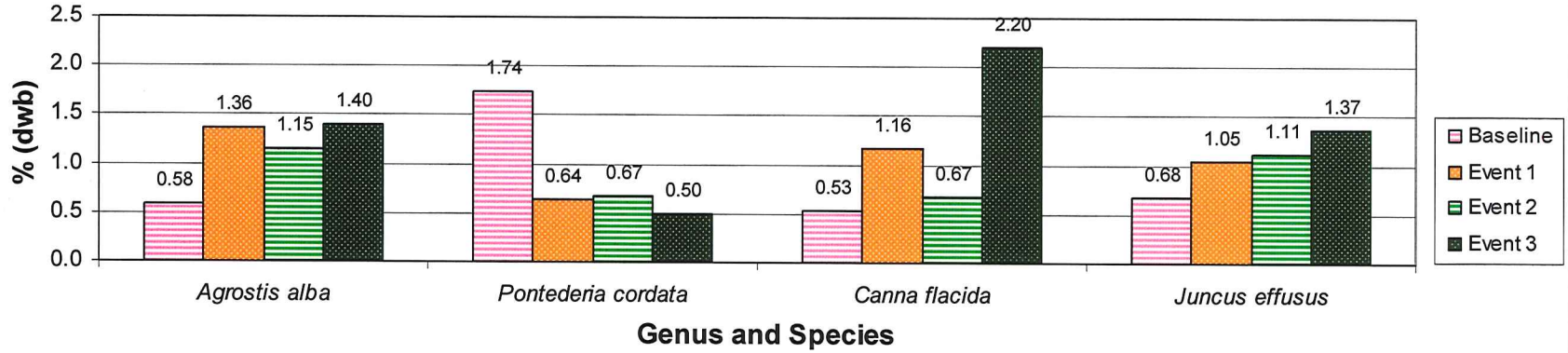


Table 22: Percent Total Nitrogen (dwb) in Sample Mat Shoots				
Genus/ Species	**Baseline**	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.74	1.10	1.52	2.28
Pontederia cordata	3.16	0.94	1.00	1.40
Canna flaccida	0.73	1.21	1.46	1.84
Juncus effusus	0.78	1.26	0.89	1.07

Figure 22: Percent Total Nitrogen in Sample Mat Shoots

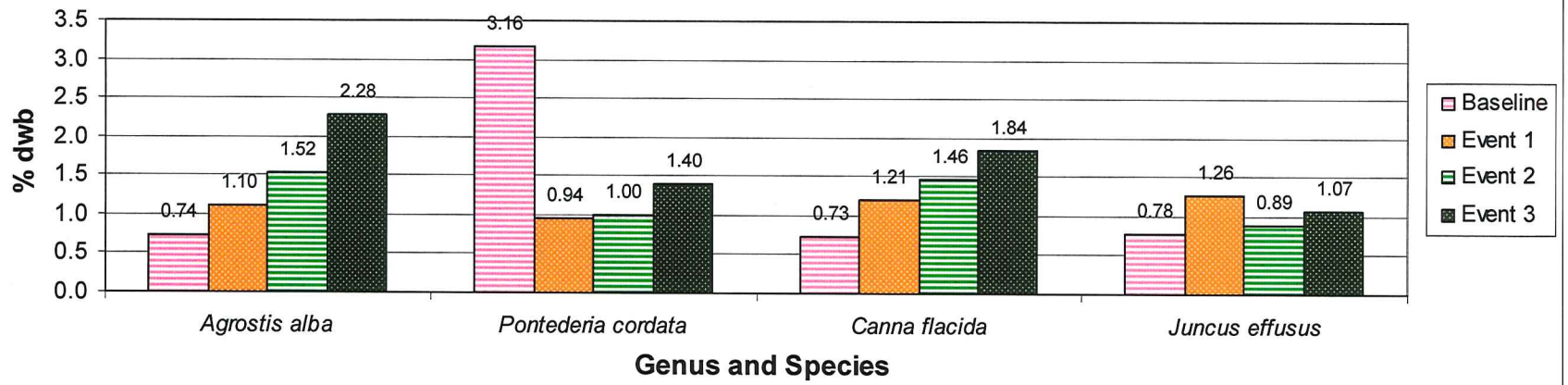
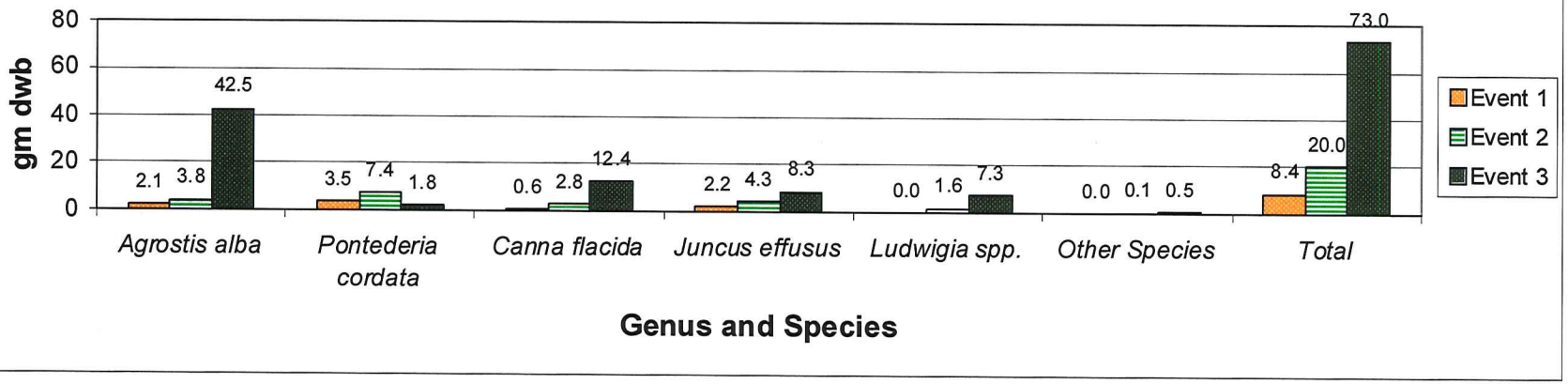


Table 23: Total Nitrogen (gm dwb) Storage in Sample Mat Roots and Shoots			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	2.10	3.83	42.53
Pontederia cordata	3.52	7.42	1.84
Canna flaccida	0.61	2.79	12.43
Juncus effusus	2.16	4.27	8.32
Ludwigia spp.	----	1.55	7.29
Other Species	----	0.15	0.53
Total	**8.39**	**20.00**	**72.95**

Figure 23: Total Nitrogen Storage in Sample Mat Roots and Shoots



The recruitment of measurable levels nitrogen from Ludwigia spp. and Other Species began during the Sample Events 1 and 2 growth period. The data from the final growth period between Sample Events 2 and 3 show a substantial contribution to the total nitrogen storage on the Sample Mats was provided by these recruitment species (i.e., 11% of the overall nitrogen storage).

Nitrogen was stored in variable amounts in the roots of the species installed on the Sample Mat during each Sample Event. The rate of total nitrogen storage in the roots of each species increased from Sample Event to Sample Event (i.e., Baseline through Sample Event 3) with the exception of *Pontederia cordata* roots that lost (albeit net storage) nitrogen between Sample Events 2 and 3 (see **Table 24** and **Figure 24**).

These results show that between the baseline and Sample Event 1, *Pontederia cordata* roots had the highest nitrogen storage followed by *Agrostis alba*, *Juncus effusus*, and *Canna flaccida*. *Pontederia cordata* roots also displayed the highest net storage during the growth period between Sample Events 1 and 2 followed by *Agrostis alba*, *Juncus effusus*, and *Canna flaccida* (see **Table 24** and **Figure 24**).

The final growth period between Sample Events 2 and 3 had the highest levels of nitrogen storage in the roots of each species with the exception of *Pontederia cordata* which declined (see **Table 24** and **Figure 24**). During this growth period net nitrogen storage in *Agrostis alba* roots increased nine-fold. *Canna flaccida* displayed the second highest nitrogen storage during this growth period (5X increase) followed by *Juncus effusus* (nearly a 2X increase) during this growth period. The reason for the increases in root stored nitrogen in *Agrostis alba*, *Juncus effusus* and *Canna flaccida* was the interaction between both an increase in biomass and an increase in the percentage of the stored biomass composed of nitrogen (see **Table 24** and **Figure 24**).

Nitrogen was stored at variable amounts and rates in the shoots of *Agrostis alba*, *Canna flaccida* and *Juncus effusus* on the Sample Mat associated with each Sample Event (see **Table 25** and **Figure 25**). *Pontederia cordata* displayed a steady decline in the nitrogen stored in its shoots beginning with nearly no gains in stored nitrogen between the Baseline and Sample Event growth period, followed by a net loss in shoot nitrogen between the Sample Events 1 and 2 and Sample Event 2 and 3 growth periods (see **Table 25** and **Figure 25**). This loss was a result of the interaction of the reduction in shoot biomass production, percent nitrogen content and the mortally of *Pontederia cordata* documented during the Sample Event 3.

During the first growth period *Juncus effusus* accumulated the most nitrogen in its shoots followed by *Agrostis alba* and *Canna flaccida*. During the next growth period, growth between Sample Events 1 and 2, *Juncus effusus* continued to have the highest nitrogen storage in its shoots followed by *Agrostis alba* and *Canna flaccida*; however, the rate of nitrogen accumulation was higher in both *Agrostis alba* and *Canna flaccida* during this growth period (see **Table 25** and **Figure 25**).

Table 24: Total Nitrogen (gm dwb) Storage in Sample Mat Roots			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	1.65	2.92	26.40
Pontederia cordata	3.52	7.84	2.30
Canna flaccida	0.42	2.26	12.12
Juncus effusus	0.62	2.44	4.38
Total	**6.21**	**15.46**	**45.20**

Figure 24: Total Nitrogen Storage in Sample Mat Roots

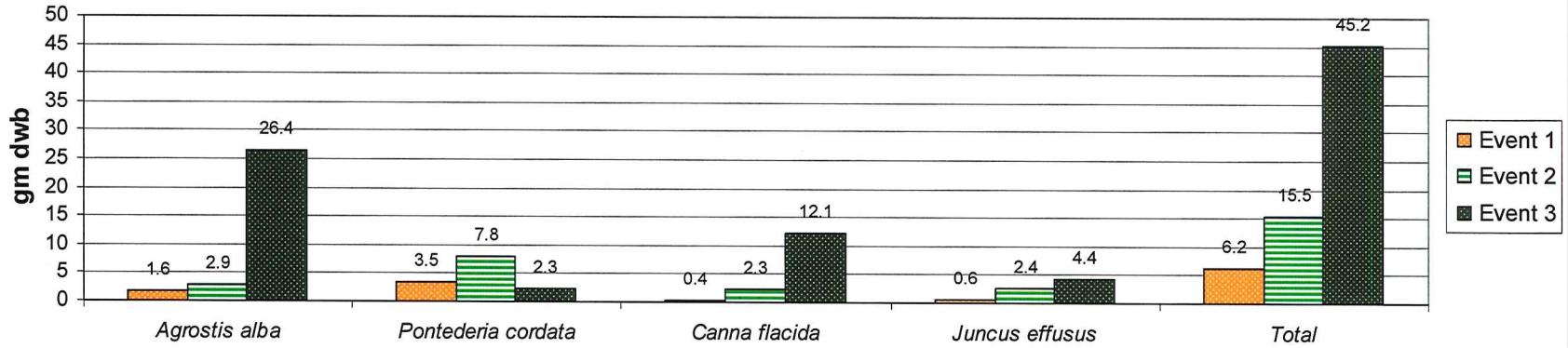
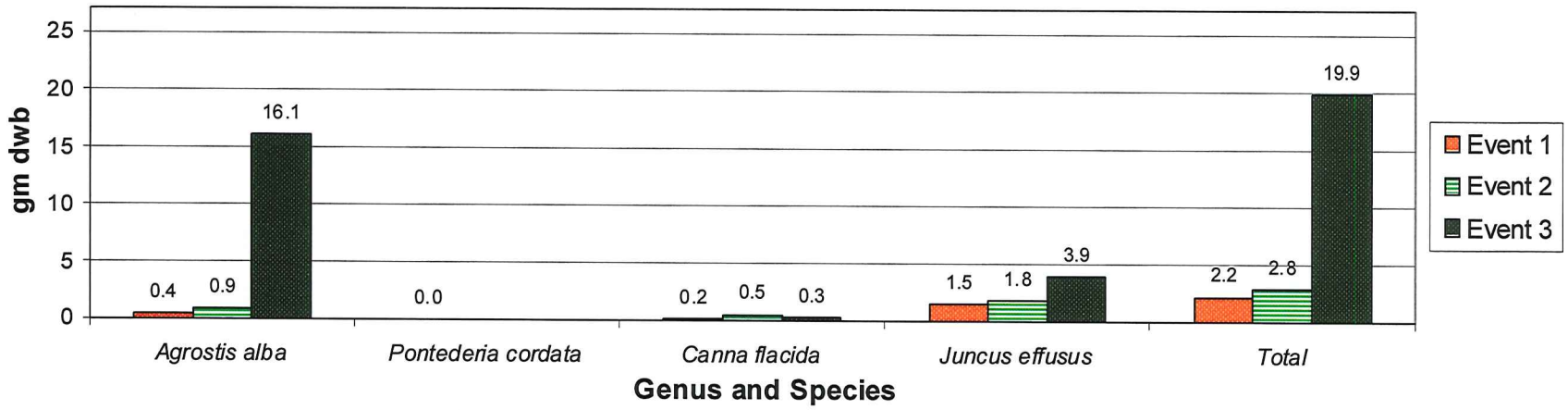


Table 25: Total Nitrogen (gm dwb) Storage in Sample Mat Shoots			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.45	0.91	16.13
Pontederia cordata	0.00	-0.42	-0.45
Canna flaccida	0.19	0.53	0.31
Juncus effusus	1.54	1.83	3.94
Total	**2.18**	**2.85**	**19.93**

Figure 25: Total Nitrogen Storage in Sample Mat Shoots



The storage of nitrogen in the shoots of *Agrostis alba* and *Juncus effusus* increased substantially during the final growth period. *Agrostis alba* shoot nitrogen storage was so substantial during this growth period that over 50 percent of the nitrogen stored in Sample Mat shoots was contained in the *Agrostis alba* biomass. The nitrogen storage by *Juncus effusus* increased more than twofold during this growth period. *Canna flaccida* nitrogen storage in shoots declined during this growth period but maintained an overall net increase in storage (see **Table 25** and **Figure 25**).

3.5 Percent Phosphorous and Total Phosphorous Storage in Sample Mat Roots and Shoots

Percent Phosphorous in Sample Mat Roots and Shoots

The total phosphorous content (% dwb) of the roots and shoots of the nursery grown plant species sampled during the Baseline and Sampling Events 1, 2 and 3 are presented in **Tables 26** and **27** and the paired **Figures 26** and **27**. These results show that the assimilation of phosphorous (% dwb) in both the root and shoot of the nursery grown plant species installed on Sample Mats were less than the baseline conditions throughout the growing season (Sampling Events 1, 2 and 3). The laboratory results of the phosphorous in the Sample Mat biomass during Sample Events 1, 2 and 3 are presented in **Appendix B**.

Although the percent phosphorous in the roots varied between each of the growth event periods, the final growth period (Sample Events 2 and 3) displayed an increase in the percent phosphorus in the roots of *Canna flaccida*, *Juncus effusus*, and *Agrostis alba* (see **Table 26** and **Figure 26**). *Pontederia cordata* declined to its lowest levels (% phosphorous) during this growth period. The data indicated that *Canna flaccida* had the highest percentage of phosphorous in its root biomass during the final growth period followed by *Juncus effusus*, *Agrostis alba*, and *Pontederia cordata* (see **Table 26** and **Figure 26**).

The percentage of phosphorous in the shoots of *Canna flaccida* and *Agrostis alba* increased while *Pontederia cordata* and *Juncus effusus* decreased slightly during the final growth period (see **Table 27** and **Figure 27**). The data in **Table 27** and **Figure 27** show that *Agrostis alba* had the highest percentage of phosphorous in its shoot biomass during each of the three (3) growing periods followed by *Canna flaccida Juncus effusus* and *Pontederia cordata* period (see **Table 27** and **Figure 27**).

Table 26: Percent Total Phosphorous (dwb) in Sample Mat Roots				
Genus/ Species	**Baseline**	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.13	0.09	0.07	0.10
Pontederia cordata	0.29	0.05	0.05	0.04
Canna flaccida	0.20	0.10	0.05	0.15
Juncus effusus	0.16	0.11	0.10	0.12

Figure 26: Percent Total Phosphorous in Sample Mat Roots

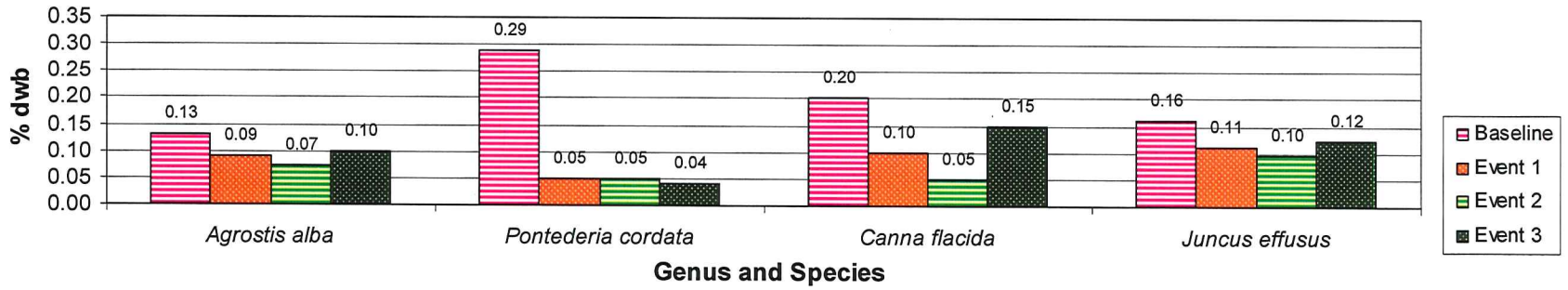
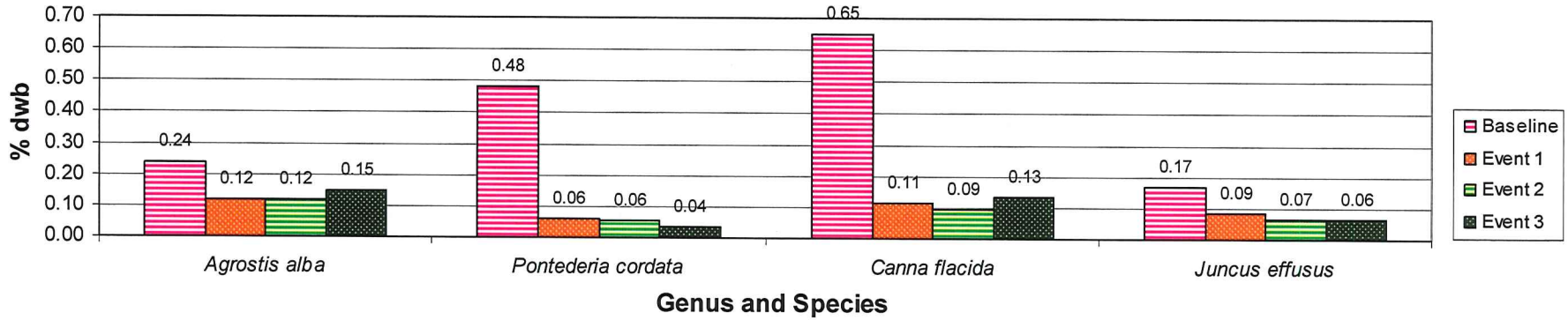


Table 27: Mean Percent Phosphorous (dwb) in Sample Mat Shoots				
Genus/ Species	**Baseline**	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.24	0.120	0.120	0.147
Pontederia cordata	0.48	0.060	0.057	0.037
Canna flaccida	0.65	0.113	0.093	0.133
Juncus effusus	0.17	0.087	0.067	0.063

Figure 27: Mean Percent Phosphorous in Sample Mat Shoots



Phosphorous Storage on Sample Mats

The estimated storage of phosphorous (gm dwb) in the Sample Mat roots and shoots (total plant) of both the planted and recruited species varied by the rate, amount, and the location (i.e., roots or shoots) of the storage. **Table 28** and **Figure 28** present the results of the net storage (roots plus shoots) of phosphorous for each of the three (3) sampling events on a per species basis. The general trend of phosphorous storage in the roots plus shoots for each installed species was an increase in phosphorous during time between the three growth periods with notable exceptions of *Pontederia cordata* that during the Sample Event 2 and 3 (final growth period) showed a net loss and *Canna flaccida* that between the Baseline and Event 1 showed a slight net loss[4] (see **Table 28** and **Figure 28**)

The recruitment of measurable levels of phosphorous from *Ludwigia* spp. and Other Species began during the Sample Event 1 through 2 growth period (see **Table 28** and **Figure 28**). During the final growth period (Sample Event 2 through 3), the phosphorous storage in the recruitment species continued to increase due to increases in shoot and root biomass production (i.e., 15% of the total phosphorous storage on Sample Mat during the final growth period).

Phosphorous was stored in variable amounts in the roots of the species installed on the Sample Mat during each Sample Event. The rate of phosphorous storage in the roots of each species increased from Sample Event to Sample Event (i.e., Baseline through Sample Event 3) with the exception of *Pontederia cordata* roots that lost (albeit net storage) phosphorous between Sample Events 2 and 3 (see **Table 29** and **Figure 29**).

These results show that between the Baseline Event and Sample Event 1 growth period, *Pontederia cordata* roots had the highest phosphorous storage followed by *Agrostis alba*, *Juncus effusus*, and *Canna flaccida*. *Pontederia cordata* roots also displayed the highest net storage during the growth period between Sample Events 1 and 2 followed by *Juncus effusus*, *Agrostis alba*, and *Canna flaccida* (see **Table 29** and **Figure 29**).

[4] Net loss means that the measured phosphorous levels (gm dwb) fell below the installed phosphorous levels (gm dwb).

Table 28: Total Phosphorous (gm dwb) Storage in Sample Mat Roots Plus Shoots			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.073	0.166	2.831
Pontederia cordata	0.196	0.202	-0.089
Canna flaccida	-0.002	0.144	0.792
Juncus effusus	0.093	0.266	0.542
Ludwigia spp.	----	0.14	0.62
Other Species	----	0.008	0.03
Total	**0.360**	**0.927**	**4.726**

Figure 28: Total Phosphorous Storage in Sample Mat Roots and Shoots

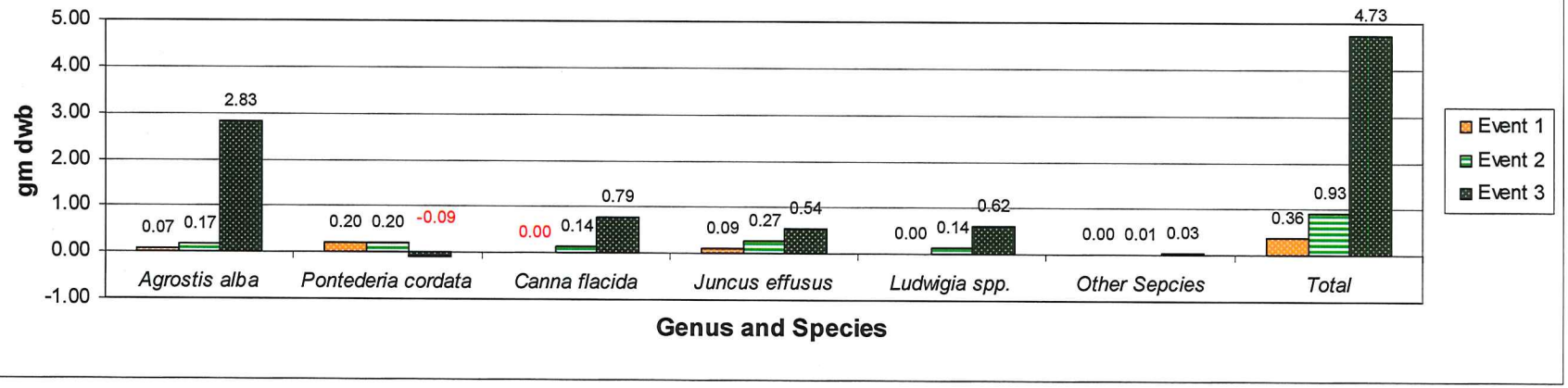
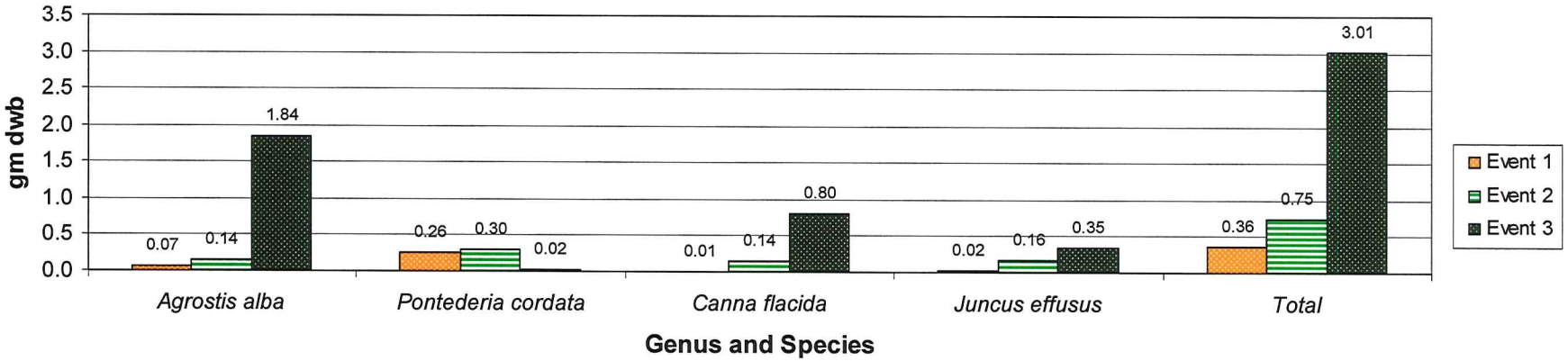


Table 29: Total Phosphorous (gm dwb) Storage in Sample Mat Roots			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.066	0.143	1.845
Pontederia cordata	0.262	0.298	0.017
Canna flaccida	0.010	0.140	0.800
Juncus effusus	0.024	0.165	0.348
Total	**0.36**	**0.75**	**3.01**

Figure 29: Total Phosphorous Storage in Sample Mat Roots



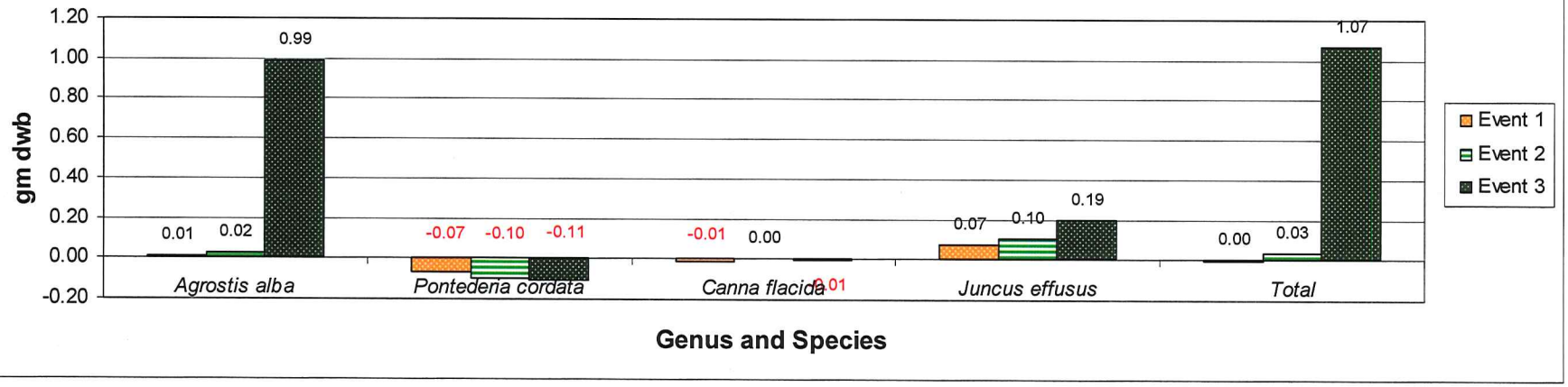
The final growth period (Sample Events 2 through 3) had the highest levels of phosphorous storage in the roots of each species with the exception of *Pontederia cordata* that displayed a decline in total phosphorus but still maintained a low level of phosphorous storage (see **Table 29** and **Figure 29**). During this growth period, net phosphorous storage in *Agrostis alba* roots increased by more than twelve-fold. *Canna flaccida* displayed the second highest phosphorous storage during this growth period (>5X increase) followed by *Juncus effusus* (>2X increase) during this growth period. The reason for the substantial increases in root stored phosphorous in *Agrostis alba*, *Juncus effusus* and *Canna flaccida* was the interaction between both an increase in biomass and the percentage of the stored biomass composed of phosphorous (see **Table 29** and **Figure 29**).

The assimilation of phosphorus into the shoots of the nursery-grown plants installed on the Sample Mats during each growth period ranged from a net loss to substantial storage of phosphorous (see **Table 30** and **Figure 30**). The data presented in **Table 30** and **Figure 30** indicate that both *Agrostis alba* and *Juncus effusus* shoots continued to accumulate phosphorous during each successive growth period with both displaying substantial phosphorous storage at the end of the final growth period. *Canna flaccida* shoots had a net loss of phosphorus during the first growth period and final growth period and only modest levels of phosphorous storage during the growth period between Sampling Events 1 and 2 (see **Table 30** and **Figure 30**).

The data show that *Pontederia cordata* had a steady decline in the phosphorous stored in its shoots beginning with nearly no gain in stored nitrogen between the Baseline and Sample Event 1 growth period, followed by a net loss in shoot nitrogen between the Sample Events 1 and 2 and Sample Event 2 and 3 growth periods (see **Table 30** and **Figure 30**). This loss was a result of the interaction of the reduction in stored shoot biomass, nitrogen content (% dwb) and the mortality of *Pontederia cordata* documented during the Sample Event 3.

Table 30: Total Phosphorous (gm dwb) Storage in Sample Mat Shoots			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.007	0.023	0.987
Pontederia cordata	-0.066	-0.096	-0.106
Canna flaccida	-0.012	0.003	-0.008
Juncus effusus	0.070	0.102	0.194
Total	**-0.002**	**0.032**	**1.067**

Figure 30: Total Phosphorous Storage in Sample Mat Shoots



4.0 ANALYSIS OF RESULTS

4.1 Normalized Biomass Production and Storage of Nitrogen and Phosphorous on a per Plant Basis

The root, shoot and root plus shoot biomass production was normalized to average biomass per plant species to evaluate performance of each planted species and to estimate the biomass production of each species on the Existing Mats for each of the three (3) growth periods monitored (Sample Events 1, 2 and 3). This data was then used to estimate the biomass production of each species on the Existing Mats for each of the three (3) growth periods monitored.

Similarly, the root, shoot and root plus shoot nitrogen and phosphorous storage data from the Sample Mats was normalized to average nitrogen and phosphorous per plant species (individual plants on a per species basis) to evaluate performance of each planted species and to estimate the nitrogen and phosphorus storage of each species on the Existing Mats for each of the three (3) growth periods analyzed (Sample Events 1, 2 and 3).

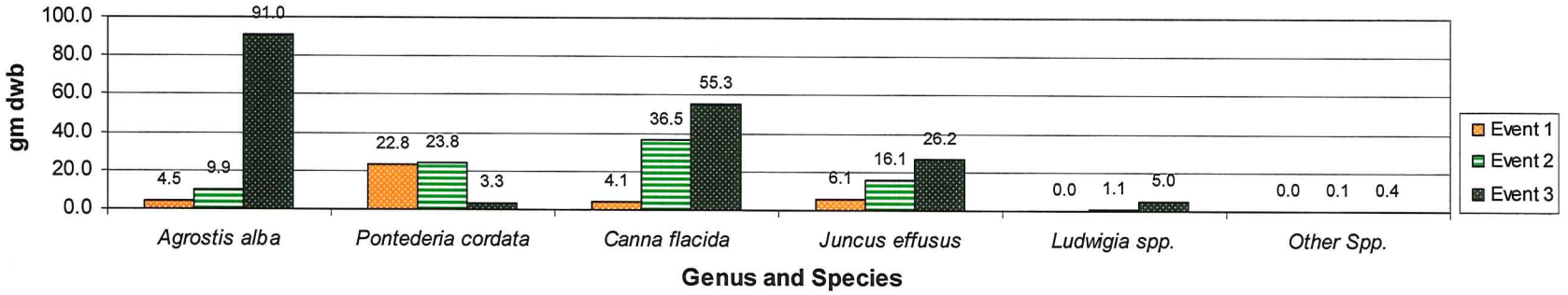
Normalized Biomass Production

The results of the normalized total biomass production of the nursery-grown plants installed on the Sample Mats indicate an increase from growth period to growth period with the exception of *Pontederia cordata* that declined between Sample Events 2 and 3 (see **Table 31** and **Figure 31**). The normalized data show that growth period between the Baseline and Sample Event 1, *Pontederia cordata* had the highest biomass production followed by *Juncus effusus*, *Agrostis alba* and *Canna flaccida*. During the growth period between Sample Events 1 and 2, *Canna flaccida* had the had the highest biomass production followed by *Pontederia cordata*, *Juncus effusus* and *Agrostis alba* (see **Table 31** and **Figure 31**).

During the final growth period between Sample Events 2 and 3, total biomass of *Agrostis alba* on a per plant basis increased by nearly tenfold. *Canna flaccida* and *Juncus effusus* biomass production on a per plant basis also increased significantly during this growth period. The biomass production rate of *Pontederia cordata* declined during this same time period due to the previously discussed mortality among its population (see **Table 31** and **Figure 31**).

Table 31: Average Root Plus Shoot Biomass (gm dwb) Storage on a per Plant Basis			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	4.5	9.9	91.0
Pontederia cordata	22.8	23.8	3.3
Canna flaccida	4.1	36.5	55.3
Juncus effusus	6.1	16.1	26.2
Ludwigia spp.	----	1.1	5.0
Other spp.	----	0.1	0.4

Figure 31: Average Root and Shoot Biomass Storage on a per Plant Basis



Pontederia cordata had the highest production of root biomass on a per plant basis between the Baseline and Event 1 growth period followed by *Agrostis alba*, *Canna flaccida* and *Juncus effusus*. Between Event 1 and 2 the cumulative normalized root biomass production was highest for *Canna flaccida* followed by *Pontederia cordata*, *Juncus effusus* and *Agrostis alba*. *Agrostis alba* had the highest biomass production on a per plant basis during the final growth period followed by *Canna flaccida* and rush (see **Table 32** and **Figure 32**).

Sample Mat shoot biomass storage on a per plant basis was highest for *Juncus effusus* followed by *Pontederia cordata*, *Canna flaccida* and *Agrostis alba* between the Baseline and Sample Event 1 growth period. *Juncus effusus* produced the highest shoot biomass on a per plant basis during the growth period between Sample Events 1 and 2. During the same growth period, both *Canna flaccida* and *Agrostis alba* shoot biomass on a per plant basis increased while the average shoot biomass of a *Pontederia cordata* plant declined (see **Table 33** and **Figure 33**).

Agrostis alba and *Juncus effusus* had large increases in shoot biomass on a per plant basis during the final growth period. During this same growth period, the per plant biomass of *Canna flaccida* shoots declined but still displayed net production (storage) beyond the Baseline event. *Pontederia cordata* shoot biomass declined to a level (gm dwb) below the Baseline Event (net loss of biomass) on a per plant basis (see **Table 33** and **Figure 33**).

Appendix B presents a summary of the Laboratory results for biomass production in Sample Mats for baseline, and sample events 1, 2, and 3.

Table 32: Average Root Biomass (gm dwb) Storage on a per Plant Basis			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	3.4	8.2	66.4
Pontederia cordata	20.8	23.4	4.9
Canna flaccida	2.7	33.2	53.9
Juncus effusus	1.7	8.0	11.8

Figure 32: Average Root Biomass Storage on a per Plant Basis

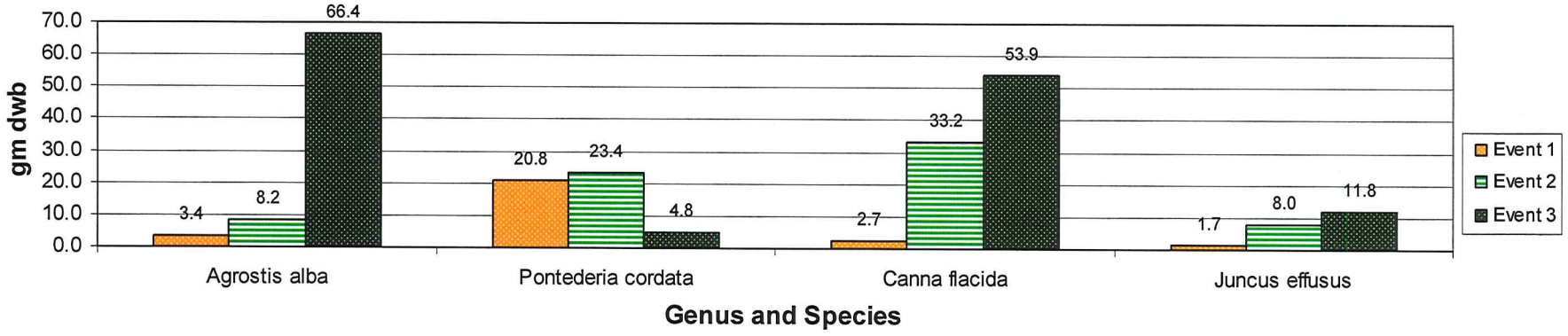
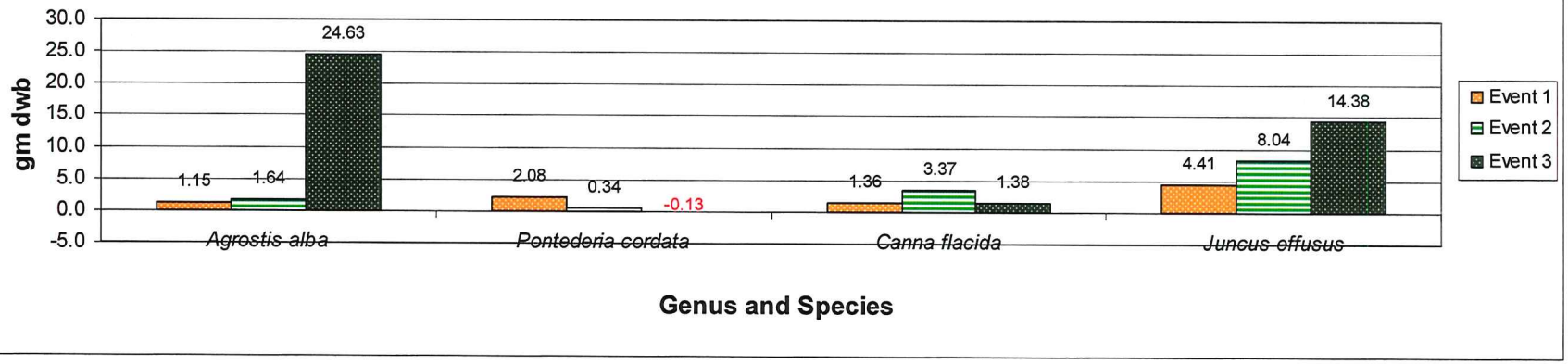


Table 33: Average Shoot Biomass (gm dwb) Storage on a per Plant Basis			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	1.15	1.64	24.63
Pontederia cordata	2.08	0.34	-0.13
Canna flaccida	1.36	3.37	1.38
Juncus effusus	4.41	8.04	14.38

Figure 33: Average Shoot Biomass Storage on a per Plant Basis



Normalized Nitrogen and Phosphorous Storage

The result of the nitrogen storage on a per plant basis (roots and shoots) in nursery-grown plants installed on the Sample Mats on a per plant basis indicate that the general trend was an increase from growth period to growth period with the exception of *Pontederia cordata* that lost nitrogen between Sample Events 2 and 3. During growth period between Sample Events 1 and 2, the recruitment of *Ludwigia* spp. and Other Species began to contribute to measurable levels of nitrogen storage on a per plant basis. The growth and subsequent storage of nitrogen in these recruitment species on a per plant basis increased substantially during the final growth period[5] (see **Table 34** and **Figure 34**).

The growth period between the Baseline and Sample Event 1, *Pontederia cordata* (roots plus shoots) displayed the highest nitrogen storage on a per plant basis followed by *Juncus effusus*, *Agrostis alba* and *Canna flaccida*. During the growth period between Sample Events 1 and 2, *Canna flaccida* had the displayed the highest accumulation of nitrogen on a per plant basis followed by *Pontederia cordata*, *Juncus effusus* and *Agrostis alba* (see **Table 34** and **Figure 34**).

During the final growth period between Sample Events 2 and 3, total nitrogen storage on a per plant basis increased substantially in *Agrostis alba*, *Canna flaccida*, and *Juncus effusus*. *Agrostis alba* had the highest total nitrogen content on a per plant basis followed by *Canna flaccida*, and *Juncus effusus*. The total nitrogen storage of *Pontederia cordata* declined during this same time period due its aforementioned mortality, reduced biomass production and percent nitrogen assimilation (gm dwb) (see **Table 34** and **Figure 34**).

In general, nitrogen storage in the roots on a per plant basis of each of the nursery grown plant species installed on the Sample Mats displayed net storage of nitrogen. Similarly, the storage of nitrogen in the roots of the installed plants (on a per plant basis) increased from growth period to growth period with one exception. The exception was *Pontederia cordata*, which displayed a decline in the rate of nitrogen assimilation on a per plant basis between the Event 2 and 3 growth period (see **Table 35** and **Figure 35**).

[5] The recruitment of *Ludwigia* spp. and Other Species and the associated nitrogen storage measurements from the Sample Mat was normalized to nitrogen storage on a per plant basis. Because the number of Sample Mat cells that these plants occurred on was not known, they were each normalized based on the total number Sample Mat cells (N=90)

Table 34: Sample Mat Total Nitrogen (gm dwb) Storage on a per Plant Basis (Roots plus Shoots)			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.075	0.137	1.519
Pontederia cordata	0.131	0.275	0.097
Canna flaccida	0.061	0.279	1.243
Juncus effusus	0.086	0.171	0.333
Ludwigia spp.	----	0.017	0.081
Other Species	----	0.002	0.006

Figure 34: Sample Mat Total Nitrogen Storage on a per Plant Basis (Roots and Shoots)

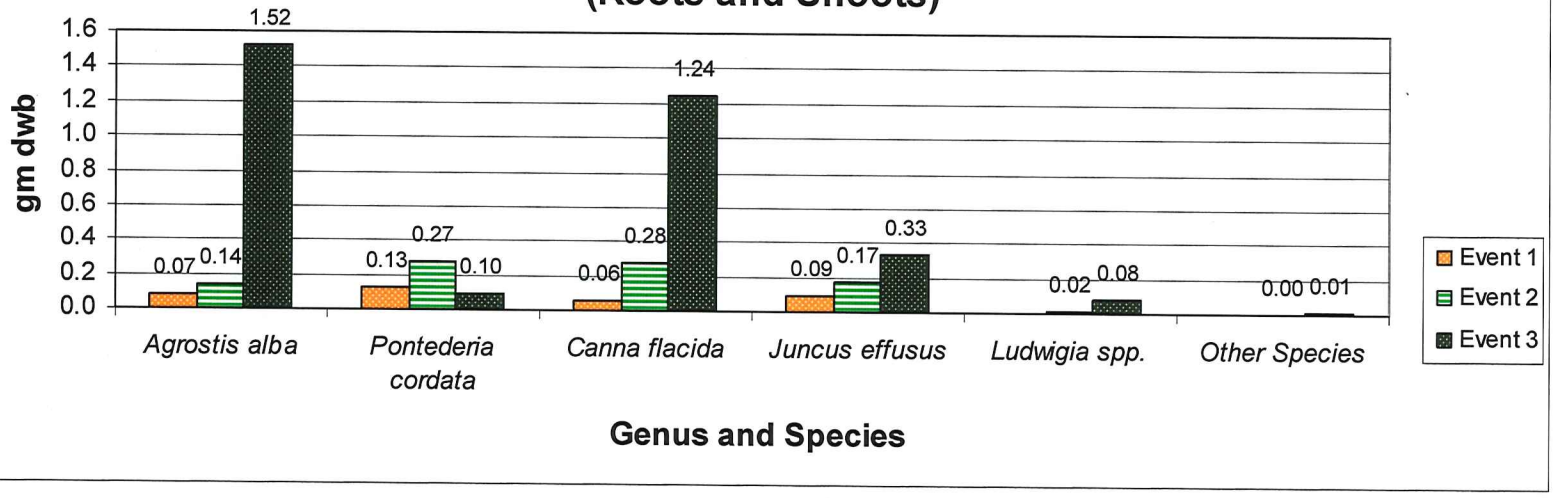
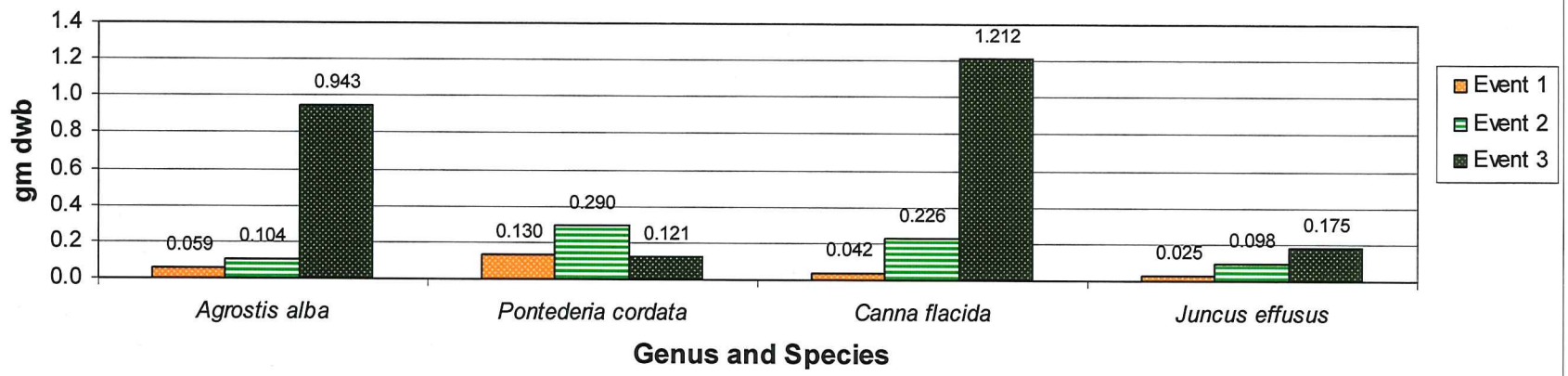


Table 35: Total Nitrogen (gm dwb) Storage in Sample Mat Roots on a per Plant Basis			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.059	0.104	0.943
Pontederia cordata	0.130	0.290	0.121
Canna flaccida	0.042	0.226	1.212
Juncus effusus	0.025	0.098	0.175

Figure 35: Total Nitrogen Storage in Sample Mat Roots on a per Plant Basis



Pontederia cordata displayed the highest storage of nitrogen in its roots on a per plant basis between the Baseline and Event 1 growth period followed by *Agrostis alba*, *Canna flaccida*, and *Juncus effusus*. Between Events 1 and 2, the storage of nitrogen in roots (on a per plant basis) was highest in *Pontederia cordata* followed by *Canna flaccida*, *Agrostis alba*, and *Juncus effusus*. *Canna flaccida* had the highest nitrogen storage on a per plant basis between Event 2 and 3 followed by: *Agrostis alba*, *Juncus effusus*, and *Pontederia cordata* (see **Table 35** and **Figure 35**).

Nitrogen storage on a per plant basis in the shoots of *Agrostis alba* and *Juncus effusus* increased during each growth period. *Canna flaccida* shoots displayed net storage of nitrogen during each growth period but showed a decline in storage during the final growth period between Sample Events 2 and 3. *Pontederia cordata* shoots on a per plant basis showed little accumulation or a net loss[6] of nitrogen of stored nitrogen during the growth periods (see **Table 36** and **Figure 36**).

Nitrogen storage on a per plant basis was the highest in *Juncus effusus* shoots between the Baseline and Sample Event 1 growth period followed *Canna flaccida*, and *Agrostis alba*. *Pontederia cordata* shoots on a per plant basis showed virtually no storage of nitrogen largely due to the decrease in the assimilation of nitrogen expressed as a percentage of the total biomass on a dry weight basis during this growth period (see **Table 36** and **Figure 36**).

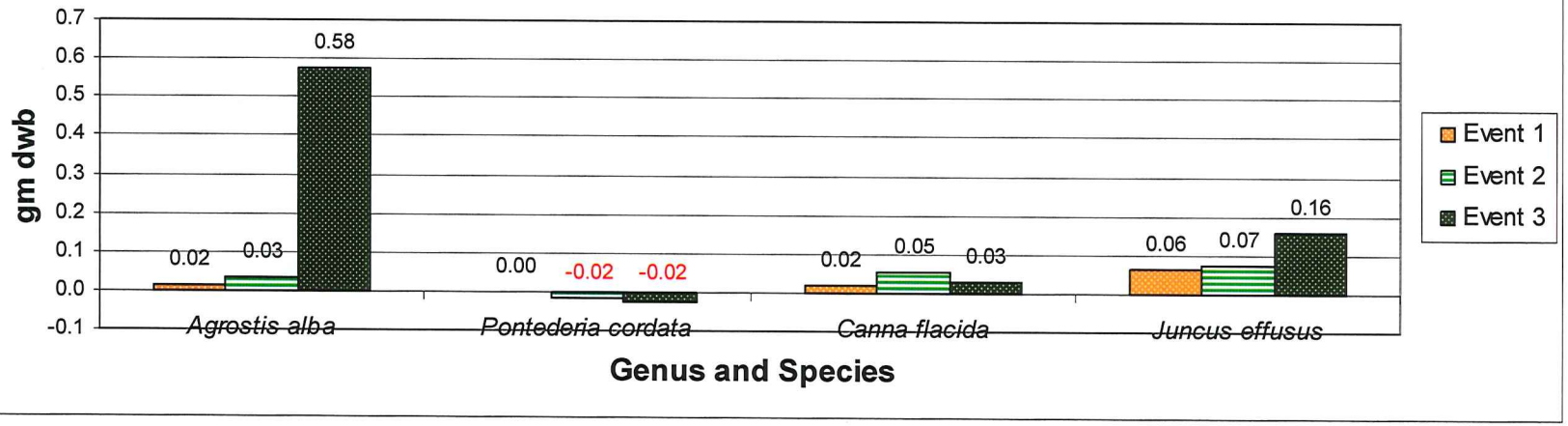
Juncus effusus continued to store the most nitrogen in its shoots on a per plant basis followed by *Canna flaccida* and *Agrostis alba* during the growth period between Sample Events 1 and 2. During the same growth period, both *Canna flaccida* and *Agrostis alba* shoot biomass on a per plant basis increased while the average shoot biomass of an average *Pontederia cordata* plant declined (see **Table 36** and **Figure 36**).

During the final growth period (Sample Event 2 and 3), Agrostis *alba shoots* displayed the highest levels of nitrogen storage on a per plant basis. *Juncus effusus* shoots stored the next most nitrogen on a per plant basis followed by *Canna flaccida*. During this growth period *Pontederia cordata* shoots showed a loss of nitrogen on a per plant basis. (see **Table 36** and **Figure 36**).

[6] Net loss means that the measured nitrogen levels (gm dwb) fell below the installed nitrogen levels (gm dwb).

Table 36: Total Nitrogen (gm dwb) Storage in Sample Mat Shoots on a per Plant Basis			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.016	0.032	0.576
Pontederia cordata	0.000	-0.016	-0.024
Canna flaccida	0.019	0.053	0.031
Juncus effusus	0.062	0.073	0.157

Figure 36: Total Nitrogen Storage in Sample Mat Shoots on a per Plant Basis



The results of the total phosphorous storage on a per plant basis in the nursery-grown plants installed on the Sample Mats on a per plant basis indicate that the general trend was an increase from growth period to growth period with the exception of *Pontederia cordata* that lost phosphorus between during the final growth period (Sample Events 2 and 3) and *Canna flaccida* that lost phosphorous during the first growth period (Baseline Event to Sample Event 1). During the growth period between Sample Events 1 and 2, the recruitment of *Ludwigia* spp. and Other Species roots and shoots began to contribute to measurable levels of phosphorous storage on a per plant basis. The growth and subsequent storage of phosphorous of these recruitment species on a per plant basis increased substantially during the final growth period[1] (see **Table 37** and **Figure 37**).

The data in **Tables 37** and **Figure 37** indicates that during the growth period between the Baseline and Sample Event 1, *Pontederia cordata* (roots plus shoots) displayed the highest phosphorous storage on a per plant basis followed by *Juncus effusus*, *Agrostis alba* and *Canna flaccida*. During the growth period between Sample Events 1 and 2, *Canna flaccida* had the highest accumulation of nitrogen on a per plant basis followed by *Pontederia cordata*, *Juncus effusus* and *Agrostis alba* (see **Table 37** and **Figure 37**).

During the final growth period between Sample Events 2 and 3, total phosphorous storage on a per plant basis in the roots plus shoots of *Agrostis alba*; *Canna flaccida* and *Juncus effusus* increased substantially. *Agrostis alba* had the highest total phosphorus content on a per plant basis, followed by *Canna flaccida*, and *Juncus effusus*. The total phosphorus storage of *Pontederia cordata* declined during this same time period due plant mortality, reduced biomass production and percent nitrogen assimilation (see **Table 37** and **Figure 37**).

In general, the roots of each species on a per plant basis displayed net storage of phosphorous. The per plant storage of phosphorous in the roots of the installed plant species installed on the Sample Mats increased from growth period to growth period with one exception. The exception was in *Pontederia cordata* roots that declined in the rate of phosphorous assimilation in *Pontederia cordata* roots on a per plant basis between the Event 2 through Event 3 growth period (see **Table 38** and **Figure 38**).

[1] The recruitment of *Ludwigia* spp. and Other Species phosphorus storage measurements from the Sample Mat was normalized to phosphorous storage on a per plant basis. Because the number of Sample Mat cells that these plants occurred on was not known, they were each normalized based on the total number Sample Mat cells (N=90)

Table 37: Total Phosphorous (gm dwb) Storage in Sample Mat Roots plus Shoots on a per Plant Basis			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.0027	0.0062	0.1011
Pontederia cordata	0.0070	0.0072	-0.0047
Canna flaccida	-0.0002	0.0144	0.0792
Juncus effusus	0.0037	0.0107	0.0217
Ludwigia spp.	----	0.0016	0.0069
Other Species	----	0.0001	0.0003

Figure 37: Total Phosphorous Storage in Sample Mat Roots and Shoots on a per Plant Basis

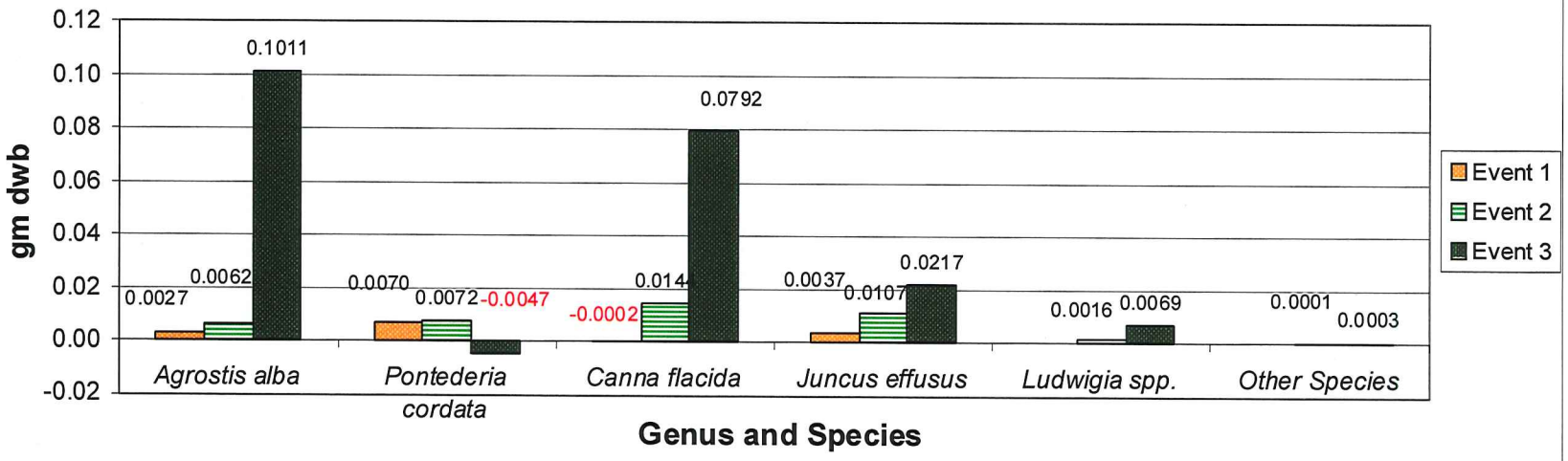
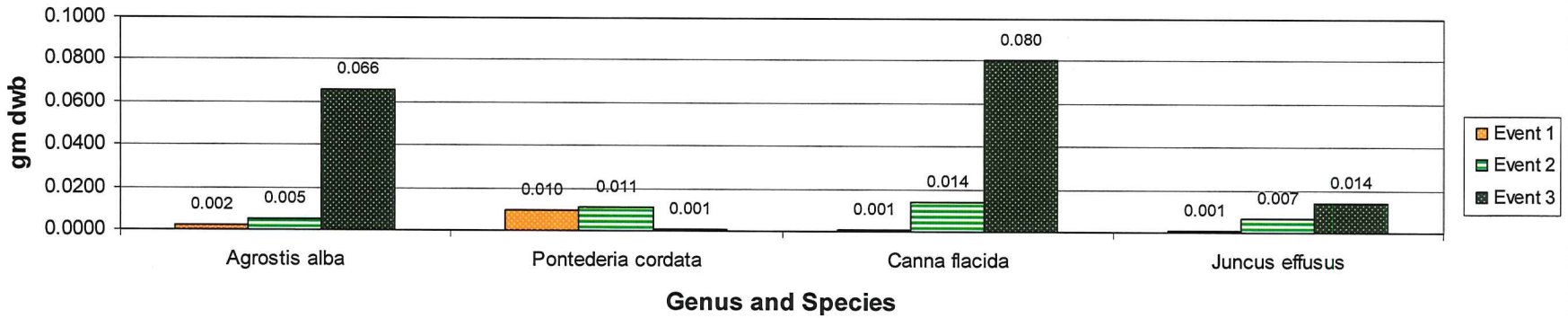


Table 38: Total Phosphorous (gm dwb) Storage in Sample Mat Roots on a per Plant Basis			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.0024	0.0051	0.0659
Pontederia cordata	0.0097	0.0110	0.0009
Canna flaccida	0.0010	0.0140	0.0800
Juncus effusus	0.0010	0.0066	0.0139

Figure 38: Total Phosphorous Storage in Sample Mat Roots on a per Plant Basis



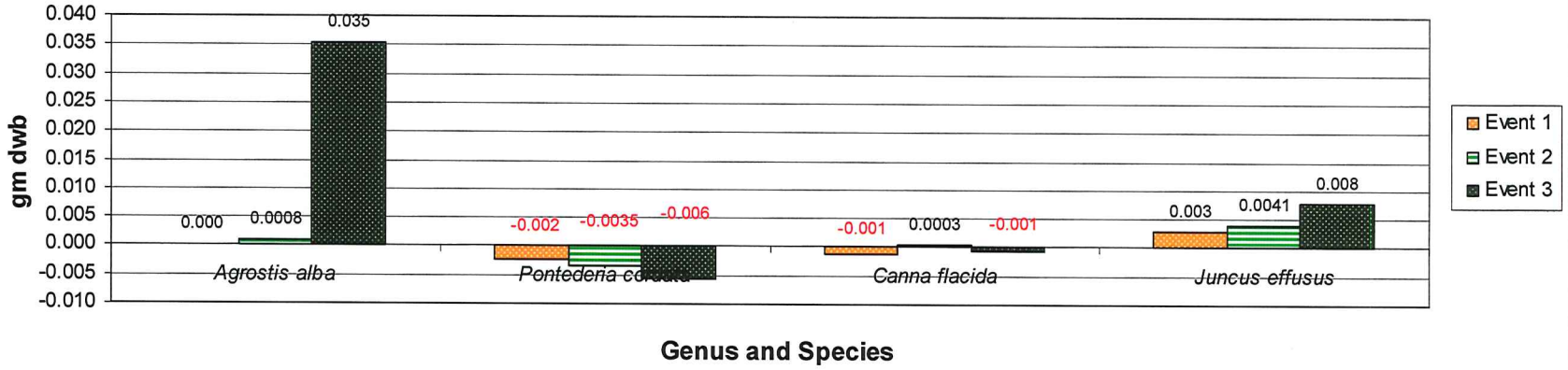
Pontederia cordata had the highest storage of phosphorous in its roots on a per plant basis between the Baseline to Event 1 growth period followed by *Agrostis alba* and *Canna flaccida* and *Juncus effusus* which displayed the same storage of phosphorous during this growth period (see **Table 38** and **Figure 38**). Between Events 1 and 2, the storage of nitrogen in roots (on a per plant basis) was highest in *Pontederia cordata* followed by *Canna flaccida*, *Agrostis alba*, and *Juncus effusus*. *Canna flaccida* had the highest phosphorus storage in roots on a per plant basis during the final growth periods followed by:*Agrostis alba*, *Juncus effusus*, and *Pontederia cordata* (see **Table 38** and **Figure 38**).

On a per plant basis, *Pontederia cordata* shoots had a net loss of phosphorous storage during the each of the three growth periods measured. The phosphorous storage in the shoots of *Agrostis alba* and *Juncus effusus* on a per species basis increased successively during each growth period. *Canna flaccida* shoots had a net loss of phosphorous on a per species basis measured during Sampling Events 1 and 3 and showed modest phosphorous storage for the grow period between Sample Event 1 and 2 (see **Table 39** and **Figure 39**).

Between the Baseline and Sample Event 1 growth period, phosphorous storage on a per plant basis was the highest in *Juncus effusus* shoots followed by *Agrostis alba*. (see **Table 39** and **Figure 39**). *Juncus effusus* continued to store the most nitrogen in its shoots on a per plant basis followed *Agrostis alba* and *Canna flaccida* during the growth period between Sample Events 1 and 2 (see **Table 39** and **Figure 39**). During the final growth period, *Agrostis alba* had the highest phosphorous storage on a per plant basis followed by *Juncus effusus* (see **Table 39** and **Figure 39**).

Table 39: Phosphorous (gm dwb) Storage in Sample Mat Shoots on a per Plant Basis			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.0002	0.0008	0.0352
Pontederia cordata	-0.0025	-0.0035	-0.0056
Canna flaccida	-0.0012	0.0003	-0.0008
Juncus effusus	0.0028	0.0041	0.0078

Figure 39: Total Phosphorous Storage in Sample Mat Shoots on a per Plant Basis



4.2 Estimated Biomass Production and Nitrogen and Phosphorous Storage on Existing Mats

The values for the root, shoot and total (root plus shoot) biomass storage on per plant basis for each Sampling Event were used to estimate the root and shoot biomass on each of the three (3) Existing Mats. Specifically, the quantity of each of the nursery grown species planted on the Existing Mat were multiplied by the corresponding average biomass production on a per plant basis. The estimate of the Existing Mats biomass production (roots plus shoots) during each Sample Event are presented in **Tables 40**, **41** and **42** and paired **Figures 40**, **41** and **42**.

Based on the results of the nitrogen storage of the planted and recruitment species on the Sample Mat normalized to storage on a per plant basis, the stored nitrogen on the Existing Mats was estimated for each of the three (3) growth periods. **Table 43** and **Figure 43** present the results of the estimated storage of total nitrogen (roots plus shoots) on the Existing Mats during Sample Events 1, 2 and 3. **Table 44** and **Figure 44** present the results of the storage of nitrogen in the roots and **Table 45** and **Figure 45** present the results of the storage of nitrogen in the roots of the plants on the Existing Mats during Sample Events 1, 2 and 3.

Based on the results of the phosphorous storage of the planted and recruitment species on the Sample Mat normalized to storage on a per plant basis, the stored phosphorous on the Existing Mats was estimated for each of the three (3) growth periods. **Table 46** and **Figure 46** present the results of the estimated storage of total phosphorous (roots plus shoots) on a per species basis during Sample Events 1, 2 and 3. **Table 47** and **Figure 47** present the results of the storage of phosphorous in the roots and **Table 48** and **Figure 48** present the results of the storage of phosphorous in the roots of the Existing Mats during Sample Events 1, 2 and 3.

Table 49 and **Figure 49** present the results of the combined estimated storage of total nitrogen (roots plus shoots) for all three Existing Mats during Sample Events 1, 2 and 3. **Table 50** and **Figure 50** present the results of the combined storage of nitrogen in the roots and **Table 51** and **Figure 51** present the results of the combined storage of nitrogen in the roots of the plants on the Existing Mats during Sample Events 1, 2 and 3.

Table 52 and **Figure 52** present the results of the combined estimated storage of total phosphorous (roots plus shoots) for all three Existing Mats during Sample Events 1, 2 and 3. **Table 53** and **Figure 53** present the results of the combined storage of phosphorous in the roots and **Table 54** and **Figure 54** present the results of the combined storage of phosphorous in the roots of the plants on the Existing Mats during Sample Events 1, 2 and 3.

Table 40: Estimated Root Plus Shoot Biomass (gm dwb) Storage on Existing Mat			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	2,074.0	4,546.5	41,862.4
Pontederia cordata	8,678.7	9,033.9	1,249.0
Canna flaccida	813.5	7,307.5	11,053.5
Juncus effusus	3,185.9	8,360.9	13,627.5
Ludwigia spp.	----	1,745.0	7,919.3
Other spp.	----	203.6	565.3
Total	**14,752.1**	**31,197.5**	**76,276.9**

Figure 40: Estimated Root and Shoot Biomass Storage on Existing Mat

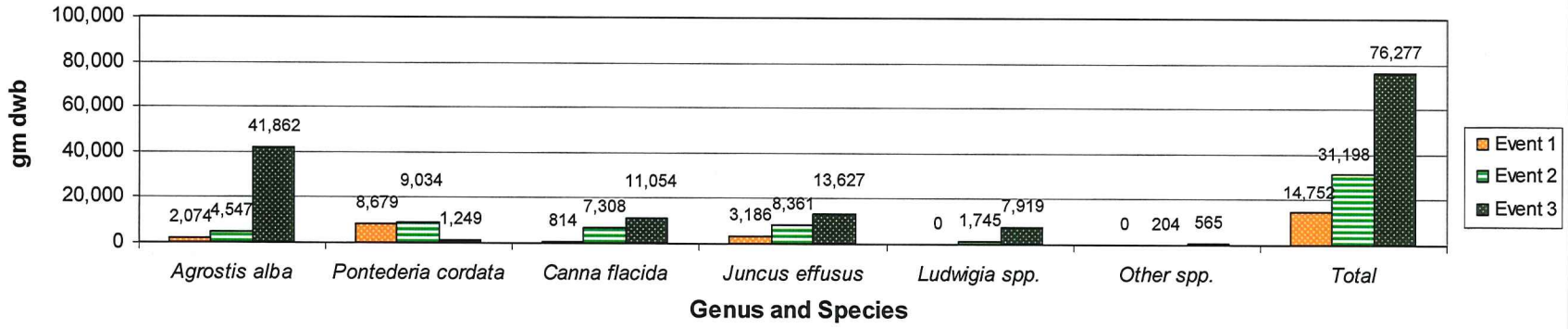


Table 41: Estimated Storage of Root Biomass (gm dwb) on Existing Mat			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	1,545.9	3,793.4	30,532.5
Pontederia cordata	7,889.2	8,903.1	1,823.0
Canna *flaccida*	541.1	6,633.1	10,777.1
Juncus effusus	891.3	4,179.8	6,151.6
Total	**10,867.5**	**23,509.3**	**49,284.2**

Figure 41: Estimated Storage of Root Biomass on Existing Mat

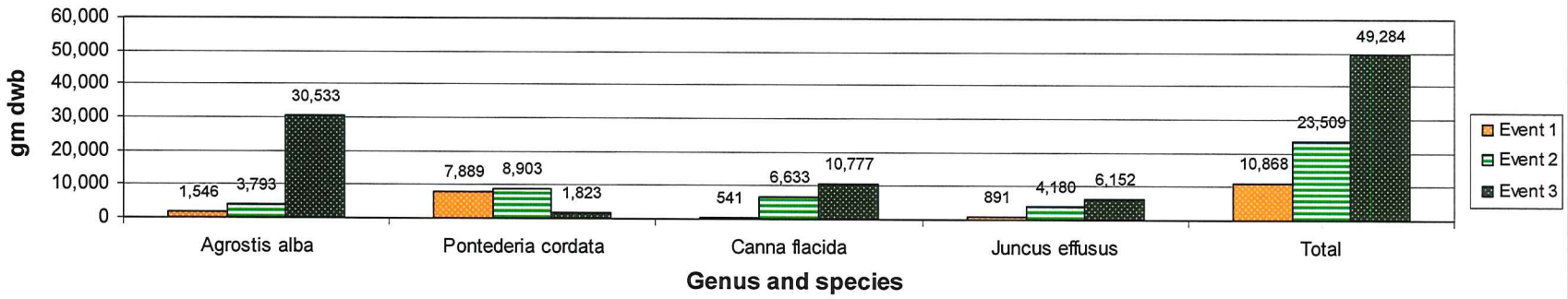


Table 42: Estimated Storage of Shoot Biomass (gm dwb) on Existing Mat			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	528.1	753.2	11,329.9
Pontederia cordata	789.4	130.8	-48.2
Canna *flaccida*	272.4	674.4	276.4
Juncus effusus	2,294.6	4,181.2	7,475.9
Total	**3,884.6**	**5,739.5**	**19,034.0**

Figure 42: Estimated Storage of Shoot Biomass on Existing Mat

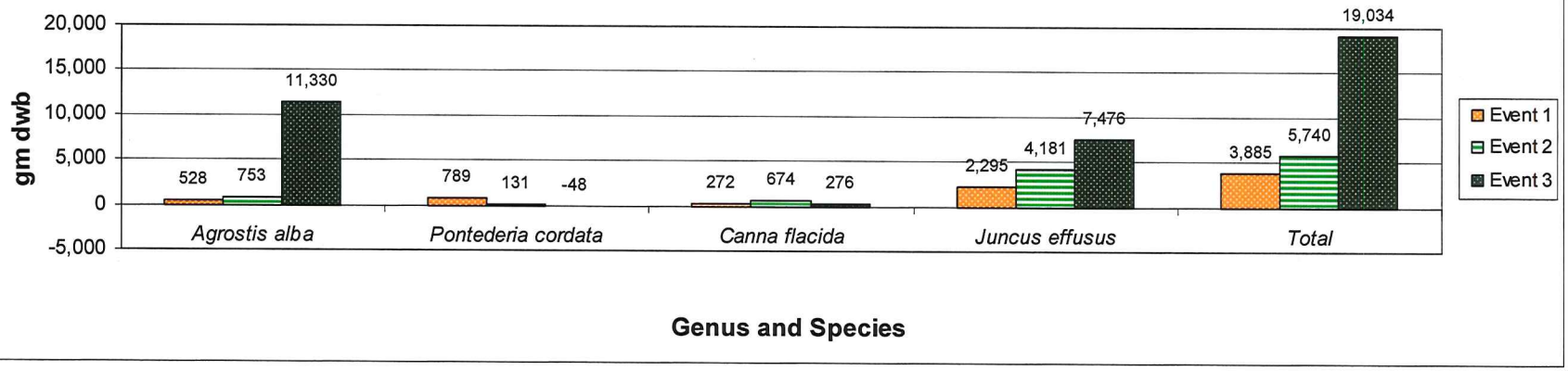


Table 43: Estimated Total Nitrogen (gm dwb) Storage on Existing Mat Roots Plus Shoots			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	34.4	62.9	698.8
Pontederia cordata	49.6	104.5	36.9
Canna flaccida	12.2	55.7	248.6
Juncus effusus	45.0	88.8	173.1
Ludwigia spp.	----	26.9	126.4
Other Species	----	2.6	9.2
Total	**141.2**	**341.3**	**1,292.9**

Figure 43: Estimated Total Nitrogen Storage on Existing Mat Roots and Shoots

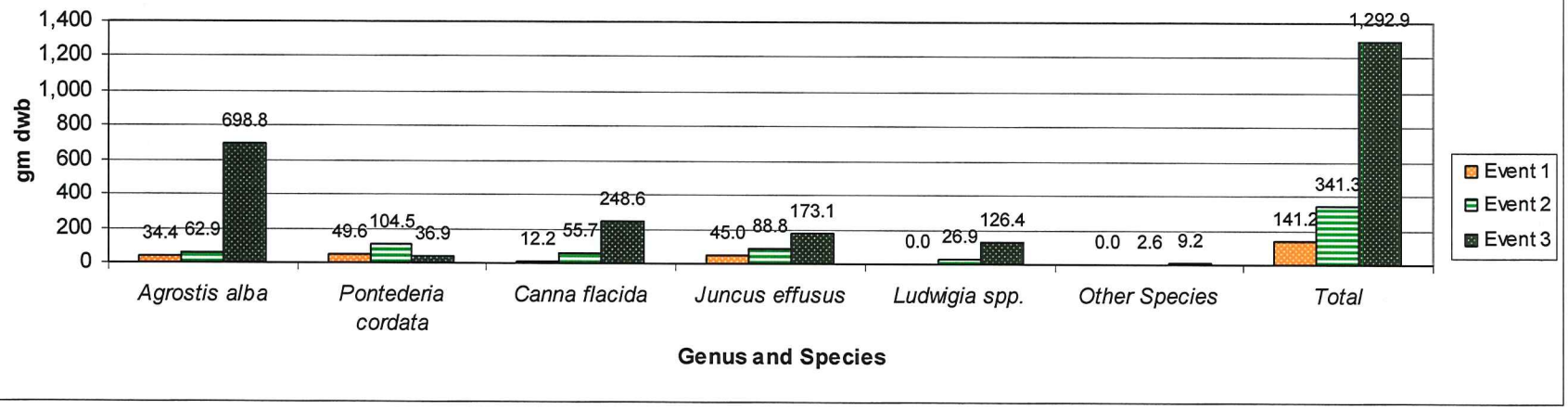


Table 44: Estimated Total Nitrogen (gm dwb) Storage in Existing Mats Roots			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	27.0	48.0	433.7
Pontederia cordata	49.6	110.4	45.9
Canna flaccida	8.4	45.1	242.4
Juncus effusus	12.9	50.7	91.2
Total	**98.0**	**254.2**	**813.2**

Figure 44: Estimated Total Nitrogen Storage in Existing Mats Roots

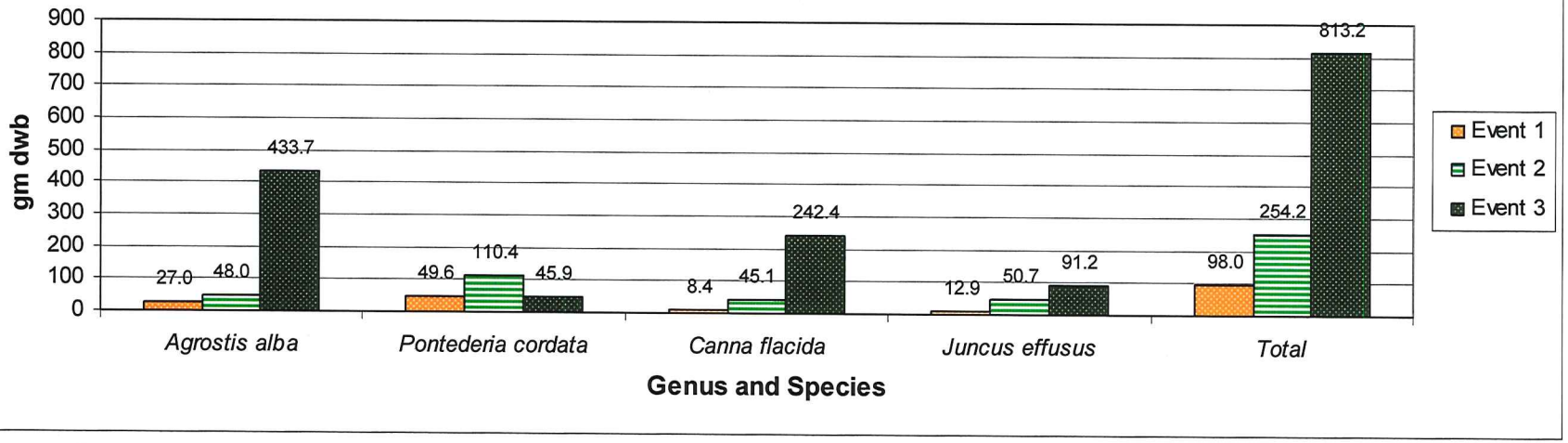


Table 45: Estimated Total Nitrogen (gm dwb) Storage in Existing Mat Shoots			
Genus/ Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	7.39	14.90	265.06
Pontederia cordata	0.02	-5.92	-9.04
Canna flaccida	3.77	10.59	6.23
Juncus effusus	32.04	38.09	81.88
Total	**43.21**	**57.67**	**344.13**

Figure 45: Estimated Total Nitrogen Storage in Existing Mat Shoots

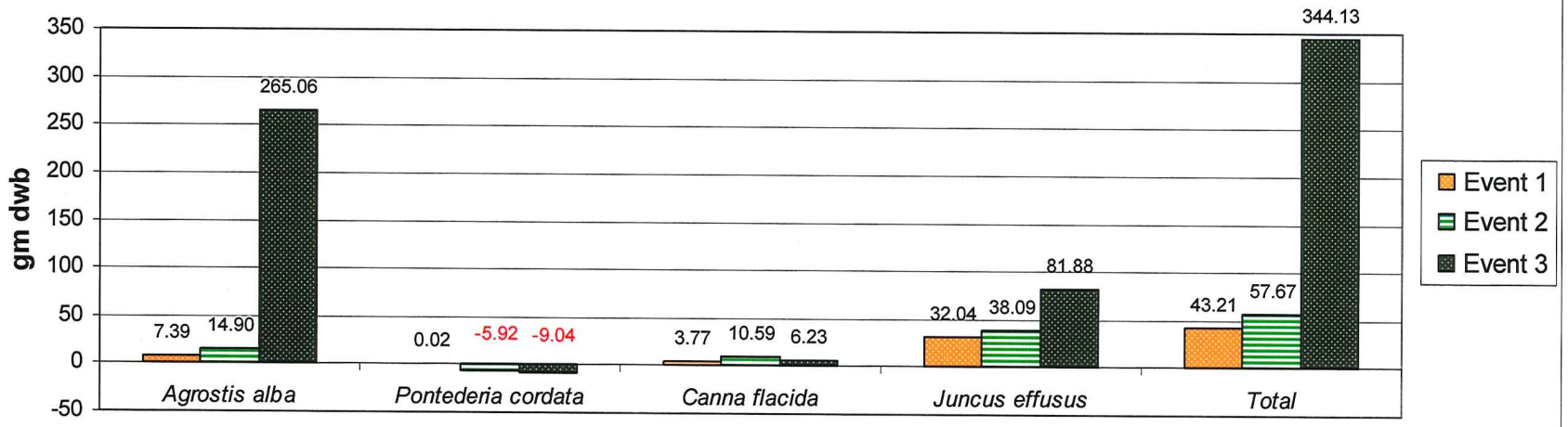


Table 46: Estimated Total Phosphorous (gm dwb) Storage in Existing Mats Roots Plus Shoots			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	1.24	2.83	46.52
Pontederia cordata	2.65	2.75	-1.78
Canna flaccida	-0.03	2.87	15.84
Juncus effusus	1.94	5.54	11.27
Ludwigia spp.	----	2.43	10.75
Other Species	----	0.14	0.52
Total	**5.81**	**16.56**	**83.11**

Figure 46: Estimated Total Phosphorous Storage in Existing Mats Roots and Shoots

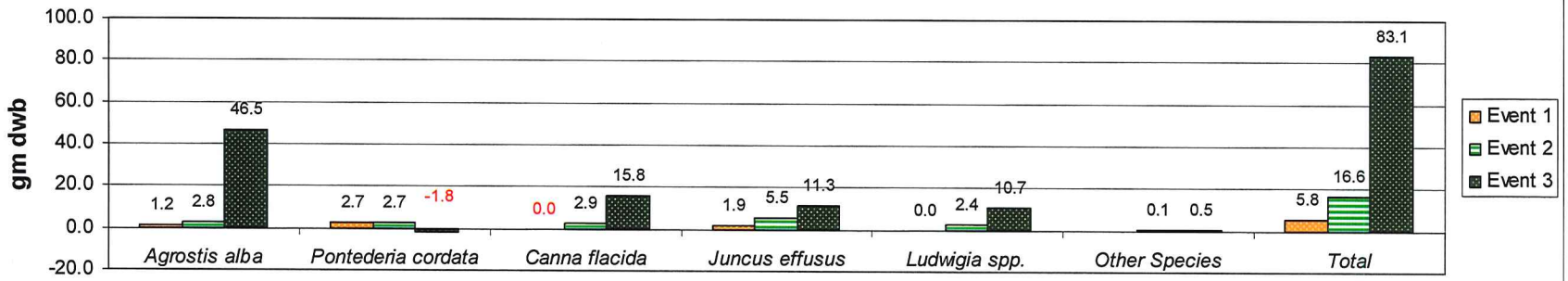


Table 47: Estimated Total Phosphorous (gm dwb) Storage in Existing Mats Roots			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	1.09	2.35	30.31
Pontederia cordata	3.69	4.19	0.35
Canna flaccida	0.20	2.81	16.00
Juncus effusus	0.50	3.43	7.23
Total	**5.47**	**12.78**	**53.88**

Figure 47: Estimated Total Phosphorous Storage in Existing Mats Roots

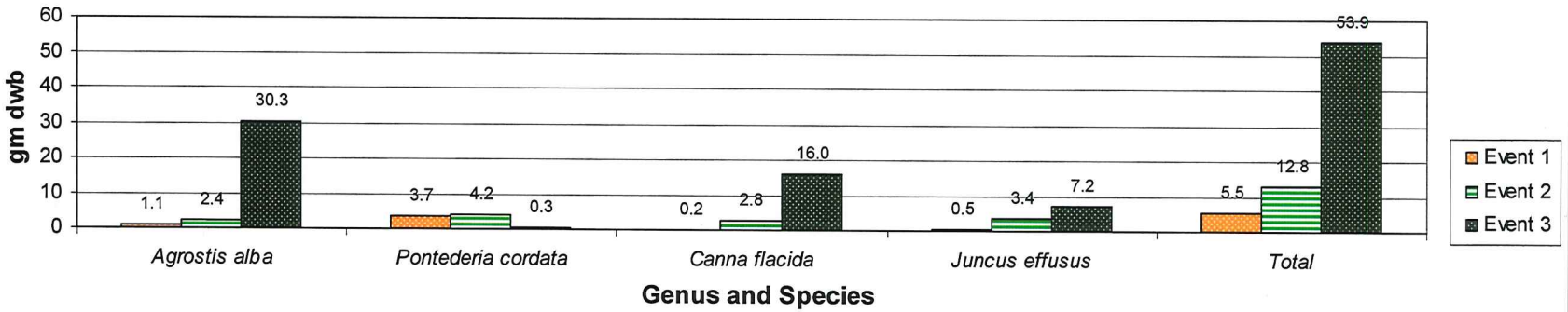


Table 48: Estimated Total Phosphorous (gm dwb) Storage in Existing Mats Shoots			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.11	0.38	16.21
Pontederia cordata	-0.93	-1.34	-2.13
Canna flaccida	-0.24	0.06	-0.16
Juncus effusus	1.45	2.12	4.04
Total	**0.38**	**1.21**	**17.96**

Figure 48: Estimated Total Phosphorous Storage in Existing Mats Shoots

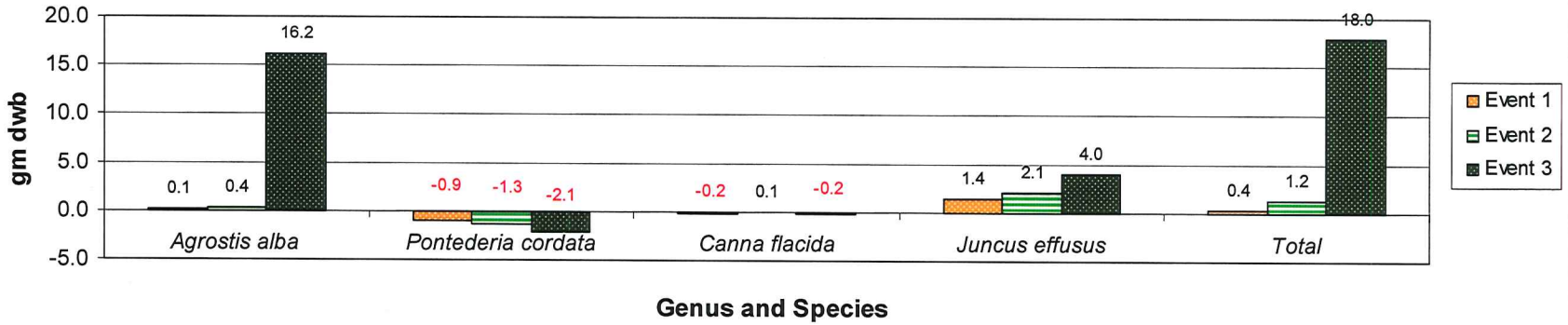


Table 49: Estimated Total Nitrogen (gm dwb) Storage in Existing Mat Roots Plus Shoots (Mat x 3)			
	Event 1	**Event 2**	**Event 3**
Agrostis alba	103.3	188.6	2,096.3
Pontederia cordata	148.8	313.4	110.7
Canna flaccida	36.6	167.2	745.8
Juncus effusus	134.9	266.5	519.2
Ludwigia spp.	----	80.6	379.1
Other Species	----	7.7	27.7
Total	**423.6**	**1,023.9**	**3,878.8**

Figure 49: Estimated Total Nitrogen Storage on Existing Mat Roots and Shoots (Mat x 3)

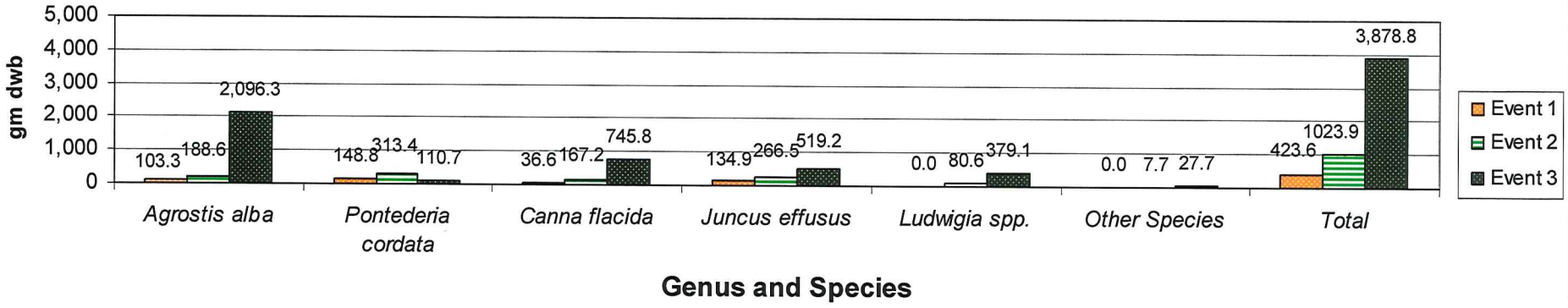


Table 50: Estimated Total Nitrogen (gm dwb) Storage in Existing Mats Roots (Mat x 3)			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	81.1	143.9	1,301.1
Pontederia cordata	148.7	331.2	137.8
Canna flaccida	25.3	135.4	727.2
Juncus effusus	38.8	152.2	273.6
Total	**294.0**	**762.7**	**2,439.6**

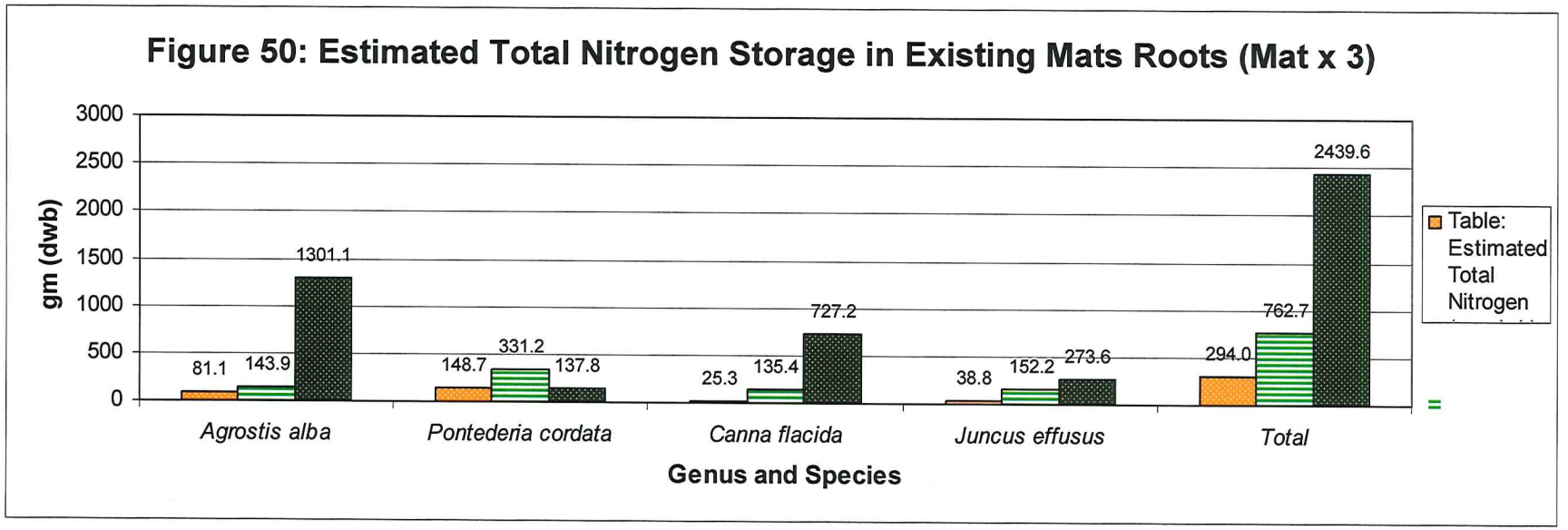


Table 51: Estimated Total Nitrogen (gm dwb) Storage in Existing Mat Shoots (Mat x 3)			
	Event 1	**Event 2**	**Event 3**
Agrostis alba	22.16	44.71	795.19
Pontederia cordata	0.06	-17.75	-27.12
Canna *flaccida*	11.31	31.76	18.68
Juncus effusus	96.11	114.27	245.64
Total	**129.63**	**173.00**	**1,032.39**

Figure 51: Estimated Total Nitrogen Storage in Existing Mat Shoots (Mat x 3)

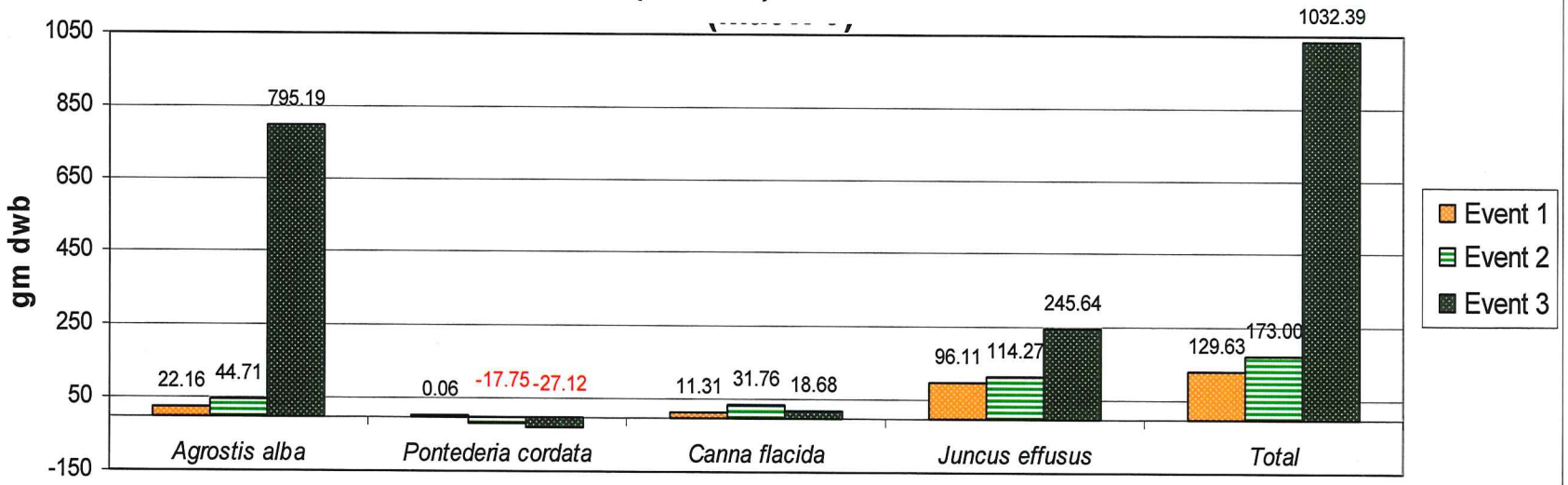


Table 52: Estimated Total Phosphorous (gm dwb) Storage in Existing Mats Roots Plus Shoots (Mat x 3)			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	3.73	8.50	139.55
Pontederia cordata	7.96	8.24	-5.35
Canna flaccida	-0.10	8.62	47.52
Juncus effusus	5.83	16.63	33.82
Ludwigia spp.	----	7.28	32.24
Other Species	----	0.42	1.56
Total	**17.42**	**49.27**	**247.78**

Figure 52: Estimated Total Phosphorous Storage in Existing Mats Roots and Shoots (Mat x 3)

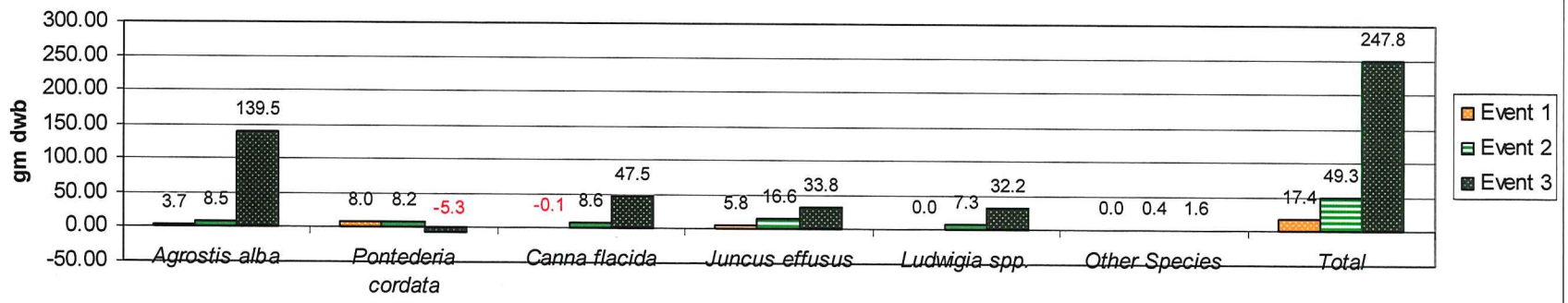


Table 53: Estimated Total Phosphorous (gm dwb) Storage in Existing Mats Roots (Mat x 3)			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	3.27	7.06	90.92
Pontederia cordata	11.06	12.58	1.04
Canna flaccida	0.61	8.42	47.99
Juncus effusus	1.49	10.28	21.70
Total	**16.42**	**38.35**	**161.65**

Figure 53: Estimated Total Phosphorous Storage in Existing Mats Roots (Mat x 3)

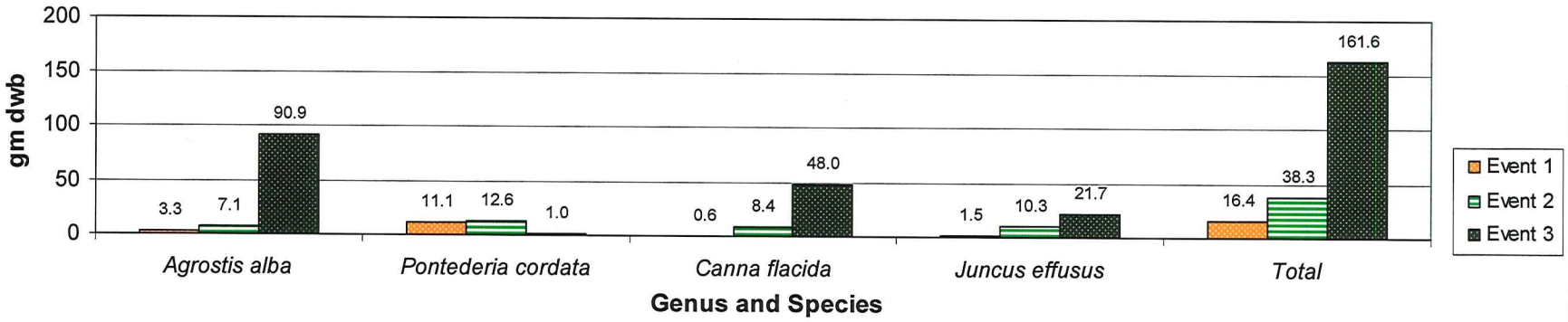
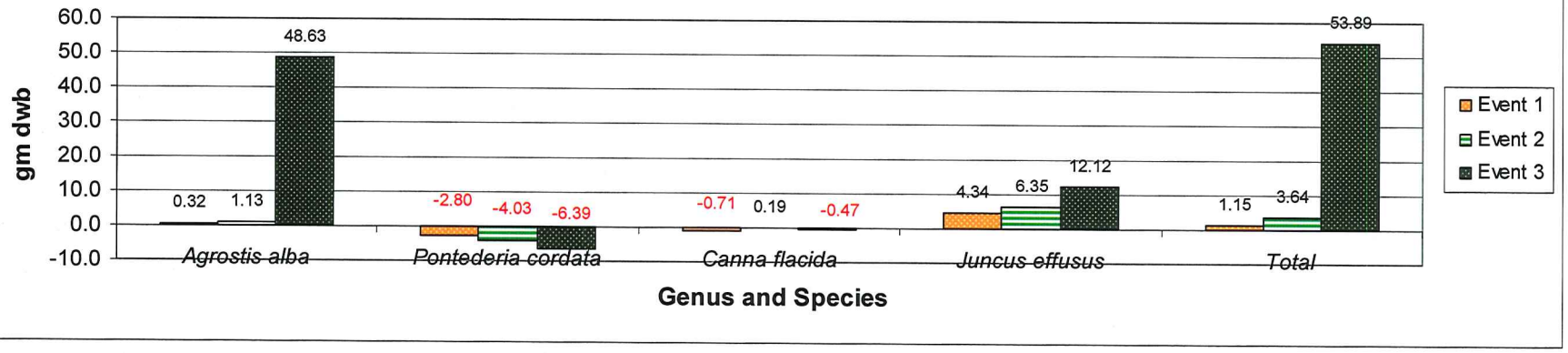


Table 54: Estimated Total Phosphorous (gm dwb) Storage in Existing Mats Shoots (Mat x 3)			
Genus Species	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.32	1.13	48.63
Pontederia cordata	-2.80	-4.03	-6.39
Canna flaccida	-0.71	0.19	-0.47
Juncus effusus	4.34	6.35	12.12
Total	**1.15**	**3.64**	**53.89**

Figure 54: Estimated Total Phosphorous Storage in Existing Mats Shoots (Mat x 3)



4.3 Management Considerations

The results of this study provide some insight into the future management considerations for the use of the vegetated floating mats for nitrogen and phosphorous sequestration and removal. This section discusses these management considerations from two perspectives including: 1) the net nitrogen and phosphorous storage in the roots and shoots of the installed and recruited plant species on the Existing Mats during the growing period analyzed; and, 2) the unit cost of the storage of both nitrogen and phosphorous in the roots and shoots of the installed and recruited plant species on the Existing Mats during the growing period analyzed.

The storage of total nitrogen (roots plus shoots) in the nursery grown plant species on a per plant basis installed on the Existing Mat(s) and Sample Mat(s) increased steadily at variable rates (on a per plant basis) during the growth period analyzed with one exception. The exception was *Pontederia cordata* that had a net storage of total nitrogen (roots plus shoots) between the Baseline through Sample Event 2 but a significant decline between Sample Events 2 and 3 growth period. Ludwigia spp. that recruited during the growth period between Sample Event 1 through 3 stored more nitrogen per plant than *Pontederia cordata* (see **Figure 55**).

Agrostis alba stored the highest amount of nitrogen on a per plant basis followed by *Canna flaccida*, *Juncus effusus*, and *Pontederia cordata*. In fact, *Agrostis alba* on a per plant basis stored more nitrogen than the other planted and recruited species combined. The management implication for the storage of nitrogen under water quality conditions similar to Mullock Creek is to maximize the use of *Agrostis alba* on future floating mat installations. Both *Canna flaccida* and *Juncus effusus*, in that order, which also stored significant amounts of total nitrogen, could be used efficiently as supplemental plantings depending on the project objectives.

The storage of total phosphorous (roots plus shoots) in *Agrostis alba*, *Canna flaccida* and *Juncus effusus* increased steadily at variable rates during the growth period. The storage of total phosphorous in *Pontederia cordata* on a per plant basis increased from the Baseline through Sample Event 2 growth period, but declined significantly during the final growth period. Similar to the nitrogen storage, *Agrostis alba* nearly stored more phosphorous than all the other installed and recruited species combined. The management implications of these results if managing the vegetated floating mats for total phosphorous storage is to maximize the use of *Agrostis alba* followed by *Canna flaccida* and *Juncus effusus* (see **Figure 56**).

Figure 55: Growing Period (May through October 2009) Total (Root and Shoot) Biomass Production and Nitrogen Storage on a per Plant Basis

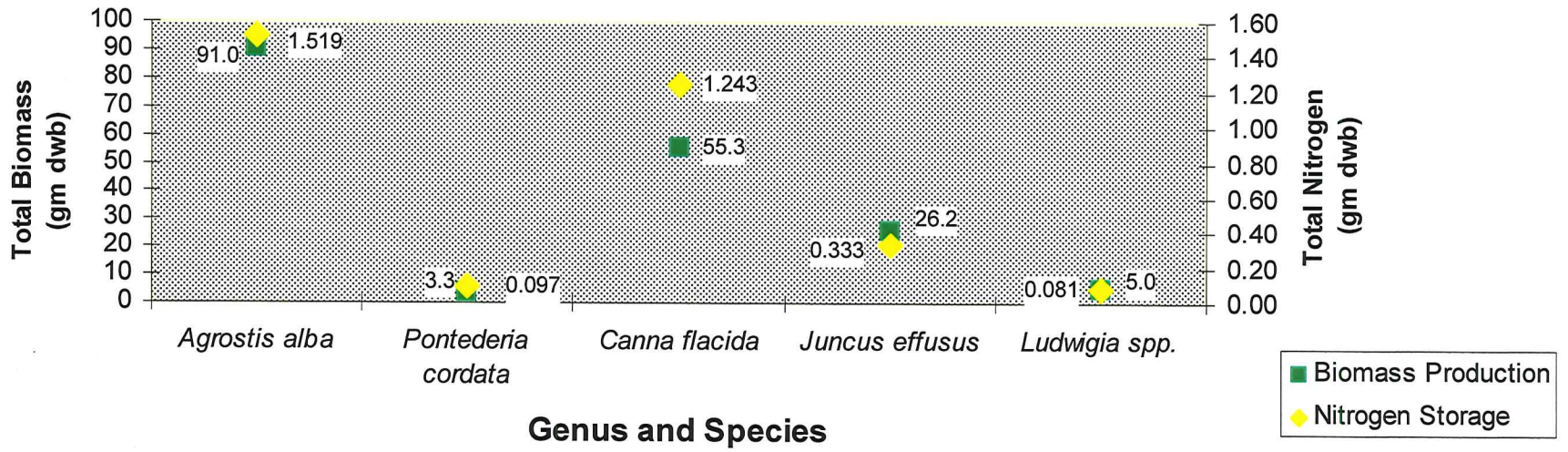
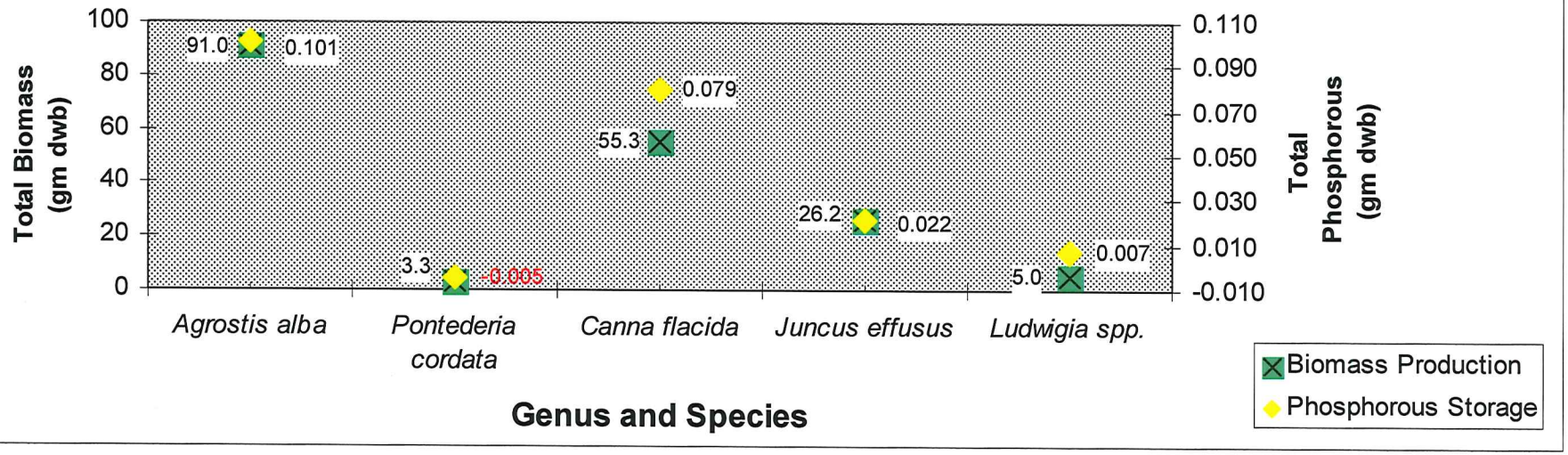


Figure 56: Growing Period (May through October 2009) Total (Root and Shoot) Biomass Production and Phosphorous Storage on a per Plant Basis



The sampling data for total nitrogen and phosphorous storage (roots plus shoots) during the growth period analyzed (May through October) generally support that the harvest of the plant material from the Existing Mats should occur near the end of a typical Lee County growing season due to the overall increase of stored phosphorous and nitrogen from Sample Event to Sample Event. The exact timing of the fall harvest is likely to vary from year to year depending on local conditions (e.g., heavy frost or possible freezes) and other management decisions.

The sample data of shoot growth during the growth period analyzed do not support the harvesting a crop of shoots of any of the species installed on the Existing Mat for several reasons[1]. Both *Agrostis alba* and *Juncus effusus* steadily increased in the amount of stored nitrogen and phosphorous in its shoots on a per plant basis during each of the three (3) growth periods measured. *Canna flaccida* shoots had successive increases in stored nitrogen and phosphorous between the Baseline through Sample Event 2 growth period and showed a slight decline between Sample Event 2 through 3 but not appreciable enough to warrant harvesting. *Pontederia cordata* shoots on a per plant basis show virtually no increase in stored nitrogen or phosphorous analyzed during the growth period analyzed.

Nearly all management decisions or practices strive to maximize the cost to benefit. In this study, the cost was considered to be the unit cost of the installation of each of the nursery-grown plants (plant plus installation) verses the nitrogen and phosphorous stored on a per plant basis. Because the price per installed plant was the same for each of the species ($0.60), the species that stored the most nitrogen and phosphorous on a per plant basis were obviously the most cost effective.

Based on the total nitrogen storage on a per plant basis and the cost of each plant, *Agrostis alba* cost $0.39 per gram of nitrogen stored on a dry weight basis, followed by *Canna flaccida* at $0.48 per gram, *Juncus effusus* at $1.80 per gram and *Pontederia cordata* at $6.18 per gram (see **Table 55**). Phosphorous storage on a per gram basis was most cost effective with *Agrostis alba* costing $5.93 per gram followed by *Canna flaccida* at $7.58 and *Juncus effusus* at $27.68 per gram (see **Table 56**).

Several scenarios of future planting configurations on the Existing Mats were evaluated based on the known cost and storage of both nitrogen and phosphorous on a per plant basis. **Tables 57** and **58** present the estimated total cost per gram of nitrogen and phosphorous storage if planting the Existing Mats with a 50 percent mix of *Canna flaccida* and *Agrostis alba* which had the highest storage of phosphorous and nitrogen on a per plant basis. **Tables 59** and **60** present the estimated total cost per gram of nitrogen and phosphorous storage when planting the Existing Mats with an equal mixture of *Agrostis alba*, *Canna flaccida* and *Juncus effuses,* species that each stored

[1] Harvesting of a "crop of shoots" refers to the removal of shoots and consequently nitrogen from species on the Existing Mat during the growing season expecting comparable shoot re-growth and storage of nitrogen during the same growing season.

appreciable amounts of both nitrogen and phosphorous storage on a per species basis. Based on the results of this study, both scenarios outlined above reveal that substantially greater amounts of nitrogen and phosphorous can be stored on the Existing Mats in a more cost effective manner.

Table 55: Estimated Cost of Total Nitrogen Storage on Existing Mat					
Genus / Species	**# Plants/ Mat**	**Plant Cost**	**Total Nitrogen Storage (gm dwb)**	**Cost per gm (dwb)**	**Cost per pound (dwb)**
Agrostis alba	460	$276.00	698.76	$0.39	$176.90
Pontederia cordata	380	$228.00	36.90	$6.18	$2,803.19
Canna flaccida	200	$120.00	248.61	$0.48	$217.72
Juncus effusus	520	$312.00	173.07	$1.80	$816.46
Totals =	**1,560**	**$936.00**	**1,157.3**	**$0.81**	**$367.41**

Table 56: Estimated Cost of Total Phosphorous Storage on Existing Mat					
Genus / Species	**# Plants/ Mat**	**Plant Cost**	**Total Phosphorous Storage (gm dwb)**	**Cost per gm (dwb)**	**Cost per pound (dwb)**
Agrostis alba	460	$276.00	46.51	$5.93	$2,689.79
Pontederia cordata	380	$228.00	NA	NA	NA
Canna flaccida	200	$120.00	15.84	$7.58	$3,438.21
Juncus effusus	520	$312.00	11.27	$27.68	$12,555.37
Totals =	**1,560**	**$936.00**	**73.62**	**$12.71**	**$5,765.13**

Table 57: Estimated Cost of Total Nitrogen Storage on Existing Mat with 50 percent Distribution of the Species with Highest Nitrogen Storage					
Genus / Species	**# Plants/ Mat**	**Plant Cost**	**Total Nitrogen Storage (gm dwb)**	**Cost per gm (dwb)**	**Cost per pound (dwb)**
Agrostis alba	780	$468.00	1,184.8	$0.39	$176.90
Canna flaccida	780	$468.00	969.54	$0.48	$217.72
Totals	**1,560**	**$936.00**	**2,154.4**	**$0.43**	**$195.03**

Table 58: Estimated Cost of Total Phosphorous Storage on Existing Mat with 50 percent Distribution of Species with Highest Phosphorous Storage					
Genus / Species	**# Plants/ Mat**	**Plant Cost**	**Total Phosphorous Storage (gm dwb)**	**Cost per gm (dwb)**	**Cost per pound (dwb)**
Agrostis alba	780	$468.00	78.9	$5.93	$2,689.79
Canna flaccida	780	$468.00	61.78	$7.58	$3,438.21
Totals	**1,560**	**$936.00**	**140.7**	**$6.65**	**$3,016.37**

Table 59: Estimated Cost of Total Nitrogen Storage on Existing Mat Maximized for Planted Species Diversity					
Genus / Species	**# Plants/ Mat**	**Plant Cost**	**Total Nitrogen Storage (gm dwb)**	**Cost per gm (dwb)**	**Cost per pound (dwb)**
Agrostis alba	520	$312.00	789.88	$0.39	$176.90
Canna flaccida	520	$312.00	646.36	$0.48	$217.72
Juncus effusus	520	$312.00	173.16	$1.80	$816.46
Totals	**1,560**	**$936.00**	**1,436.24**	**$0.65**	**$651,464.10**

Table 60: Estimated Cost of Total Phosphorous Storage on Existing Mat Maximized for Planted Species Diversity					
Genus / Species	**# Plants/ Mat**	**Plant Cost**	**Total Phosphorous Storage (gm dwb)**	**Cost per gm (dwb)**	**Cost per pound (dwb)**
Agrostis alba	520	$588.00	52.58	$11.18	$5,071.14
Canna flaccida	520	$228.00	41.18	$5.54	$2,512.89
Juncus effusus	520	$120.00	11.27	$10.65	$4,830.73
Totals	**1,560**	**$816.00**	**105.04**	**$7.77**	**$3,524.39**

Another way of considering the management implication and future deployment of the mats as a management practice is to relate the storage of nitrogen and phosphorus on the Existing Mats as gallons of water treated at prescribed nitrogen and phosphorus reduction target levels. As an example, the examination of stored nitrogen on the Existing Mats (N=3) was estimated to be 3,878.8 grams that on a parts per million basis is equivalent to 3.9 million mg for a one liter volume.

The levels of inorganic nitrogen (i.e., plant available nitrogen) analyzed between May and November, 2009 ranged from <0.076 mg/L in May to a high of 0.695 mg/L in August. Using a treatment reduction goal of 0.25 mg/L and the aforementioned storage of nitrogen on the Sample Mats during the growth period analyzed, the equivalent volume of water treated at this rate of plant uptake would be equivalent to 15.5 million liters or 4.1 million gallons. Based on the cost analysis results of **Table 55**, the cost treatment at the 0.25 mg/L rate is 0.08 cents per gallon or 0.02 cents per liter.

4.4 Additional Considerations

The results of this study clearly show that additional considerations with regards to providing recommendations for the implementation of vegetated floating mats for the sequestration of nutrient under a wide range of water quality conditions is needed. This study explored the effectiveness of the use of vegetated floating mats for the storage of nitrogen and phosphorous under a specific set of conditions. These conditions include a specific palate of plants located in a waterbody that has water quality better than the mean of all waterbodies in the state of Florida. While this study provides insight and useful information with regard to the future use of the vegetated floating mats for nutrient sequestration in Lee County waterbodies, some recommended further studies that would aid in the understanding of the best methods for the implementation of the mats include:

- A bench or field study of the nutrient storage capabilities of plant species under variable nutrient levels ranging from low levels of nutrients to high levels of nutrients.
- Analysis of the contribution of bio-film associated with the roots of plants installed on floating mats in the storage of nutrients.
- Exploration of the best practices for the beneficial use of harvested biomass from the floating mats (compositing, etc.).
- Study of complimentary practices such as waterbody aeration or denitrification walls or zones that may maximize the effectiveness of nutrient storage of the plants installed on the mats.
- Effects of selective harvesting on biomass production and nutrient uptake.

5.0 CONCLUSIONS

The objective of this study was to document the effectiveness of the floating plant mats in sequestering nutrients from a structurally controlled portion of Mulloch Creek Creek during a typical Lee County growing season (May through October, 2009). The design of this study included the installation of three 6-ft X 6-ft planted floating sample mats paired with the replanting of each of the 22-ft by 20-ft Existing mats. Baseline conditions were established and sampling for roots and shoots biomass was conducted during Sample Events 1, 2 and 3 where a single sample mat was pulled, roots and shoots weighed and triplicate samples analyzed for total nitrogen and phosphorous.

Water quality monitoring was also conducted on a monthly basis beginning in May 2009 through November 2009 to document the concentrations of both organic and inorganic forms of nitrogen and phosphorous at two (2) upgradient and one downgradient locations. While these results did not display trends in nitrogen and phosphorous reduction from the upgradient to downgradient sample location, they did show that the water quality in the creek measured by nitrogen and phosphorous concentrations was below the values that are typical of such water quality parameters for Florida's lakes and streams. In addition, the water quality monitoring showed that the inorganic fraction of the total nitrogen and ortho-phosphate that are the plant available forms of these nutrients occurred at relatively low levels, particularly from a plant nutrient standpoint.

The storage of total nitrogen (roots and shoots) of both the planted and recruited species on the Sample Mat varied by the rate, amount, and location (i.e., roots or shoots) of the storage. The general trend of the total nitrogen storage for each species was an increase in nitrogen during the three growth periods with a notable exception of *Pontederia cordata* that showed a decline in total nitrogen during the final growth period (Sample Events 2 through 3). *Agrostis alba* stored the most total nitrogen during the growth period (May through October) analyzed followed by *Canna flaccida*, *Juncus effusus* and *Pontederia cordata* largely due to the increases in biomass.

The recruitment of measurable levels of nitrogen from *Ludwigia* spp. and Other Species began between the Sample Events 1 and 2 growth period. These recruitment species had a substantial contribution to the total nitrogen storage stored on the Sample Mats over the growth period analyzed.

Agrostis alba stored the highest levels of root nitrogen on the Sample Mats, followed by *Canna flaccida*, *Juncus effusus*, and *Pontederia cordata*. Nitrogen storage in the Sample Mat shoots was also highest, followed by *Juncus effusus* and *Canna flaccida*. *Pontederia cordata* shoots lost nitrogen during the growth period analyzed.

Total nitrogen storage (roots plus shoots) normalized to a per plant basis was highest in *Agrostis alba*, followed by *Canna flaccida*, *Juncus effusus*, and *Pontederia cordata*. The roots of *Canna flaccida* stored the most nitrogen on a per plant basis which was

followed by *Agrostis alba*, *Juncus effusus* and *Pontederia cordata*. Conversely the shoots of *Agrostis alba* on a per plant basis stored the highest levels of nitrogen, followed by *Juncus effusus* and *Canna flaccida*.

Based on the quantities of the nursery grown plant species installed and recruited on the Existing Mats and the associated total nitrogen storage on a per plant basis for these species, a total of 1,292 grams on a dry weight basis of nitrogen was stored on each Existing Mat. *Agrostis alba* accounted for the highest nitrogen storage (698.8 gm) followed by *Canna flaccida* (248.6 gm), *Juncus effusus* 173.1 gm, Ludwigia species (126.4 gm), *Pontederia cordata* (36.9 gm) and other recruitment species (9.2 gm).

The general trend of phosphorous storage in the roots plus shoots for each installed species was an increase in phosphorous during the three growth periods except for *Pontederia cordata* that showed a net loss during the Sample Event 2 and 3 (final growth period). Also contributing to Sample Mat phosphorous storage in the roots plus shoots over the growth period analyzed were the recruitment of *Ludwigia* spp. and Other Species.

The highest levels of phosphorous stored in Sample Mats roots occurred in *Agrostis alba* followed by *Canna flaccida* and *Juncus effusus*. *Pontederia cordata* roots did not store phosphorous on the Sample Mats. Phosphorous storage in the Sample Mat shoots was also highest in *Agrostis alba* followed by *Juncus effusus*. Both *Pontederia cordata* and *Canna flaccida* shoots did not store phosphorous during the growing season (May through October).

Total phosphorous storage (roots plus shoots) normalized to a per plant basis was highest in *Agrostis alba*, followed by *Canna flaccida*, *Juncus effusus*, Ludwigia spp. and Other Species. The roots of *Canna flaccida* stored the most phosphorous on a per plant basis which was followed by *Agrostis alba*, *Juncus effusus* and *Pontederia cordata*. Conversely, the shoots of *Agrostis alba* on a per plant basis stored the highest levels of phosphorous followed by *Juncus effusus*. Neither *Pontederia cordata* nor *Canna flaccida* shoots on a per plant basis stored phosphorous during the growing season.

Based on the quantities of the nursery grown plant species installed and recruited on the Existing Mats and the associated total phosphorous storage (roots plus shoots) on a per plant basis for these species, a total of 83.11 grams on a dry weight basis of phosphorous was stored on each Existing Mat. *Agrostis alba* accounted for the highest phosphorous storage (46.52 gm) followed by *Canna flaccida* (15.84 gm), *Juncus effusus* (11.27 gm), Ludwigia species (10.75 gm), and other recruitment species (0.52 gm).

The sampling data for total nitrogen and phosphorous storage (roots plus shoots) during the growth period analyzed (May through October) generally support that the harvest of the plant material from the Existing Mats should occur near the end of a typical Lee County growing season due to the overall increase of stored phosphorous and nitrogen from Sample Event to Sample Event. The exact timing of the fall harvest is likely to vary

from year to year depending on local conditions (e.g., heavy frost or possible freezes) and other management decisions.

The sample data of shoot growth during the growth period analyzed do not support the harvesting a crop of shoots of any of the species installed on the Existing Mat for several reasons. Both *Agrostis alba* and *Juncus effusus* steadily increased in the amount of stored nitrogen and phosphorous in its shoots on a per plant basis during each of the three (3) growth periods measured. *Canna flaccida* shoots had successive increases in stored nitrogen and phosphorous between the Baseline through Sample Event 2 growth period and showed a slight decline between Sample Event 2 through 3 but not appreciable enough to warrant harvesting. *Pontederia cordata* shoots on a per plant basis show virtually no increase in stored nitrogen or phosphorous analyzed during the growth period analyzed.

Nearly all management decisions or practices strive to maximize the cost to benefit. In the case of this study, the cost was considered to be the unit cost of the installation of each of the nursery-grown plants (plant plus installation) versus the nitrogen and phosphorous stored on a per plant basis. Because the price per installed plant was the same for each of the species ($0.60), the species that stored the most nitrogen and phosphorous on a per plant basis were obviously the most cost effective.

Based on the total nitrogen storage on a per plant basis and the cost of each plant ($0.60 per plant installed), *Agrostis alba* cost $0.39 per a gram of nitrogen stored on a dry weight basis, followed by *Canna flaccida* at $0.48 per gram, *Juncus effusus* at $1.80 per gram and *Pontederia cordata* at $6.18 per gram (see **Table 55**). Phosphorous storage on a per gram basis among the species evaluated was most cost effective with *Agrostis alba* costing $5.93 per gram followed by *Canna flaccida* at $7.58 and *Juncus effusus* at $27.68 per gram (see **Table 56**). Because *Pontederia cordata* did not store phosphorous, no costs were calculated.

Another way of considering the management implication and future deployment of the mats as a management practice is to relate the storage of nitrogen and phosphorus on the Existing Mats as gallons of water treated at prescribed nitrogen and phosphorus reduction target levels. As an example, the examination of stored nitrogen on the Existing Mats (N=3) was estimated to be 3,878.8 grams that on a parts per million basis is equivalent to 3.9 million mg for a one liter volume.

The levels of inorganic nitrogen (i.e., plant available nitrogen) analyzed between May and November, 2009 ranged from <0.076 mg/L in May to a high of 0.695 mg/L in August. Using a treatment reduction goal of 0.25 mg/L and the aforementioned storage of nitrogen on the Sample Mats during the growth period analyzed, the equivalent volume of water treated at this rate of plant uptake would be equivalent to 15.5 million liters or 4.1 million gallons. Based on the cost analysis results of **Table 55**, the cost of treatment at the 0.25 mg/L rate is 0.08 cents per gallon or 0.02 cents per liter.

Based on the cost of storage of either nitrogen or phosphorous on a per plant basis, altering the plant quantities to favor both *Agrostis alba* and *Canna flaccida* and to a lesser extent *Juncus effusus* can result in substantially greater amounts of nitrogen and phosphorous stored on the Existing Mats in a more cost effective manner.

While a substantial level of insight into the use of vegetated floating mats was gained by this study, further study with regards to providing recommendations for the implementation of vegetated floating mats for the sequestration of nutrients under a wide range of water quality conditions is needed.

6.0 LIST OF REFERENCES

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APPENDIX A

WATER QUALITY LABORATORY REPORTS

July 8, 2009

Nick Gallant
PSI
12650 New Brittany Blvd
Fort Myers, FL 33907

Re: SunLabs Project Number: **090701.01**
Client Project Description: **Lee County Plant Study**

Dear Mr. Gallant:

Enclosed is the report of laboratory analysis for the following samples:

Sample Number	Sample Description	Date Collected
86526	Outfall 1	6/30/2009
86527	Outfall 2	6/30/2009
86528	Weir	6/30/2009

TKN and Ammonia were analyzed by Benchmark Enviroanalytical, Inc. NELAC# E84167.

Copies of the Chain(s)-of-Custody, if received, are attached to this report.

If you have any questions or comments concerning this report, please do not hesitate to contact us.

Sincerely,

Michael W. Palmer
Vice President, Laboratory Operations

Enclosures

Report of Laboratory Analysis

SunLabs Project Number	PSI
090701.01	Project Description: Lee County Plant Study

July 8, 2009

SunLabs Sample Number **86527**
Sample Designation **Outfall 2**

Matrix: Surface Water
Date Collected: 6/30/2009 12:50
Date Received: 7/1/2009 10:00

Parameters	Method	Units	Results	Dil Factor	MDL	RL	CAS Number	Date/Time Analyzed	Date/Time Prep
Anions by Ion Chromatography									
Date Analyzed			07/01/2009	1				07/01/09 18:19	07/01/09 12:10
Nitrate as N	300.0	mg/L	0.014 U	1	0.014	0.056	14797-55-8	07/01/09 18:19	07/01/09 12:10
Ortho-phosphate as P	300.0	mg/L	0.022 U	1	0.022	0.088	14265-44-2	07/01/09 18:46	07/01/09 12:10
Ammonia									
Nitrogen Ammonia (as N)	350.2	mg/L	0.040 S7	1	0.005	0.02		07/07/09 13:50	
Total Kjeldahl Nitrogen									
Date Digested	351.2		7/6/09 S7	1				07/06/09 11:00	
Total Kjeldahl Nitrogen (TKN)	351.2	mg/L	0.655	1	0.05	0.2		07/06/09 11:00	
Total Phosphorous									
Date Digested	3010		7/1/2009						07/01/09 13:00
Total Phosphorous	6010	mg/L	0.015 U	1	0.015	0.06		07/06/09 15:23	07/01/09 13:00

Report of Laboratory Analysis

SunLabs Project Number	PSI
090701.01	Project Description: Lee County Plant Study

July 8, 2009

Footnotes	
*	SunLabs is not currently NELAC certified for this analyte.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Sample not analyzed at client's request.
RL	RL(reporting limit) = PQL(practical quantitation limit).
RPD	Relative Percent Difference
S7	This analysis performed by Benchmark EnviroAnalytical, Inc., Certification number E84167.
U	Compound was analyzed for but not detected.
V	Indicates that the analyte was detected in both the sample and the associated method blank.

SunLabs, Inc. Chain of Custody

№ 22169

Client Name: PSI
Contact: Nick Gallant
Address: 1265 New Britain Blvd. Suite 102
Phone / Fax: 2396909967 / 2396909966
E-Mail: nick.gallant@psiusa.com

SunLabs Project # 090701.01

Project Name: Lee County Plants Stg
Project #: 756-176006
PO #:
Alt Bill To:

SunLabs Sample #	Sample Description	Sample Date	Sample Time	# of Bottles	Bottle Type	P	P	P							
					Preservative	H	N								
					Matrix	SW	SW	SW							
					Analysis / Method Requested	TKN/Ammonia	Total Mets 6010	Nitrate/Nitrite 300.0							
861526	Outfall 1	6/30/09	1235	3		X	X	X							
861527	Outfall 2	↓	1250	3		X	X	X							
861528	Weir	↓	1310	3		X	X	X							

Due Date Requested:

☐ FDEP PreApproval site
☐ Cash rates

Remarks / Comments:

Length of Record Retention if other than 5 years: _____

Sampler Signature / Date: 6/30/09

Printed Name / Affiliation: Nicholas Gallant / PSI

SUNLABS, INC. RESERVES THE RIGHT TO BILL FOR UNUSED/ UNRETURNED SAMPLES AND TO RETURN UNUSED SAMPLES.

Relinquished By:	Relinquished To:	Date:	Time:
Nick Gallant	UPS	6/30	
Relinquished By:	Relinquished To:	Date:	Time:
	Fed Ex	6/30/09	1820
Relinquished By:	Relinquished To:	Date:	Time:
Fed Ex	LA Palmer	7/1/09	1000
Relinquished By:	Relinquished To:	Date:	Time:

Bottle Type Codes:

GV = Glass Vial	GVS = Low Level Volatile Kit
GA = Glass Amber	T = Tedlar Bag
P = Plastic	O = Other
S = Soil Jar	

Preservative Codes:

H = Hydrochloric Acid + Ice	S = Sulfuric Acid + Ice
I = Ice only	VS = MeOH, OFW, + Ice
N = Nitric Acid + Ice	O = Other (Specify)

Matrix Codes:

A = Air	SO = Soil
DW = Drinking Water	SOL = Solid
GW = Ground Water	SW = Surface Water
SE = Sediment	W = Water (Blanks)
	O = Other (Specify)

Internal Use Only

Sample Condition Upon Receipt:

Custody Seals present?	Y / N / (NA)
Shipping Bills attached?	(Y) / N / NA
Sample containers intact?	(Y) / N / NA
Samples within holding times?	(Y) / N / NA
Sufficient volume for all analyses?	(Y) / N / NA
Are vials head-space free?	Y / N / (NA)
Proper containers and preservatives?	(Y) / N / NA

Temp: 5.4°

Received on Ice? (Y) / N / NA

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520, Tampa, Florida 33634
Phone: 813-881-9401 / Fax: 813-354-4661
e-mail: info@SunLabsInc.com www.SunLabsInc.com

August 11, 2009

Nick Gallant
PSI
12650 New Brittany Blvd
Fort Myers, FL 33907

Re: SunLabs Project Number: **090731.02**
Client Project Description: **Lee County Plant Study**

Dear Mr. Gallant:

Enclosed is the report of laboratory analysis for the following samples:

Sample Number	Sample Description	Date Collected
88195	Outfall 1	7/30/2009
88196	Outfall 2	7/30/2009
88197	Weir	7/30/2009

Ammonia was analyzed by Benchmark Enviroanalytical, Inc. NELAC# E84167.

Copies of the Chain(s)-of-Custody, if received, are attached to this report.

If you have any questions or comments concerning this report, please do not hesitate to contact us.

Sincerely,

Michael W. Palmer
Vice President, Laboratory Operations

Enclosures

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520
Tampa, FL 33634

Phone: (813) 881-9401
Email: Info@SunLabsInc.com
Website: www.SunLabsInc.com

Unless Otherwise Noted and Where Applicable:

Report of Laboratory Analysis

SunLabs Project Number	PSI
090731.02	Project Description: Lee County Plant Study

August 11, 2009

SunLabs Sample Number **88196**
Sample Designation **Outfall 2**

Matrix: Surface Water
Date Collected: 7/30/2009 18:25
Date Received: 7/31/2009 09:45

Parameters	Method	Units	Results	Dil Factor	MDL	RL	CAS Number	Date/Time Analyzed	Date/Time Prep
Anions by Ion Chromatography									
Date Analyzed			07/31/2009	1				07/31/09 22:40	07/31/09 12:00
Nitrate as N	300.0	mg/L	0.12	1	0.014	0.056	14797-55-8	07/31/09 22:40	07/31/09 12:00
Ortho-phosphate as P	300.0	mg/L	0.022 U	1	0.022	0.088	14265-44-2	07/31/09 22:40	07/31/09 12:00
Ammonia									
Nitrogen Ammonia (as N)	350.2	mg/L	0.042	1	0.005	0.020		08/07/09 16:00	
Total Kjeldahl Nitrogen									
Date Digested	351.2		8/4/09 S7	1				08/04/09 10:00	
Total Kjeldahl Nitrogen (TKN)	351.2	mg/L	0.587	1	0.05	0.2		08/04/09 10:00	
Total Phosphorous									
Date Digested	3010		8/3/2009						08/03/09 09:30
Total Phosphorous	6010	mg/L	0.015 U	1	0.015	0.06		08/06/09 14:52	08/03/09 09:30

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520
Tampa, FL 33634

Laboratory ID Number - E84809

Phone: (813) 881-9401
Email: Info@SunLabsInc.com
Website: www.SunLabsInc.com

Report of Laboratory Analysis

SunLabs Project Number	PSI
090731.02	Project Description: Lee County Plant Study

August 11, 2009

Footnotes	
*	SunLabs is not currently NELAC certified for this analyte.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Sample not analyzed at client's request.
RL	RL(reporting limit) = PQL(practical quantitation limit).
RPD	Relative Percent Difference
S7	This analysis performed by Benchmark EnviroAnalytical, Inc., Certification number E84167.
U	Compound was analyzed for but not detected.
V	Indicates that the analyte was detected in both the sample and the associated method blank.

SunLabs, Inc. Chain of Custody

№ 21665

Client Name: PSI
Contact: Nick Gallant
Address: 12650 New Brittany Blvd. Suite 102
Phone / Fax: 239-690-9967
E-Mail: nick.gallant@psiusa.com

SunLabs Project # 090731.02

Project Name: Lee County Plant Study
Project #: 756-96606
PO #:
Alt Bill To:

SunLabs Sample #	Sample Description	Sample Date	Sample Time	# of Bottles	Bottle Type	Preservative	Matrix	Analysis / Method Requested: TKN / NH3	Tot Phos	Ortho Phos
					P	P	P			
					S	N	I			
					SW	SW	SW			
88195	Outfall #1	7-30-09	1810	3				✓	✓	✓
88196	Outfall #2	7-30-09	1625	3				✓	✓	✓
88197	Weir	7-30-09	1845	3				✓	✓	✓

Due Date Requested:

☐ FDEP PreApproval site
☐ Cash rates

Remarks / Comments:

Length of Record Retention if other than 5 years: _____

Sampler Signature / Date: 7-30-09

Printed Name / Affiliation: Nick Gallant / PSI

SUNLABS, INC. RESERVES THE RIGHT TO BILL FOR UNUSED/ UNRETURNED SAMPLES AND TO RETURN UNUSED SAMPLES.

Relinquished By:	Relinquished To:	Date:	Time:
L N Palmer	UPS	7/24/09	1700
UPS		7-27-09	1100
	FedEx	7-30-09	1930
fedex	courier	7/31/09	945

Bottle Type Codes:
GV = Glass Vial; GVS = Low Level Volatile Kit
GA = Glass Amber; T = Tedlar Bag
P = Plastic; O = Other
S = Soil Jar

Preservative Codes:
H = Hydrochloric Acid + Ice; S = Sulfuric Acid + Ice
I = Ice only; VS = MeOH, OFW, + Ice
N = Nitric Acid + Ice; O = Other (Specify)

Matrix Codes:
A = Air; SO = Soil
DW = Drinking Water; SOL = Solid
GW = Ground Water; SW = Surface Water
SE = Sediment; W = Water (Blanks)
O = Other (Specify)

Temp: 3.4

Received on Ice? Y / N / NA

Internal Use Only

Sample Condition Upon Receipt:

Custody Seals present?	Y / N / (NA)
Shipping Bills attached?	(Y) / N / NA
Sample containers intact?	(Y) / N / NA
Samples within holding times?	(Y) / N / NA
Sufficient volume for all analyses?	(Y) / N / NA
Are vials head-space free?	Y / N / (NA)
Proper containers and preservatives?	(Y) / N / NA

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520, Tampa, Florida 33634
Phone: 813-881-9401 / Fax: 813-354-4661
e-mail: info@SunLabsInc.com www.SunLabsInc.com

September 11, 2009

Nick Gallant
PSI
12650 New Brittany Blvd
Suite 102
Fort Myers, FL 33907

Re: SunLabs Project Number: **090901.03**
Client Project Description: **Lee County Plant Study**

Dear Mr. Gallant:

Enclosed is the report of laboratory analysis for the following samples:

Sample Number	Sample Description	Date Collected
89380	Outfall 1	8/31/2009
89381	Outfall 2	8/31/2009
89382	Weir	8/31/2009

Ammonia was analyzed by Benchmark Enviroanalytical, Inc. NELAC# E84167.

Copies of the Chain(s)-of-Custody, if received, are attached to this report.

If you have any questions or comments concerning this report, please do not hesitate to contact us.

Sincerely,

Michael W. Palmer
Vice President, Laboratory Operations

Enclosures

Report of Laboratory Analysis

SunLabs Project Number	PSI
090901.03	Project Description: Lee County Plant Study

September 11, 2009

SunLabs Sample Number **89381**
Sample Designation **Outfall 2**

Matrix: Surface Water
Date Collected: 8/31/2009 14:20
Date Received: 9/1/2009 10:10

Parameters	Method	Units	Results	Dil Factor	MDL	RL	CAS Number	Date/Time Analyzed	Date/Time Prep
Anions by Ion Chromatography									
Date Analyzed			09/01/2009	1				09/01/09 20:04	09/01/09 12:50
Nitrate as N	300.0	mg/L	0.014 U	1	0.014	0.056	14797-55-8	09/01/09 20:04	09/01/09 12:50
Ortho-phosphate as P	300.0	mg/L	0.022 U	1	0.022	0.088	14265-44-2	09/01/09 20:04	09/01/09 12:50
Ammonia									
Nitrogen Ammonia (as N)	350.2	mg/L	0.083 I	1	0.005	0.020		09/02/09 11:51	
Total Kjeldahl Nitrogen									
Date Digested	351.2		9/8/09 S7	1				09/08/09 10:00	
Total Kjeldahl Nitrogen (TKN)	351.2	mg/L	0.771	1	0.05	0.2		09/08/09 10:00	
Total Phosphorous									
Date Digested	3010		9/2/2009						09/02/09 09:15
Total Phosphorous	6010	mg/L	0.015 U	1	0.015	0.06		09/03/09 11:50	09/02/09 09:15

Report of Laboratory Analysis

SunLabs Project Number	PSI
090901.03	Project Description: Lee County Plant Study

September 11, 2009

Footnotes	
*	SunLabs is not currently NELAC certified for this analyte.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Sample not analyzed at client's request.
RL	RL(reporting limit) = PQL(practical quantitation limit).
RPD	Relative Percent Difference
S7	This analysis performed by Benchmark EnviroAnalytical, Inc., Certification number E84167.
U	Compound was analyzed for but not detected.
V	Indicates that the analyte was detected in both the sample and the associated method blank.

SunLabs, Inc. Chain of Custody

№ 22189

Client Name: PSI
Contact: NICK GALLANT
Address: 12650 New Brittany Blvd Suite 102
Phone / Fax: 239-90-1967 / 239-693-3968
E-Mail: nick.gallant@psiusa.com

SunLabs Project # 090501 090901.03

Project Name: Lee County Plant Study
Project #:
PO #:
Alt Bill To:

SunLabs Sample #	Sample Description	Sample Date	Sample Time	# of Bottles	Bottle Type	Preservative	Matrix	Analysis / Method Requested: Nitrate/Nitrite	TKN/Ammonia	Total P
89380	Out Call #1	8/31/09	1410	2			SW	✓	✓	✓
89381	Out Call #2	8/31/09	1420	3			SW	✓	✓	✓
89382	Weir	8/31/09	1440	3			SW	✓	✓	✓

Due Date Requested:

☐ FDEP PreApproval site
☐ Cash rates

Remarks / Comments:

Length of Record Retention if other than 5 years:

Sampler Signature / Date: 8/31/09

Printed Name / Affiliation: Nick Gallant / PSI

SUNLABS, INC. RESERVES THE RIGHT TO BILL FOR UNUSED/ UNRETURNED SAMPLES AND TO RETURN UNUSED SAMPLES.

Relinquished By:	Relinquished To:	Date:	Time:
[illegible]	UPS	8/31/09	1700
[illegible]	Fedex	8/31/09	3:30
Fedex	Gfuber	9/1/09	1010

Bottle Type Codes:
GV = Glass Vial; GVS = Low Level Volatile Kit
GA = Glass Amber; T = Tedlar Bag
P = Plastic; O = Other
S = Soil Jar

Preservative Codes:
H = Hydrochloric Acid + Ice; S = Sulfuric Acid + Ice
I = Ice only; VS = MeOH, OFW, + Ice
N = Nitric Acid + Ice; O = Other (Specify)

Matrix Codes:
A = Air; SO = Soil
DW = Drinking Water; SOL = Solid
GW = Ground Water; SW = Surface Water
SE = Sediment; W = Water (Blanks)
O = Other (Specify)

Temp: 20
Received on Ice? (Y) / N / NA

Internal Use Only
Sample Condition Upon Receipt:

Custody Seals present?	Y / N / (NA)
Shipping Bills attached?	(Y) / N / NA
Sample containers intact?	(Y) / N / NA
Samples within holding times?	(Y) / N / NA
Sufficient volume for all analyses?	(Y) / N / NA
Are vials head-space free?	Y / N / (NA)
Proper containers and preservatives?	(Y) / N / NA

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520, Tampa, Florida 33634
Phone: 813-881-9401 / Fax: 813-354-4661
e-mail: info@SunLabsInc.com www.SunLabsInc.com

October 2, 2009

Nick Gallant
PSI
12650 New Brittany Blvd
Suite 102
Fort Myers, FL 33907

Re: SunLabs Project Number: **090922.03**
Client Project Description: **Lee County Plant Study**

Dear Mr. Gallant:

Enclosed is the report of laboratory analysis for the following samples:

Sample Number	Sample Description	Date Collected
90464	Outfall 1	9/21/2009
90465	Outfall 2	9/21/2009
90466	Weir	9/21/2009

Ammonia was analyzed by Benchmark Enviroanalytical, Inc. NELAC# E84167.

Copies of the Chain(s)-of-Custody, if received, are attached to this report.

If you have any questions or comments concerning this report, please do not hesitate to contact us.

Sincerely,

Michael W. Palmer
Vice President, Laboratory Operations

Enclosures

Report of Laboratory Analysis

SunLabs Project Number	PSI
090922.03	Project Description: Lee County Plant Study

October 2, 2009

SunLabs Sample Number **90465**
Sample Designation **Outfall 2**

Matrix: Surface Water
Date Collected: 9/21/2009 17:15
Date Received: 9/21/2009 18:45

Parameters	Method	Units	Results	Dil Factor	MDL	RL	CAS Number	Date/Time Analyzed	Date/Time Prep
Anions by Ion Chromatography									
Date Analyzed			9/23/2009	1				09/23/09 08:38	09/22/09 12:15
Nitrate as N	300.0	mg/L	0.014 U	1	0.014	0.056	14797-55-8	09/23/09 08:38	09/22/09 12:15
Ortho-phosphate as P	300.0	mg/L	0.022 U	1	0.022	0.088	14265-44-2	09/23/09 08:38	09/22/09 12:15
Ammonia									
Nitrogen Ammonia (as N)	350.2	mg/L	0.092	1	0.005	0.020		09/28/09 12:25	
Total Kjeldahl Nitrogen									
Date Digested	351.2		9/30/09 S7	1				09/30/09 10:00	
Total Kjeldahl Nitrogen (TKN)	351.2	mg/L	0.798	1	0.05	0.2		09/30/09 10:00	
Total Phosphorous									
Date Digested	3010		9/23/2009						09/23/09 09:00
Total Phosphorous	6010	mg/L	0.015 U	1	0.015	0.06		09/23/09 18:49	09/23/09 09:00

Report of Laboratory Analysis

SunLabs Project Number	PSI
090922.03	Project Description: Lee County Plant Study

October 2, 2009

Footnotes	
*	SunLabs is not currently NELAC certified for this analyte.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Sample not analyzed at client's request.
RL	RL(reporting limit) = PQL(practical quantitation limit).
RPD	Relative Percent Difference
S7	This analysis performed by Benchmark EnviroAnalytical, Inc., Certification number E84167.
U	Compound was analyzed for but not detected.
V	Indicates that the analyte was detected in both the sample and the associated method blank.

SunLabs, Inc. Chain of Custody

№ 22459

Client Name: PSI
Contact: Nick Gallant
Address: 12650 New Brittany Blvd. Suite 102 Fort Myers FL 33907
Phone / Fax: 239-690-2767 / 690-2768
E-Mail: nick.gallant@psiusa.com

SunLabs Project # 090922.03

Project Name: Lee County Plant Study
Project #: 75-96006
PO #:
Alt Bill To:

SunLabs Sample #	Sample Description	Sample Date	Sample Time	# of Bottles	Bottle Type	Preservative	Matrix	Analysis / Method Requested: Oil & Grease 1664	TKN / NH3	TSS 160.2
					P	P	P			
					1	S	N			
					SW	→	→			
90922	Outfall #1	9-21-09	9:[illegible]	3				✓	✓	✓
90923	Outfall #2	9-21-09	[illegible]:15	3				✓	✓	✓
90924	Weir	9-21-09	[illegible]:30	3				✓	✓	✓

Due Date Requested:

☐ FDEP PreApproval site
☐ Cash rates

Remarks / Comments:

Length of Record Retention if other than 5 years: _____

Sampler Signature / Date: 9-21-09

Printed Name / Affiliation: Nicholas Gallant / PSI

SUNLABS, INC. RESERVES THE RIGHT TO BILL FOR UNUSED/ UNRETURNED SAMPLES AND TO RETURN UNUSED SAMPLES.

Relinquished By:	Relinquished To:	Date:	Time:
Jn Palmer	LIPS	9/18/09	1200
[signature]	Fedex	9-21-09	16:45
fedex	Ctfeber	9/22/09	1145

Bottle Type Codes:
GV = Glass Vial; GVS = Low Level Volatile Kit
GA = Glass Amber; T = Tedlar Bag
P = Plastic; O = Other
S = Soil Jar

Preservative Codes:
H = Hydrochloric Acid + Ice; S = Sulfuric Acid + Ice
I = Ice only; VS = MeOH, OFW, + Ice
N = Nitric Acid + Ice; O = Other (Specify)

Matrix Codes:
A = Air; SO = Soil
DW = Drinking Water; SOL = Solid
GW = Ground Water; SW = Surface Water
SE = Sediment; W = Water (Blanks)
O = Other (Specify)

Temp: 5.1
Received on Ice? (Y) / N / NA

Internal Use Only
Sample Condition Upon Receipt:

Custody Seals present?	(Y) / N / NA
Shipping Bills attached?	(Y) / N / NA
Sample containers intact?	(Y) / N / NA
Samples within holding times?	(Y) / N / NA
Sufficient volume for all analyses?	(Y) / N / NA
Are vials head-space free?	Y / N / (NA)
Proper containers and preservatives?	(Y) / N / NA

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520, Tampa, Florida 33634
Phone: 813-881-9401 / Fax: 813-354-4661
e-mail: info@SunLabsInc.com www.SunLabsInc.com

fedex airbill 8672 3836 6987

October 29, 2009

Nick Gallant
PSI
12650 New Brittany Blvd
Suite 102
Fort Myers, FL 33907

Re: SunLabs Project Number: **091021.09**
Client Project Description: **Lee County Plant Study**

Dear Mr. Gallant:

Enclosed is the report of laboratory analysis for the following samples:

Sample Number	Sample Description	Date Collected
91752	Outfall 1	10/20/2009
91753	Outfall 2	10/20/2009
91754	Weir	10/20/2009

TKN and Ammonia were analyzed by Benchmark Enviroanalytical Inc. NELAC# E84167.

Copies of the Chain(s)-of-Custody, if received, are attached to this report.

If you have any questions or comments concerning this report, please do not hesitate to contact us.

Sincerely,

Michael W. Palmer
Vice President, Laboratory Operations

Enclosures

Report of Laboratory Analysis

SunLabs Project Number	PSI
091021.09	Project Description: Lee County Plant Study

October 29, 2009

SunLabs Sample Number **91753**
Sample Designation **Outfall 2**

Matrix: Surface Water
Date Collected: 10/20/2009 18:20
Date Received: 10/21/2009 12:15

Parameters	Method	Units	Results	Dil Factor	MDL	RL	CAS Number	Date/Time Analyzed	Date/Time Prep
Anions by Ion Chromatography									
Date Analyzed			10/22/2009	1				10/22/09 02:14	10/21/09 15:00
Nitrate as N	300.0	mg/L	0.12	1	0.014	0.056	14797-55-8	10/22/09 02:14	10/21/09 15:00
Ortho-phosphate as P	300.0	mg/L	0.022 U	1	0.022	0.088	14265-44-2	10/22/09 02:14	10/21/09 15:00
Ammonia									
Nitrogen Ammonia (as N)	350.2	mg/L	0.046	1	0.005	0.020		10/23/09 13:00	
Total Kjeldahl Nitrogen									
Date Digested	351.2		10/27/09 S7	1				10/27/09 10:00	
Total Kjeldahl Nitrogen (TKN)	351.2	mg/L	0.794	1	0.05	0.2		10/27/09 10:00	
Total Phosphorous									
Date Digested	3010		10/22/2009						10/22/09 08:45
ıtal Phosphorous	6010	mg/L	0.015 U	1	0.015	0.06		10/23/09 16:58	10/22/09 08:45

Report of Laboratory Analysis

SunLabs Project Number	PSI
091021.09	Project Description: Lee County Plant Study

October 29, 2009

Footnotes

*	*SunLabs is not currently NELAC certified for this analyte.*
I	*The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.*
I,V	
LCS	*Laboratory Control Sample*
LCSD	*Laboratory Control Sample Duplicate*
MB	*Method Blank*
MS	*Matrix Spike*
MSD	*Matrix Spike Duplicate*
NA	*Sample not analyzed at client's request.*
Q	*Sample held beyond the accepted holding time.*
RL	*RL(reporting limit) = PQL(practical quantitation limit).*
RPD	*Relative Percent Difference*
S7	*This analysis performed by Benchmark EnviroAnalytical, Inc., Certification number E84167.*
U	*Compound was analyzed for but not detected.*
V	*Indicates that the analyte was detected in both the sample and the associated method blank.*

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520
Tampa, FL 33634

Laboratory ID Number - E84809

Phone: (813) 881-9401
Email: Info@SunLabsInc.com
Website: www.SunLabsInc.com

SunLabs, Inc. Chain of Custody

№ 22934

Client Name: PSI
Contact: Nick Gallant
Address: [illegible] Blvd. Ste 102, [illegible] FL 33907
Phone / Fax: 239-[illegible] / 239-[illegible]
E-Mail: nick.gallant@psiusa.com

SunLabs Project # 091021.09

Project Name: Lee County Plant Study
Project #:
PO #:
Alt Bill To:

	TKN, NH3	TP	Nitrate/Ortho
Bottle Type	P	P	P
Preservative	S	N	I
Matrix	SW	SW	SW

SunLabs Sample #	Sample Description	Sample Date	Sample Time	# of Bottles	TKN, NH3	TP	Nitrate/Ortho
91752	Outfall 1	10-20-09	1812	3	1	1	1
91753	Outfall 2	10-20-09	1820	3	1	1	1
91754	Weir	10-20-09	1832	3	1	1	1

Due Date Requested:

☐ FDEP PreApproval site
☐ Cash rates

Remarks / Comments:

Length of Record Retention if other than 5 years: ____

Sampler Signature / Date: [signature] 10-20-09

Printed Name / Affiliation: Nicholas Gallant / PSI

SUNLABS, INC. RESERVES THE RIGHT TO BILL FOR UNUSED/ UNRETURNED SAMPLES AND TO RETURN UNUSED SAMPLES.

Relinquished By:	Relinquished To:	Date:	Time:
[illegible]	UPS	10/19	1700
[signature]	FedEx	10-20-09	1845
FedEx	[signature]	10/21/09	12:15

Bottle Type Codes:
GV = Glass Vial; GVS = Low Level Volatile Kit
GA = Glass Amber; T = Tedlar Bag
P = Plastic; O = Other
S = Soil Jar

Preservative Codes:
H = Hydrochloric Acid + Ice; S = Sulfuric Acid + Ice
I = Ice only; VS = MeOH, OFW, + Ice
N = Nitric Acid + Ice; O = Other (Specify)

Matrix Codes:
A = Air; SO = Soil
DW = Drinking Water; SOL = Solid
GW = Ground Water; SW = Surface Water
SE = Sediment; W = Water (Blanks)
O = Other (Specify)

Temp: 3.0
Received on Ice? Y / N / NA (Y circled)

Internal Use Only
Sample Condition Upon Receipt:
Custody Seals present? Y / N / NA (NA circled)
Shipping Bills attached? Y / N / NA (Y circled)
Sample containers intact? Y / N / NA (Y circled)
Samples within holding times? Y / N / NA (Y circled)
Sufficient volume for all analyses? Y / N / NA (Y circled)
Are vials head-space free? Y / N / NA (NA circled)
Proper containers and preservatives? Y / N / NA (Y circled)

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520, Tampa, Florida 33634
Phone: 813-881-9401 / Fax: 813-354-4661
e-mail: info@SunLabsInc.com www.SunLabsInc.com

November 25, 2009

Nick Gallant
PSI
12650 New Brittany Blvd
Suite 102
Fort Myers, FL 33907

Re: SunLabs Project Number: **091117.05**
Client Project Description: **Lee County Plant Study**

Dear Mr. Gallant:

Enclosed is the report of laboratory analysis for the following samples:

Sample Number	Sample Description	Date Collected
93045	Outfall 1	11/16/2009
93046	Outfall 2	11/16/2009
93047	Weir	11/16/2009

Ammonia was analyzed by Benchmark Enviroanalytical, Inc. NELAC# E84167.

Copies of the Chain(s)-of-Custody, if received, are attached to this report.

If you have any questions or comments concerning this report, please do not hesitate to contact us.

Sincerely,

Michael W. Palmer
Vice President, Laboratory Operations

Enclosures

Report of Laboratory Analysis

SunLabs Project Number	PSI
091117.05	Project Description: Lee County Plant Study

November 25, 2009

SunLabs Sample Number **93046**
Sample Designation **Outfall 2**

Matrix: Surface Water
Date Collected: 11/16/2009 16:05
Date Received: 11/17/2009 08:30

Parameters	Method	Units	Results	Dil Factor	MDL	RL	CAS Number	Date/Time Analyzed	Date/Time Prep
Anions by Ion Chromatography									
Date Analyzed			11/17/2009	1				11/17/09 22:46	11/17/09 18:00
Nitrate as N	300.0	mg/L	0.15	1	0.014	0.056	14797-55-8	11/17/09 22:46	11/17/09 18:00
Ortho-phosphate as P	300.0	mg/L	0.022 U	1	0.022	0.088	14265-44-2	11/17/09 22:46	11/17/09 18:00
Ammonia									
Nitrogen Ammonia (as N)	SM4500-NH3C	mg/L	0.079	1	0.005	0.020		11/19/09 11:32	
Total Kjeldahl Nitrogen									
Date Digested	351.2		11/19/09 S7	1				11/19/09 11:00	
Total Kjeldahl Nitrogen (TKN)	351.2	mg/L	0.781	1	0.05	0.2		11/19/09 11:00	
Total Phosphorous									
Date Digested	3010		11/18/2009						11/18/09 09:50
tal Phosphorous	6010	mg/L	0.015 U	1	0.015	0.06		11/24/09 18:40	11/18/09 09:50

Report of Laboratory Analysis

SunLabs Project Number	PSI
091117.05	Project Description: Lee County Plant Study

November 25, 2009

Footnotes	
*	SunLabs is not currently NELAC certified for this analyte.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Sample not analyzed at client's request.
Q	Sample held beyond the accepted holding time.
RL	RL(reporting limit) = PQL(practical quantitation limit).
RPD	Relative Percent Difference
S7	This analysis performed by Benchmark EnviroAnalytical, Inc., Certification number E84167.
U	Compound was analyzed for but not detected.
V	Indicates that the analyte was detected in both the sample and the associated method blank.

SunLabs, Inc. Chain of Custody

№ 22822

Client Name: PSI
Contact: Nick Gallant
Address: 12650 New Brittany Blvd Suite 102 Fort Myers FL 33907
Phone / Fax: 239-690-9967
E-Mail: nick.gallant@psiusa.com

SunLabs Project # 091117.05

Project Name: Lee County Plant Study
Project #: 0552189
PO #:
Alt Bill To:

Bottle Type					P	P	P
Preservative					I	S	N
Matrix					SW		
Analysis / Method Requested					NO3 Orthophos	TKN NH3	Total Phos
SunLabs Sample #	**Sample Description**	**Sample Date**	**Sample Time**	**# of Bottles**			
93045	Outfall 1	11-16-09	1555	3	1	1	1
93046	Outfall 2	11-16-09	1605	3	1	1	1
93047	Weir	11-16-09	1620	3	1	1	1

Due Date Requested:

☐ FDEP PreApproval site
☐ Cash rates

Remarks / Comments:

Length of Record Retention if other than 5 years: ______

Sampler Signature / Date: [signature] 11-16-09

Printed Name / Affiliation: Nick Gallant / PSI

Bottle Type Codes:
GV = Glass Vial; GVS = Low Level Volatile Kit; GA = Glass Amber; T = Tedlar Bag; P = Plastic; O = Other; S = Soil Jar

Preservative Codes:
H = Hydrochloric Acid + Ice; S = Sulfuric Acid + Ice; I = Ice only; VS = MeOH, OFW, + Ice; N = Nitric Acid + Ice; O = Other (Specify)

Matrix Codes:
A = Air; SO = Soil; SOL = Solid; DW = Drinking Water; SW = Surface Water; GW = Ground Water; W = Water (Blanks); SE = Sediment; O = Other (Specify)

Temp: 3.4
Received on Ice? Y / N / NA (Y circled)

Internal Use Only
Sample Condition Upon Receipt:

Custody Seals present?	Y / N / NA (NA circled)
Shipping Bills attached?	Y / N / NA (NA circled)
Sample containers intact?	Y / N / NA (Y circled)
Samples within holding times?	Y / N / NA (Y circled)
Sufficient volume for all analyses?	Y / N / NA (Y circled)
Are vials head-space free?	Y / N / NA (NA circled)
Proper containers and preservatives?	Y / N / NA (Y circled)

SUNLABS, INC. RESERVES THE RIGHT TO BILL FOR UNUSED/ UNRETURNED SAMPLES AND TO RETURN UNUSED SAMPLES.

Relinquished By:	Relinquished To:	Date:	Time:
Lin Palmer		11/12/09	
[signature]	[signature]	11/17/09	8:30

SunLabs, Inc.
5460 Beaumont Center Blvd., Suite 520, Tampa, Florida 33634
Phone: 813-881-9401 / Fax: 813-354-4661
e-mail: info@SunLabsInc.com www.SunLabsInc.com

APPENDIX B

ROOTS AND SHOOTS
TISSUE ANALYSIS LABORATORY REPORTS
AND DATA SUMMARY SHEETS

THORNTON LABORATORIES
TESTING & INSPECTION SERVICES, INC.

1145 E. Cass St, Tampa, FL 33602
Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
Id: Baseline Agrostis Roots
Sampled on 4/29/09 @ 1600 hrs.

Attn: Jeff Medcalf
Proj: Lee County Nutrient Study

Date Received: 30-Apr-2009

Laboratory Number: 321713, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	76.82	%
	Analysis on Dry Basis		
AOAC 993.13	Nitrogen, Total (N)	0.58	%
AOAC 931.01,958.01	Phosphorus, Total (P)	0.13	%
AOAC 975.03	Potassium, Total (K)	0.15	%

THORNTON LABORATORIES
Steve Fickett, III

THORNTON LABORATORIES
TESTING & INSPECTION SERVICES, INC.

1145 E. Cass St, Tampa, FL 33602
Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
Id: Baseline Agrostis Shoots
Sampled on 4/29/09 @ 1600 hrs.

Attn: Jeff Medcalf
Proj: Lee County Nutrient Study

Date Received: 30-Apr-2009

Laboratory Number: 321714, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	57.69	%
	Analysis on Dry Basis		
AOAC 993.13	Nitrogen, Total (N)	0.74	%
AOAC 931.01,958.01	Phosphorus, Total (P)	0.24	%
AOAC 975.03	Potassium, Total (K)	0.66	%

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Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
Id: Baseline Juncus Roots
Sampled on 4/29/09 @ 1440 hrs.

Attn: Jeff Medcalf
Proj: Lee County Nutrient Study

Date Received: 30-Apr-2009

Laboratory Number: 321715, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	70.16	%
	Analysis on Dry Basis		
AOAC 993.13	Nitrogen, Total (N)	0.68	%
AOAC 931.01,958.01	Phosphorus, Total (P)	0.16	%
AOAC 975.03	Potassium, Total (K)	0.54	%

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Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
Id: Baseline Juncus Shoots
Sampled on 4/29/09 @ 1440 hrs.

Attn: Jeff Medcalf
Proj: Lee County Nutrient Study

Date Received: 30-Apr-2009

Laboratory Number: 321716, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	58.29	%
	Analysis on Dry Basis		
AOAC 993.13	Nitrogen, Total (N)	0.78	%
AOAC 931.01,958.01	Phosphorus, Total (P)	0.17	%
AOAC 975.03	Potassium, Total (K)	0.84	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
Id: Baseline Canna Roots
Sampled on 4/29/09 @ 1430 hrs.

Attn: Jeff Medcalf
Proj: Lee County Nutrient Study

Date Received: 30-Apr-2009

Laboratory Number: 321717, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	87.53	%
	Analysis on Dry Basis		
AOAC 993.13	Nitrogen, Total (N)	0.53	%
AOAC 931.01,958.01	Phosphorus, Total (P)	0.20	%
AOAC 975.03	Potassium, Total (K)	1.41	%

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Phone: 813-223-9702 Fax: 813-223-9332
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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
Id: Baseline Canna Shoots
Sampled on 4/29/09 @ 1430 hrs.

Attn: Jeff Medcalf
Proj: Lee County Nutrient Study

Date Received: 30-Apr-2009

Laboratory Number: 321718, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	89.53	%
	Analysis on Dry Basis		
AOAC 993.13	Nitrogen, Total (N)	0.73	%
AOAC 931.01,958.01	Phosphorus, Total (P)	0.65	%
AOAC 975.03	Potassium, Total (K)	4.17	%

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TESTING & INSPECTION SERVICES, INC.

1145 E. Cass St, Tampa, FL 33602
Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

25-May-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
Id: Baseline Pontederia Roots
Sampled on 4/29/09 @ 1530 hrs.

Attn: Jeff Medcalf
Proj: Lee County Nutrient Study

Date Received: 30-Apr-2009

Laboratory Number: 321719, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	90.43	%
	Analysis on Dry Basis		
AOAC 993.13	Nitrogen, Total (N)	1.74	%
AOAC 931.01,958.01	Phosphorus, Total (P)	0.29	%
AOAC 975.03	Potassium, Total (K)	1.72	%

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1145 E. Cass St, Tampa, FL 33602
Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
Id: Baseline Pontederia Shoots
Sampled on 4/29/09 @ 1530 hrs.

Attn: Jeff Medcalf
Proj: Lee County Nutrient Study

Date Received: 30-Apr-2009

Laboratory Number: 321720, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	90.18	%
	Analysis on Dry Basis		
AOAC 993.13	Nitrogen, Total (N)	3.16	%
AOAC 931.01,958.01	Phosphorus, Total (P)	0.48	%
AOAC 975.03	Potassium, Total (K)	5.29	%

THORNTON LABORATORIES
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BASELINE RESULTS

Baseline Roots						
Genus Species	**Wet Weight (gm)**	**% Moisture**	**Dry Weight (gm)**	**N (%)**	**P (%)**	**K (%)**
Agrostis alba	71.0	76.82	16.5	0.58	0.13	0.15
Pontederia cordata	29.6	90.43	2.8	1.74	0.29	1.72
Canna flacida	135.9	87.53	16.9	0.53	0.20	1.41
Juncus effusus	62.4	70.16	18.6	0.68	0.16	0.54
Totals =	**298.9**		**54.9**			

Baseline Shoots						
Genus Species	**Wet Weight (gm)**	**% Moisture**	**Dry Weight (gm)**	**N (%)**	**P (%)**	**K (%)**
Agrostis alba	22.5	57.69	9.5	0.74	0.24	0.66
Pontederia cordata	89.8	90.18	8.8	3.16	0.48	5.29
Canna flacida	48.5	89.53	5.1	0.73	0.65	4.17
Juncus effusus	30.0	58.29	12.5	0.78	0.17	0.84
	190.8		**35.9**			

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Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Canna (Roots)
Sampled on 6/29/09
Total Dry Weight: 44.0 grams

Attn: Jeff Medcalf
Proj: Lee County Vegetated Mat
Nutrient Study
Proj# 756-9G006

Date Received: 1-Jul-2009

Laboratory Number: 322888, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	86.69	%
	ANALYSIS ON DRY BASIS		
AOAC 978.02			
	Nitrogen, Total (N)	1.23	%
	Nitrogen, Total (N)	1.12	%
	Nitrogen, Total (N)	1.14	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.10	%
	Phosphorus, Total (P)	0.10	%
	Phosphorus, Total (P)	0.10	%
AOAC 975.03			
	Potassium, Total (K)	1.18	%
	Potassium, Total (K)	1.16	%
	Potassium, Total (K)	1.12	%

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TESTING & INSPECTION SERVICES, INC.

1145 E. Cass St, Tampa, FL 33602
Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Canna (Roots)
Sampled on 6/29/09
Total Dry Weight: 44.0 grams

Attn: Jeff Medcalf
Proj: Lee County Vegetated Mat
Nutrient Study
Proj# 756-9G006

Date Received: 1-Jul-2009

Laboratory Number: 322888, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	86.69	%
	ANALYSIS ON DRY BASIS		
AOAC 978.02			
	Nitrogen, Total (N)	1.23	%
	Nitrogen, Total (N)	1.12	%
	Nitrogen, Total (N)	1.14	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.10	%
	Phosphorus, Total (P)	0.10	%
	Phosphorus, Total (P)	0.10	%
AOAC 975.03			
	Potassium, Total (K)	1.18	%
	Potassium, Total (K)	1.16	%
	Potassium, Total (K)	1.12	%

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Phone: 813-223-9702 Fax: 813-223-9332
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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Agrostis (Shoots)
Sampled on 6/29/09
Total Dry Weight: 58.8 grams

Attn: Jeff Medcalf
Proj: Lee County Vegetated Mat
Nutrient Study
Proj# 756-9G006

Date Received: 1-Jul-2009

Laboratory Number: 322889, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	76.89	%
	ANALYSIS ON DRY BASIS		
AOAC 978.02			
	Nitrogen, Total (N)	1.05	%
	Nitrogen, Total (N)	1.15	%
	Nitrogen, Total (N)	1.10	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.10	%
	Phosphorus, Total (P)	0.13	%
	Phosphorus, Total (P)	0.13	%
AOAC 975.03			
	Potassium, Total (K)	1.63	%
	Potassium, Total (K)	1.82	%
	Potassium, Total (K)	1.63	%

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1145 E. Cass St, Tampa, FL 33602
Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

22-Jul-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Agrostis (Roots)
Sampled on 6/29/09
Total Dry Weight: 140.3 grams

Attn: Jeff Medcalf
Proj: Lee County Vegetated Mat
Nutrient Study
Proj# 756-9G006

Date Received: 1-Jul-2009

Laboratory Number: 322890, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	80.59	%
	ANALYSIS ON DRY BASIS		
AOAC 978.02			
	Nitrogen, Total (N)	2.01	%
	Nitrogen, Total (N)	1.02	%
	Nitrogen, Total (N)	1.06	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.09	%
	Phosphorus, Total (P)	0.09	%
	Phosphorus, Total (P)	0.09	%
AOAC 975.03			
	Potassium, Total (K)	0.23	%
	Potassium, Total (K)	0.28	%
	Potassium, Total (K)	0.27	%

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1145 E. Cass St, Tampa, FL 33602
Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Pontederia (Shoots)
Sampled on 6/29/09
Total Dry Weight: 79.9 grams

Attn: Jeff Medcalf
Proj: Lee County Vegetated Mat
Nutrient Study
Proj# 756-9G006

Date Received: 1-Jul-2009

Laboratory Number: 322891, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	77.40	%
	ANALYSIS ON DRY BASIS		
AOAC 978.02			
	Nitrogen, Total (N)	1.02	%
	Nitrogen, Total (N)	1.01	%
	Nitrogen, Total (N)	0.80	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.04	%
	Phosphorus, Total (P)	0.07	%
	Phosphorus, Total (P)	0.07	%
AOAC 975.03			
	Potassium, Total (K)	1.70	%
	Potassium, Total (K)	1.71	%
	Potassium, Total (K)	1.70	%

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THORNTON LABORATORIES
TESTING & INSPECTION SERVICES, INC.

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WWW.THORNTONLAB.COM

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Pontederia (Roots)
Sampled on 6/29/09
Total Dry Weight: 568.2 grams

Attn: Jeff Medcalf
Proj: Lee County Vegetated Mat
Nutrient Study
Proj# 756-9G006

Date Received: 1-Jul-2009

Laboratory Number: 322892, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	74.79	%
	ANALYSIS ON DRY BASIS		
AOAC 978.02			
	Nitrogen, Total (N)	0.67	%
	Nitrogen, Total (N)	0.65	%
	Nitrogen, Total (N)	0.61	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.06	%
	Phosphorus, Total (P)	0.04	%
	Phosphorus, Total (P)	0.05	%
AOAC 975.03			
	Potassium, Total (K)	0.10	%
	Potassium, Total (K)	0.15	%
	Potassium, Total (K)	0.098	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Juncus (Shoots)
Sampled on 6/29/09
Total Dry Weight: 141.6 grams

Attn: Jeff Medcalf
Proj: Lee County Vegetated Mat
Nutrient Study
Proj# 756-9G006

Date Received: 1-Jul-2009

Laboratory Number: 322893, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	68.60	%
	ANALYSIS ON DRY BASIS		
AOAC 978.02			
	Nitrogen, Total (N)	1.25	%
	Nitrogen, Total (N)	1.26	%
	Nitrogen, Total (N)	1.27	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.08	%
	Phosphorus, Total (P)	0.09	%
	Phosphorus, Total (P)	0.09	%
AOAC 975.03			
	Potassium, Total (K)	1.51	%
	Potassium, Total (K)	1.54	%
	Potassium, Total (K)	1.33	%

THORNTON LABORATORIES
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TESTING & INSPECTION SERVICES, INC.

1145 E. Cass St, Tampa, FL 33602
Phone: 813-223-9702 Fax: 813-223-9332
WWW.THORNTONLAB.COM

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Juncus (Roots)
Sampled on 6/29/09
Total Dry Weight: 89.4 grams

Attn: Jeff Medcalf
Proj: Lee County Vegetated Mat
Nutrient Study
Proj# 756-9G006

Date Received: 1-Jul-2009

Laboratory Number: 322894, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	78.01	%
	ANALYSIS ON DRY BASIS		
AOAC 978.02			
	Nitrogen, Total (N)	1.06	%
	Nitrogen, Total (N)	1.01	%
	Nitrogen, Total (N)	1.08	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.11	%
	Phosphorus, Total (P)	0.11	%
	Phosphorus, Total (P)	0.11	%
AOAC 975.03			
	Potassium, Total (K)	0.44	%
	Potassium, Total (K)	0.65	%
	Potassium, Total (K)	0.60	%

THORNTON LABORATORIES
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EVENT 1 RESULTS

Sample Event 1 N, P K (Roots)																	
Genus Species	Wet Weight (gm)	% Moisture	Dry Weight (gm)	N Sample Results (% dwb)			N Mean (% dwb)	N SD (% dwb)	P Sample Results (% dwb)			P Mean (% dwb)	P SD (% dwb)	K Sample Results (% dwb)			K Mean (% dwb)	K SD (% dwb)
				N1	N2	N3			P1	P2	P3			K1	K2 (%)	K3 (%)		
Agrostis alba	253.4	80.59	140.3	2.01	1.02	1.06	1.36	0.431	0.09	0.09	0.09	0.09	0.0000	0.23	0.28	0.27	0.26	0.020
Pontederia cordata	993.2	74.79	568.2	0.67	0.65	0.61	0.64	0.022	0.06	0.04	0.05	0.05	0.0067	0.10	0.15	0.098	0.116	0.023
Canna flacida	82.1	86.69	44.0	1.23	1.12	1.14	1.16	0.044	0.10	0.10	0.10	0.10	0.0000	1.18	1.16	1.12	1.15	0.022
Juncus effusus	159.1	78.01	89.4	1.06	1.01	1.08	1.05	0.027	0.11	0.11	0.11	0.11	0.0000	0.44	0.65	0.60	0.56	0.082
Totals =	**1,487.81**		**841.9**															

Sample Event 1 Total (gm) N, P K (Roots)																
Genus Species	Total N (gm dwb)			N Mean (gm dwb)	N SD (gm dwb)	Total P (gm dwb)			P Mean (gm dwb)	P SD (gm dwb)	Total K (gm dwb)			K Mean (gm dwb)	K SD (gm dwb)
	N1	N2	N3			P1	P2	P3			K1	K2 (%)	K3 (%)		
Agrotis alba	2.82	1.43	1.49	1.91	0.605	0.13	0.13	0.13	0.13	0.000	0.32	0.39	0.38	0.36	0.0281
Pontederia cordata	3.81	3.69	3.47	3.66	0.126	0.34	0.23	0.28	0.28	0.038	0.57	0.85	0.56	0.66	0.1288
Canna flacida	0.54	0.49	0.50	0.51	0.020	0.04	0.04	0.04	0.04	0.000	0.52	0.51	0.49	0.51	0.0098
Juncus effusus	0.95	0.90	0.97	0.94	0.024	0.10	0.10	0.10	0.10	0.000	0.39	0.58	0.54	0.50	0.0735
Totals =	**8.12**	**6.52**	**6.42**	**7.02**		**0.61**	**0.50**	**0.55**	**0.55**		**1.80**	**2.34**	**1.96**	**2.03**	

Sample Event 1 Total N, P K (Shoots)																	
Genus Species	Wet Weight (gm)	% Moisture	Dry Weight (gm)	N Sample Results (% dwb)			N Mean (% dwb)	N SD (% dwb)	P Sample Results (% dwb)			P Mean (% dwb)	P SD (% dwb)	K Sample Results (% dwb)			K Mean (% dwb)	K SD (% dwb)
				N1	N2	N3			P1	P2	P3			K1	K2 (%)	K3 (%)		
Agrostis alba	104.0	76.89	58.80	1.05	1.15	1.10	1.10	0.033	0.10	0.13	0.13	0.120	0.0133	1.63	1.82	1.63	1.69333	0.0844
Pontederia cordata	141.7	77.40	79.90	1.02	1.01	0.80	0.94	0.096	0.04	0.07	0.07	0.060	0.0133	1.70	1.71	1.70	1.70333	0.0044
Canna flacida	35.6	90.32	18.70	1.22	1.25	1.15	1.21	0.038	0.12	0.11	0.11	0.113	0.0044	5.34	5.82	5.39	5.51667	0.2022
Juncus effusus	238.7	68.60	141.60	1.25	1.26	1.27	1.26	0.007	0.08	0.09	0.09	0.087	0.0044	1.51	1.54	1.33	1.46000	0.0867
Total =	**520.08**		**299.00**															

Sample Event 1 Total of N, P K (Shoots)															
Genus Species	Total N (gm dwb)			N Mean (gm dwb)	N SD (gm dwb)	Total P (gm dwb)			P Mean (gm dwb)	P SD (gm dwb)	Total K (gm dwb)			K Mean (gm)	K SD (gm dwb)
	N1	N2	N3			P1	P2	P3			K1	K2	K3		
Agrostis alba	0.62	0.68	0.65	0.65	0.020	0.06	0.08	0.08	0.07	0.008	0.96	1.07	0.96	1.00	0.050
Pontederia cordata	0.81	0.81	0.64	0.75	0.076	0.03	0.06	0.06	0.05	0.011	1.36	1.37	1.36	1.36	0.004
Canna flacida	0.23	0.23	0.22	0.23	0.007	0.02	0.02	0.02	0.02	0.001	1.00	1.09	1.01	1.03	0.038
Juncus effusus	1.77	1.78	1.80	1.78	0.009	0.11	0.13	0.13	0.12	0.006	2.14	2.18	1.88	2.07	0.123
Total =	**3.43**	**3.50**	**3.30**	**3.41**		**0.23**	**0.28**	**0.28**	**0.26**		**5.45**	**5.71**	**5.21**	**5.46**	

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22-Sep-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Agrostis Roots
Sampled on 8/27/09
Total Dry Weight: 277.1 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324492, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	76.39	%
AOAC 993.13			
	Nitrogen, Total (N)	1.21	%
	Nitrogen, Total (N)	1.11	%
	Nitrogen, Total (N)	1.13	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.07	%
	Phosphorus, Total (P)	0.08	%
	Phosphorus, Total (P)	0.07	%
AOAC 975.03			
	Potassium, Total (K)	0.15	%
	Potassium, Total (K)	0.13	%
	Potassium, Total (K)	0.14	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Agrostis Shoots
Sampled on 8/27/09
Total Dry Weight: 72.5 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324493, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	78.93	%
AOAC 993.13			
	Nitrogen, Total (N)	1.53	%
	Nitrogen, Total (N)	1.52	%
	Nitrogen, Total (N)	1.52	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.11	%
	Phosphorus, Total (P)	0.11	%
	Phosphorus, Total (P)	0.14	%
AOAC 975.03			
	Potassium, Total (K)	1.45	%
	Potassium, Total (K)	1.37	%
	Potassium, Total (K)	1.45	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Pontederia Roots
Sampled on 8/27/09
Total Dry Weight: 1190.5 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324494, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	80.56	%
AOAC 993.13			
	Nitrogen, Total (N)	0.72	%
	Nitrogen, Total (N)	0.62	%
	Nitrogen, Total (N)	0.67	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.06	%
	Phosphorus, Total (P)	0.05	%
	Phosphorus, Total (P)	0.04	%
AOAC 975.03			
	Potassium, Total (K)	0.14	%
	Potassium, Total (K)	0.10	%
	Potassium, Total (K)	0.12	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Pontederia Shoots
Sampled on 8/27/09
Total Dry Weight: 33.1 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324495, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	72.73	%
AOAC 993.13			
	Nitrogen, Total (N)	0.92	%
	Nitrogen, Total (N)	1.10	%
	Nitrogen, Total (N)	0.99	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.05	%
	Phosphorus, Total (P)	0.06	%
	Phosphorus, Total (P)	0.06	%
AOAC 975.03			
	Potassium, Total (K)	0.65	%
	Potassium, Total (K)	0.62	%
	Potassium, Total (K)	0.67	%

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22-Sep-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Juncus Roots
Sampled on 8/27/09
Total Dry Weight: 247.5 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324496, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	74.29	%
AOAC 993.13			
	Nitrogen, Total (N)	1.13	%
	Nitrogen, Total (N)	1.02	%
	Nitrogen, Total (N)	1.19	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.09	%
	Phosphorus, Total (P)	0.09	%
	Phosphorus, Total (P)	0.11	%
AOAC 975.03			
	Potassium, Total (K)	0.44	%
	Potassium, Total (K)	0.43	%
	Potassium, Total (K)		%

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22-Sep-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Juncus Shoots
Sampled on 8/27/09
Total Dry Weight: 232.3 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324497, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	50.70	%
AOAC 993.13			
	Nitrogen, Total (N)	0.90	%
	Nitrogen, Total (N)	0.88	%
	Nitrogen, Total (N)	0.90	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.06	%
	Phosphorus, Total (P)	0.07	%
	Phosphorus, Total (P)	0.07	%
AOAC 975.03			
	Potassium, Total (K)	0.86	%
	Potassium, Total (K)	0.85	%
	Potassium, Total (K)		%

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22-Sep-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Canna Roots
Sampled on 8/27/09
Total Dry Weight: 348.6 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324498, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	75.36	%
AOAC 993.13			
	Nitrogen, Total (N)	0.64	%
	Nitrogen, Total (N)	0.66	%
	Nitrogen, Total (N)	0.72	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.05	%
	Phosphorus, Total (P)	0.05	%
	Phosphorus, Total (P)	0.05	%
AOAC 975.03			
	Potassium, Total (K)	0.31	%
	Potassium, Total (K)	0.31	%
	Potassium, Total (K)	0.29	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Canna Shoots
Sampled on 8/27/09
Total Dry Weight: 38.8 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324499, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	87.60	%
AOAC 993.13			
	Nitrogen, Total (N)	1.51	%
	Nitrogen, Total (N)	1.43	%
	Nitrogen, Total (N)	1.44	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.12	%
	Phosphorus, Total (P)	0.07	%
	Phosphorus, Total (P)	0.09	%
AOAC 975.03			
	Potassium, Total (K)	4.48	%
	Potassium, Total (K)	4.25	%
	Potassium, Total (K)	4.05	%

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22-Sep-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Ludwigia Roots
Sampled on 8/27/09
Total Dry Weight: 62.7 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324500, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	83.20	%
AOAC 993.13			
	Nitrogen, Total (N)	0.82	%
	Nitrogen, Total (N)	0.73	%
	Nitrogen, Total (N)	1.35	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.11	%
	Phosphorus, Total (P)	0.16	%
	Phosphorus, Total (P)	0.17	%
AOAC 975.03			
	Potassium, Total (K)	4.79	%
	Potassium, Total (K)	4.92	%
	Potassium, Total (K)	5.23	%

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22-Sep-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Ludwigia Shoots
Sampled on 8/27/09
Total Dry Weight: 36.7 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324501, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	57.57	%
AOAC 993.13			
	Nitrogen, Total (N)	2.61	%
	Nitrogen, Total (N)	2.52	%
	Nitrogen, Total (N)	2.58	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.13	%
	Phosphorus, Total (P)	0.13	%
	Phosphorus, Total (P)	0.13	%
AOAC 975.03			
	Potassium, Total (K)	1.42	%
	Potassium, Total (K)	1.47	%
	Potassium, Total (K)	1.44	%

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22-Sep-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Other Shoots
Sampled on 8/27/09
Total Dry Weight: 11.6 grams

Attn: Jeff Medcalf
Proj: Lee County (Nutrient) Floating Mat Supply

Date Received: 28-Aug-2009

Laboratory Number: 324502, Revised

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	15.94	%
AOAC 993.13			
	Nitrogen, Total (N)	1.27	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.07	%
AOAC 975.03			
	Potassium, Total (K)	0.95	%

Note: Insufficient sample to analyze in triplicate.

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EVENT 2 RESULTS

Sample Event 2 Total N, P K (Roots)																	
Genus Species	Wet Weight (gm)	% Moisture	Dry Weight (gm)	N Sample Results (% dwb)			N Mean (% dwb)	N SD (% dwb)	P Sample Results (% dwb)			P Mean (% dwb)	P SD (% dwb)	K Sample Results (% dwb)			K Mean (% dwb)	K SD (% dwb)
				N1	N2	N3			P1	P2	P3			K1	K2	K3		
Agrotis alba	488.8	76.4	277.1	1.21	1.11	1.13	1.150	0.0400	0.07	0.08	0.07	0.073	0.0000	0.15	0.13	0.14	0.140	0.0067
Pontederia cordata	1,156.0	80.6	640.2	0.72	0.62	0.67	0.670	0.0333	0.06	0.05	0.04	0.050	0.0067	0.14	0.10	0.120	0.120	0.0133
Canna flacida	611.3	75.4	348.6	0.64	0.66	0.72	0.673	0.0311	0.05	0.05	0.05	0.050	0.0000	0.31	0.31	0.29	0.303	0.0089
Juncus effusus	431.4	74.3	247.5	1.13	1.02	1.19	1.113	0.0622	0.09	0.09	0.11	0.097	0.0089	0.44	0.43	0.44	0.435	0.0050
Ludwigia spp.	114.9	83.2	62.7	0.82	0.73	1.35	0.967	0.2556	0.11	0.16	0.17	0.147	0.0244	4.79	4.92	5.23	4.980	0.1667
Total =	**2,802.3**		**1,576.1**															

Sample Event 2 Total (gm) N, P K (Roots)																	
Genus Species	Total N (gm dwb)			N Mean (gm dwb)	N SD (gm dwb)	Total P (gm dwb)			P Mean (gm dwb)	P SD (gm dwb)	Total K (gm dwb)			K Mean (gm dwb)	K SD (gm dwb)
	N1	N2	N3			P1	P2	P3			K1	K2	K3		
Agrotis alba	3.35	3.08	3.13	3.19	0.111	0.19	0.22	0.19	0.20	0.012	0.42	0.36	0.39	0.39	0.018
Pontederia cordata	4.61	3.97	4.29	4.29	0.213	0.38	0.32	0.26	0.32	0.043	0.90	0.64	0.77	0.77	0.085
Canna flacida	2.23	2.30	2.51	2.35	0.108	0.17	0.17	0.17	0.17	0.000	1.08	1.08	1.01	1.06	0.031
Juncus effusus	2.80	2.52	2.95	2.76	0.154	0.22	0.22	0.27	0.24	0.022	1.09	1.06	1.09	1.08	0.011
Ludwigia spp.	0.51	0.46	0.85	0.61	0.160	0.07	0.10	0.11	0.09	0.015	3.00	3.08	3.28	3.12	0.105
Total =				**13.19**					**1.03**					**6.42**	

Sample Event 2 Total N, P K (Shoots)																	
Genus Species	Wet Weight (gm)	% Moisture	Dry Weight (gm)	N Sample Results (% dwb)			N Mean (% dwb)	N SD (% dwb)	P Sample Results (% dwb)			P Mean (% dwb)	P SD (% dwb)	K Sample Results (% dwb)			K Mean (% dwb)	K SD (% dwb)
				N1	N2	N3			P1	P2	P3			K1	K2 (%)	K3		
Agrotis alba	129.7	78.93	72.5	1.53	1.52	1.52	1.52	0.004	0.11	0.11	0.14	0.12	0.013	1.45	1.37	1.45	1.42	0.036
Pontederia cordata	57.2	72.73	33.1	0.92	1.10	0.99	1.00	0.064	0.05	0.06	0.06	0.06	0.004	0.65	0.62	0.67	0.65	0.018
Canna flacida	72.8	87.60	38.8	1.51	1.43	1.44	1.46	0.033	0.12	0.07	0.09	0.09	0.018	4.48	4.25	4.05	4.26	0.147
Juncus effusus	350.1	50.70	232.3	0.90	0.88	0.90	0.89	0.009	0.06	0.07	0.07	0.07	0.004	0.86	0.85	----	0.86	0.005
Ludwigia spp.	57.8	57.57	36.7	2.61	2.52	2.58	2.57	0.033	0.13	0.13	0.13	0.13	0.000	1.42	1.47	1.44	1.44	0.018
Total =	**609.76**		**413.4**															

Sample Event 2 Total (gm) of N, P K (Shoots)																
Genus Species	Total N (gm dwb)			N Mean (gm dwb)	N SD (gm dwb)	Total P (gm dwb)			P Mean (gm dwb)	P SD (gm dwb)	Total K (gm dwb)			K Mean (gm dwb)	K SD (gm dwb)
	N1	N2	N3			P1	P2	P3			K1	K2	K3		
Agrotis alba	1.11	1.10	1.10	1.10	0.003	0.08	0.08	0.10	0.09	0.010	1.05	0.99	1.05	1.03	0.026
Pontederia cordata	0.30	0.36	0.33	0.33	0.021	0.02	0.02	0.02	0.02	0.001	0.22	0.21	0.22	0.21	0.006
Canna flacida	0.59	0.55	0.56	0.57	0.013	0.05	0.03	0.03	0.04	0.007	1.74	1.65	1.57	1.65	0.057
Juncus effusus	2.09	2.04	2.09	2.08	0.021	0.14	0.16	0.16	0.15	0.010	2.00	1.97		1.99	0.012
Ludwigia spp.	0.96	0.92	0.95	0.94	0.012	0.05	0.05	0.05	0.05	0.000	0.52	0.54	0.53	0.53	0.007
Total =				**5.02**					**0.34**					**5.41**	

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3-Dec-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant Attn: Jeff Medcalf
ID: Pontedaria Shoots
Total Dry Weight: 21.4 grams

Date Received: 30-Oct-2009

Laboratory Number: 325968

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	86.11	%
AOAC 993.13			
	Nitrogen, Total (N)	1.42	%
	Nitrogen, Total (N)	1.40	%
	Nitrogen, Total (N)	1.39	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.04	%
	Phosphorus, Total (P)	0.04	%
	Phosphorus, Total (P)	0.03	%
AOAC 975.03			
	Potassium, Total (K)	0.94	%
	Potassium, Total (K)	1.22	%
	Potassium, Total (K)	1.09	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant Attn: Jeff Medcalf
ID: Pontedaria Roots with Husk
Total Dry Weight: 486.0 grams

Date Received: 30-Oct-2009

Laboratory Number: 325969

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	78.92	%
AOAC 993.13			
	Nitrogen, Total (N)	0.67	%
	Nitrogen, Total (N)	0.48	%
	Nitrogen, Total (N)	0.35	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.04	%
	Phosphorus, Total (P)	0.04	%
	Phosphorus, Total (P)	0.04	%
AOAC 975.03			
	Potassium, Total (K)	0.043	%
	Potassium, Total (K)	0.038	%
	Potassium, Total (K)	0.036	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant Attn: Jeff Medcalf
ID: Argostis Shoots
Total Dry Weight: 716.3 grams

Date Received: 30-Oct-2009

Laboratory Number: 325970

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	83.60	%
AOAC 993.13			
	Nitrogen, Total (N)	2.25	%
	Nitrogen, Total (N)	2.42	%
	Nitrogen, Total (N)	2.17	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.16	%
	Phosphorus, Total (P)	0.16	%
	Phosphorus, Total (P)	0.12	%
AOAC 975.03			
	Potassium, Total (K)	1.79	%
	Potassium, Total (K)	1.82	%
	Potassium, Total (K)	1.87	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
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Sample Identification:

Plant Attn: Jeff Medcalf
ID: Argostis Roots
Total Dry Weight: 1904.7 grams

Date Received: 30-Oct-2009

Laboratory Number: 325971

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	86.61	%
AOAC 993.13			
	Nitrogen, Total (N)	1.37	%
	Nitrogen, Total (N)	1.41	%
	Nitrogen, Total (N)	1.42	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.10	%
	Phosphorus, Total (P)	0.10	%
	Phosphorus, Total (P)	0.10	%
AOAC 975.03			
	Potassium, Total (K)	0.27	%
	Potassium, Total (K)	0.24	%
	Potassium, Total (K)	0.24	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Canna Shoots
Total Dry Weight: 18.9 grams

Attn: Jeff Medcalf

Date Received: 30-Oct-2009

Laboratory Number: 325972

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	94.79	%
AOAC 993.13			
	Nitrogen, Total (N)	1.78	%
	Nitrogen, Total (N)	1.78	%
	Nitrogen, Total (N)	1.97	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.13	%
	Phosphorus, Total (P)	0.14	%
	Phosphorus, Total (P)	0.14	%
AOAC 975.03			
	Potassium, Total (K)	3.67	%
	Potassium, Total (K)	3.70	%
	Potassium, Total (K)	3.72	%

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3-Dec-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant Attn: Jeff Medcalf
ID: Canna Roots
Total Dry Weight: 555.8 grams

Date Received: 30-Oct-2009

Laboratory Number: 325973

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	52.38	%
AOAC 993.13			
	Nitrogen, Total (N)	2.17	%
	Nitrogen, Total (N)	2.21	%
	Nitrogen, Total (N)	2.21	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.14	%
	Phosphorus, Total (P)	0.18	%
	Phosphorus, Total (P)	0.13	%
AOAC 975.03			
	Potassium, Total (K)	1.07	%
	Potassium, Total (K)	1.07	%
	Potassium, Total (K)	0.81	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Juncus Roots
Total Dry Weight: 342.3 grams

Attn: Jeff Medcalf

Date Received: 30-Oct-2009

Laboratory Number: 325975

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	87.39	%
AOAC 993.13			
	Nitrogen, Total (N)	1.25	%
	Nitrogen, Total (N)	1.41	%
	Nitrogen, Total (N)	1.46	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.13	%
	Phosphorus, Total (P)	0.13	%
	Phosphorus, Total (P)	0.11	%
AOAC 975.03			
	Potassium, Total (K)	0.66	%
	Potassium, Total (K)	0.70	%
	Potassium, Total (K)	1.01	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant Attn: Jeff Medcalf
ID: Juncus Shoots
Total Dry Weight: 390.7 grams

Date Received: 30-Oct-2009

Laboratory Number: 325974

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	70.01	%
AOAC 993.13			
	Nitrogen, Total (N)	1.16	%
	Nitrogen, Total (N)	1.05	%
	Nitrogen, Total (N)	1.00	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.06	%
	Phosphorus, Total (P)	0.06	%
	Phosphorus, Total (P)	0.07	%
AOAC 975.03			
	Potassium, Total (K)	1.06	%
	Potassium, Total (K)	1.07	%
	Potassium, Total (K)	1.15	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant Attn: Jeff Medcalf
ID: Ludwigia Shoots
Total Dry Weight: 343.9 grams

Date Received: 30-Oct-2009

Laboratory Number: 325976

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	83.5	%
AOAC 993.13			
	Nitrogen, Total (N)	1.56	%
	Nitrogen, Total (N)	1.52	%
	Nitrogen, Total (N)	1.38	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.10	%
	Phosphorus, Total (P)	0.11	%
	Phosphorus, Total (P)	0.15	%
AOAC 975.03			
	Potassium, Total (K)	1.79	%
	Potassium, Total (K)	1.97	%
	Potassium, Total (K)	1.79	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant Attn: Jeff Medcalf
ID: Ludwigia Roots
Total Dry Weight: 107.2 grams

Date Received: 30-Oct-2009

Laboratory Number: 325977

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	90.62	%
AOAC 993.13			
	Nitrogen, Total (N)	2.08	%
	Nitrogen, Total (N)	1.97	%
	Nitrogen, Total (N)	2.04	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.18	%
	Phosphorus, Total (P)	0.20	%
	Phosphorus, Total (P)	0.21	%
AOAC 975.03			
	Potassium, Total (K)	0.89	%
	Potassium, Total (K)	0.84	%
	Potassium, Total (K)	0.92	%

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8-Dec-2009

Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant
ID: Unknown Shoots
Total Dry Weight: 26.2 grams

Attn: Jeff Medcalf

Date Received: 30-Oct-2009

Laboratory Number: 325978

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	76.42	%
AOAC 993.13			
	Nitrogen, Total (N)	1.58	%
	Nitrogen, Total (N)	1.76	%
	Nitrogen, Total (N)	1.74	%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.11	%
	Phosphorus, Total (P)	0.10	%
	Phosphorus, Total (P)	0.10	%
AOAC 975.03			
	Potassium, Total (K)	1.68	%
	Potassium, Total (K)	1.70	%
	Potassium, Total (K)	1.77	%

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Report For: Professional Service Industries, Inc.
5801 Benjamin Center Drive
Tampa, FL 33634

Sample Identification:

Plant Attn: Jeff Medcalf
ID: Unknown Roots
Total Dry Weight: 6.0 grams

Date Received: 30-Oct-2009

Laboratory Number: 325979

CERTIFICATE OF ANALYSIS

Method	Parameter	Result	Units
	Crude Moisture	76.10	%
AOAC 993.13			
	Nitrogen, Total (N)	1.47	%
	Nitrogen, Total (N)	1.49	%
	Nitrogen, Total (N)		%
AOAC 931.01,958.01			
	Phosphorus, Total (P)	0.09	%
	Phosphorus, Total (P)	0.09	%
	Phosphorus, Total (P)	0.10	%
AOAC 975.03			
	Potassium, Total (K)	0.74	%
	Potassium, Total (K)	0.77	%
	Potassium, Total (K)	0.75	%

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EVENT 3 RESULTS

Sample Event 3 Total N, P K (Roots)																		
Genus Species	Wet Weight (gm)	% Moisture	Dry Weight (gm)	N Sample Results (% dwb)			N Mean (% dwb)	N SD (% dwb)	P Sample Results (% dwb)			P Mean (% dwb)	P SD (% dwb)	K Sample Results (% dwb)			K Mean (% dwb)	K SD (% dwb)
				N1	N2	N3			P1	P2	P3			K1	K2	K3		
Agrotis alba	3,554.4	86.61	1,904.7	1.37	1.41	1.42	1.40	0.020	0.10	0.10	0.10	0.10	0.000	0.27	0.24	0.24	0.250	0.0133
Pontederia cordata	176.8	78.92	98.8	0.67	0.48	0.35	0.50	0.113	0.04	0.04	0.04	0.04	0.000	0.04	0.04	0.036	0.039	0.0027
Canna flacida	846.9	52.38	555.8	2.17	2.21	2.21	2.20	0.018	0.14	0.18	0.13	0.15	0.020	1.07	1.07	0.81	0.983	0.1156
Juncus effusus	641.4	87.39	342.3	1.25	1.41	1.46	1.37	0.082	0.13	0.13	0.11	0.12	0.009	0.66	0.70	1.01	0.790	0.1467
Ludwigia spp.	204.3	90.62	107.2	2.08	1.97	2.04	2.03	0.040	0.18	0.20	0.21	0.20	0.011	0.89	0.84	0.92	0.883	0.0289
Total =	**5,219.5**		**2,901.6**															

Sample Event 3 Total (gm) N, P K (Roots)																	
Genus Species	Total N (gm dwb)			N Mean (gm dwb)	N SD (gm dwb)	Total P (gm dwb)			P Mean (gm dwb)	P SD (gm dwb)	Total K (gm dwb)			K Mean (gm dwb)	K SD (gm dwb)
	N1	N2	N3			P1	P2	P3			K1	K2	K3		
Agrotis alba	26.09	26.86	27.05	26.67	0.38	1.90	1.90	1.90	1.90	0.000	5.14	4.57	4.57	4.76	0.254
Pontederia cordata	0.66	0.47	0.35	0.49	0.11	0.04	0.04	0.04	0.04	0.000	0.04	0.04	0.04	0.04	0.003
Canna flacida	12.06	12.28	12.28	12.21	0.10	0.78	1.00	0.72	0.83	0.111	5.95	5.95	4.50	5.47	0.642
Juncus effusus	4.28	4.83	5.00	4.70	0.28	0.44	0.44	0.38	0.42	0.030	2.26	2.40	3.46	2.70	0.502
Ludwigia spp.	2.23	2.11	2.19	2.18	0.04	0.19	0.21	0.23	0.21	0.012	0.95	0.90	0.99	0.95	0.031
Total =	**45.33**	**46.55**	**46.86**	**46.25**		**3.36**	**3.60**	**3.27**	**3.41**		**14.35**	**13.85**	**13.55**	**13.92**	**1.432**

Sample Event 3 Total N, P K (Shoots)																		
Genus Species	Wet Weight (gm)	% Moisture	Dry Weight (gm)	N Sample Results (% dwb)			N Mean (% dwb)	N SD (% dwb)	P Sample Results (% dwb)			P Mean (% dwb)	P SD (% dwb)	K Sample Results (% dwb)			K Mean (% dwb)	K SD (% dwb)
				N1	N2	N3			P1	P2	P3			K1	K2	K3		
Agrotis alba	1,315.1	83.60	716.3	2.25	2.42	2.17	2.28	0.093	0.16	0.16	0.12	0.15	0.018	1.79	1.82	1.87	1.83	0.029
Pontederia cordata	39.8	86.11	21.4	1.42	1.40	1.39	1.40	0.011	0.04	0.04	0.03	0.04	0.004	0.94	1.22	1.09	1.08	0.096
Canna flacida	36.8	94.79	18.9	1.78	1.78	1.97	1.84	0.084	0.13	0.13	0.14	0.13	0.004	3.67	3.70	3.72	3.70	0.018
Juncus effusus	664.2	70.01	390.7	1.16	1.05	1.00	1.07	0.060	0.06	0.06	0.07	0.06	0.004	1.06	1.07	1.15	1.09	0.038
Ludwigia spp.	631.1	83.50	343.9	1.56	1.52	1.38	1.49	0.071	0.10	0.11	0.15	0.12	0.020	1.79	1.97	1.79	1.85	0.080
Total =	**2,687.1**		**1,491.2**															

Sample Event 3 Total (gm) N, P K (Shoots)																
Genus Species	Total N (gm dwb)			N Mean (gm dwb)	N SD (gm dwb)	Total P (gm dwb)			P Mean (gm dwb)	P SD (gm dwb)	Total K (gm dwb)			K Mean (gm dwb)	K SD (gm dwb)
	N1	N2	N3			P1	P2	P3			K1	K2	K3		
Agrotis alba	16.12	17.33	15.54	16.33	0.669	1.15	1.15	0.86	1.05	0.127	12.82	13.04	13.3948	13.08	0.207
Pontederia cordata	0.30	0.30	0.30	0.30	0.002	0.01	0.01	0.01	0.01	0.001	0.20	0.02	0.02	0.08	0.082
Canna flacida	0.34	0.34	0.37	0.35	0.016	0.02	0.02	0.03	0.03	0.001	0.69	0.07	0.07	0.28	0.279
Juncus effusus	4.53	4.10	3.91	4.18	0.234	0.23	0.23	0.27	0.25	0.017	4.14	0.01	0.01	1.39	1.835
Ludwigia spp.	5.36	5.23	4.75	5.11	0.245	0.34	0.38	0.52	0.41	0.069	6.16	0.03	0.03	2.07	2.723
Total =	**26.65**	**27.30**	**24.87**	**26.27**		**1.76**	**1.79**	**1.68**	**1.74**		**24.01**	**13.16**	**13.52**	**16.90**	

APPENDIX C

BASELINE THROUGH SAMPLE EVENT 3
COMPOSITE RESULTS

Table: Gross Root Biomass (gm dwb) on Sample Mats				
Genus/ Species	**Baseline**	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	46.20	140.3	277.1	1,904.7
Pontederia cordata	7.65	568.2	640.2	98.8
Canna flacida	16.95	44.0	348.6	555.8
Juncus effusus	46.55	89.4	247.5	342.3
Total	**117.3**	**841.9**	**1,513.4**	**2,901.6**

Figure: Gross Root Biomass on Sample Mats

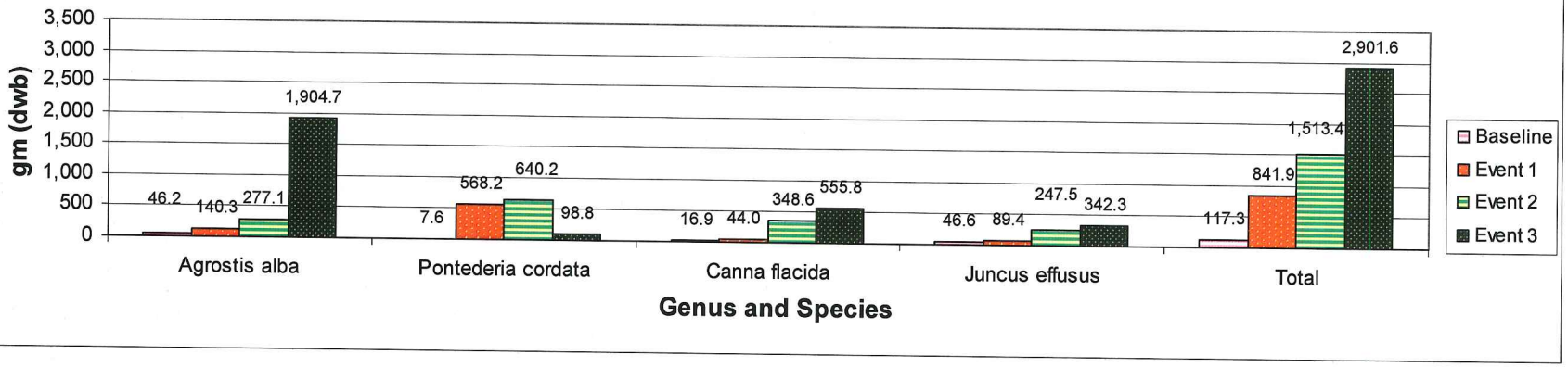

Table: Gross Shoot Biomass (gm dry weight basis) on Sample Mats				
Genus/ Species	**Baseline**	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	26.7	58.8	72.5	716.3
Pontederia cordata	23.8	79.9	33.1	21.4
Canna flacida	5.1	18.7	38.8	18.9
Juncus effusus	31.3	141.6	232.3	390.7
Total =	**86.8**	**299.0**	**376.7**	**1,147.3**

Figure: Gross Shoot Biomass on Sample Mats

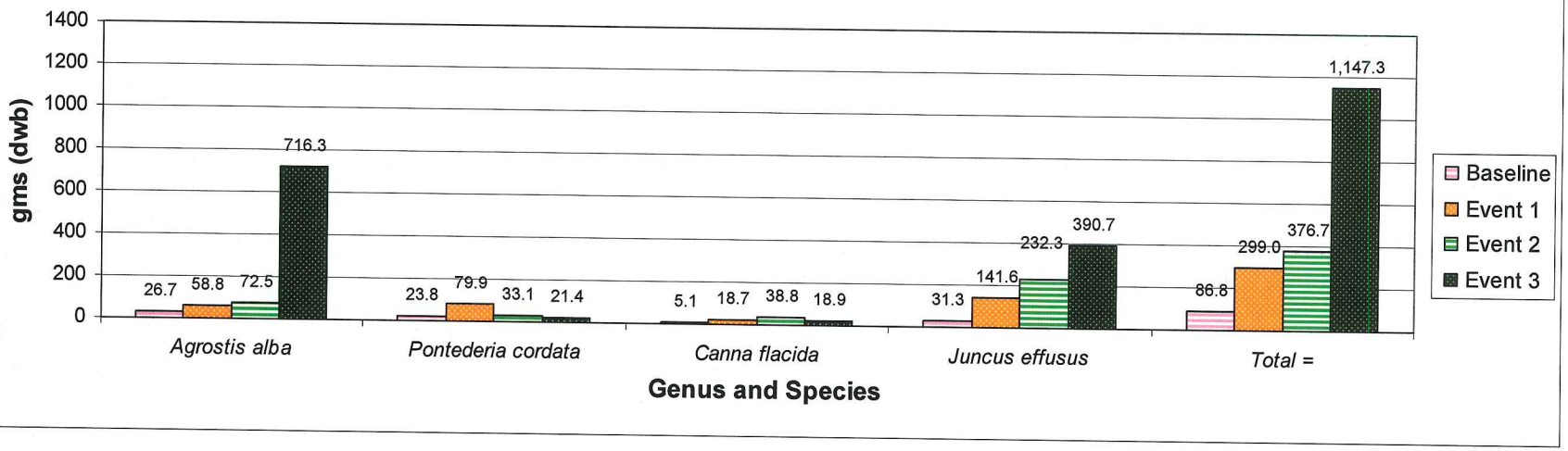

Table: Gross Root and Shoot Biomass (gm dry weight basis) on Sample Mats				
Genus/ Species	**Baseline**	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	72.9	199.1	349.6	2,621.0
Pontederia cordata	31.5	648.1	673.3	120.2
Canna flacida	22.0	62.7	387.4	574.7
Juncus effusus	77.8	231.0	479.8	733.0
Ludwigia spp.	.----	.----	99.4	451.1
Other Spp.	.----	.----	11.6	32.2
Total	**204.2**	**1,140.9**	**2,001.1**	**4,532.2**

Figure: Gross Root and Shoot Biomass on Sample Mats

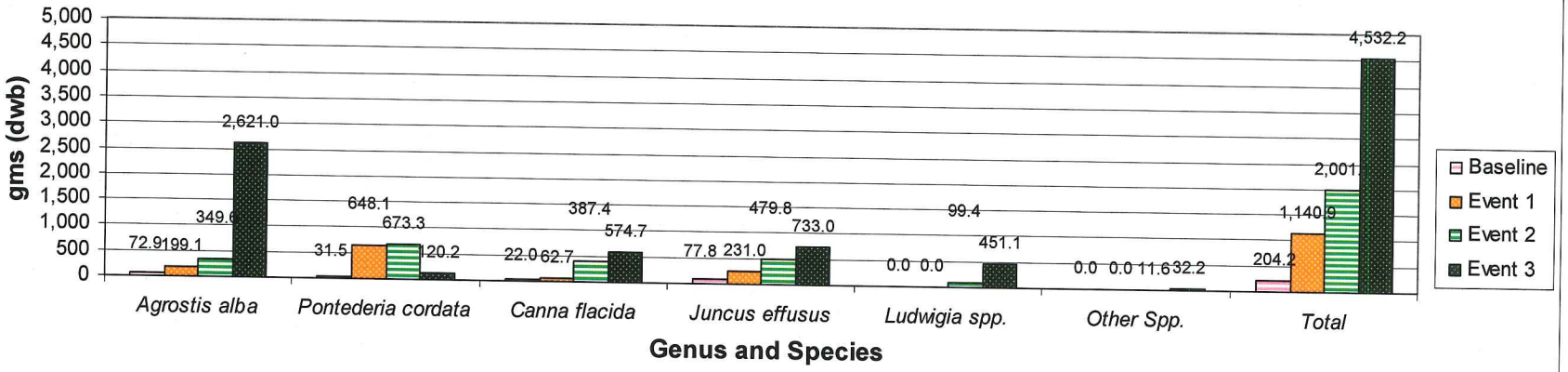

Table: Total Nitrogen (gm dwb) in Sample Mat Roots				
Genus Species	**Baseline**	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.27	1.91	3.19	26.67
Pontederia cordata	0.13	3.66	7.98	2.43
Canna flacida	0.09	0.51	2.35	12.21
Juncus effusus	0.32	0.94	2.76	4.70
Total	**0.81**	**7.02**	**16.27**	**46.01**

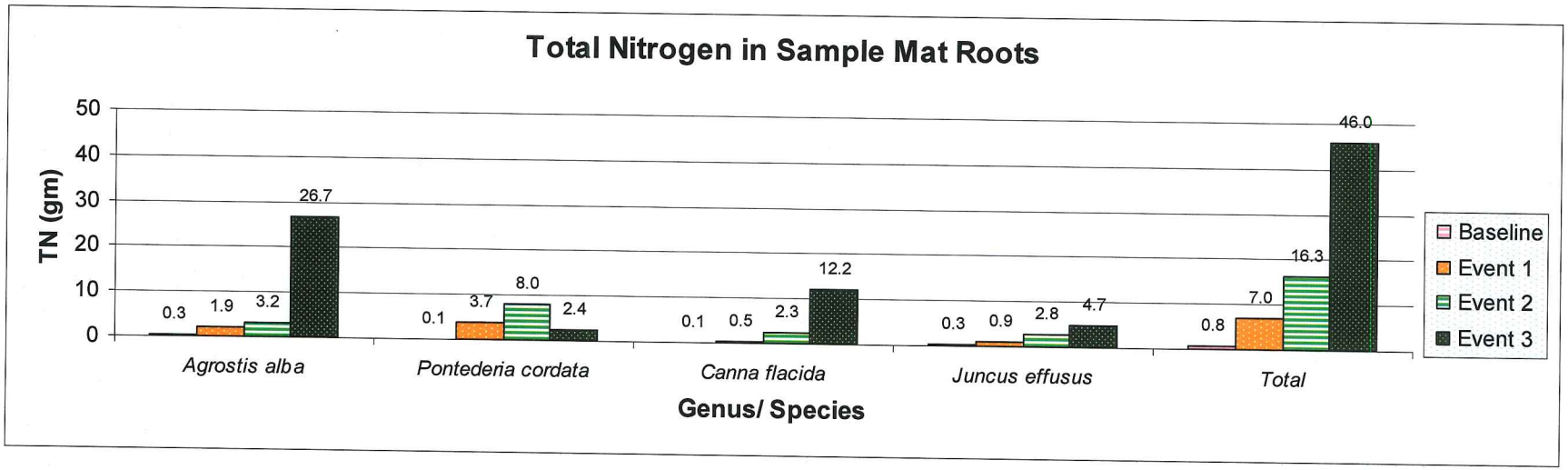

Table: Total Nitrogen (gm dwb) in Sample Mat Shoots				
	Baseline	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.20	0.65	1.10	16.33
Pontederia cordata	0.75	0.75	0.33	0.30
Canna flacida	0.04	0.23	0.57	0.35
Juncus effusus	0.24	1.78	2.08	4.18
Total	**1.23**	**3.41**	**4.08**	**21.16**

Figure: Total Nitrogen in Sample Mat Shoots

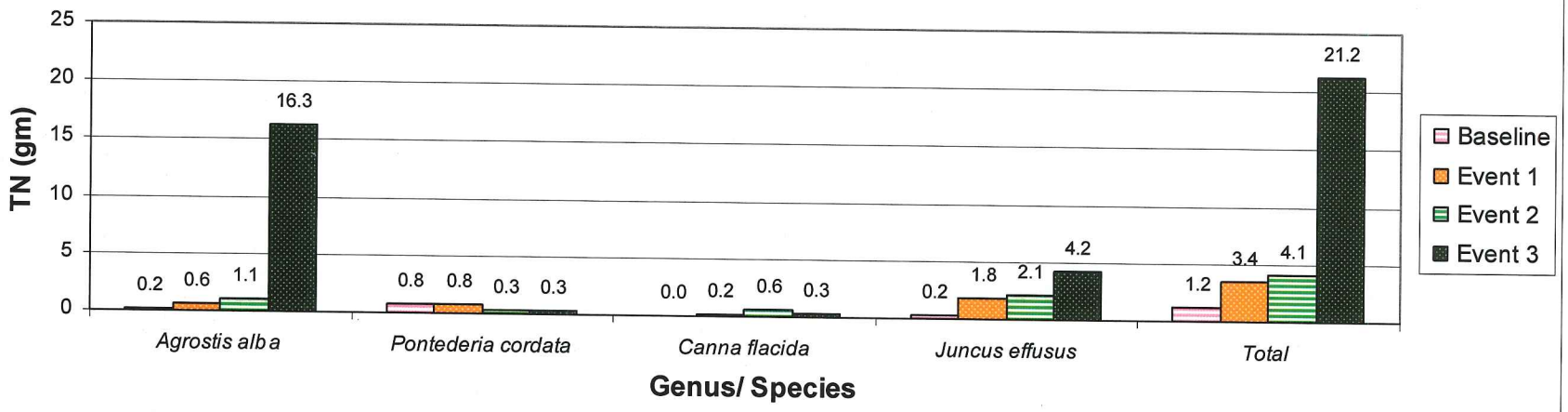

Table: Total Nitrogen (gm dwb) in Sample Mat Roots and Shoots				
	Baseline	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.46	2.56	4.29	43.00
Pontederia cordata	0.89	4.41	8.31	2.73
Canna flacida	0.13	0.74	2.91	12.56
Juncus effusus	0.56	2.72	1.55	8.88
Ludwigia spp.	----	----	1.55	7.29
Other Species	----	----	0.15	0.53
Total	**2.04**	**10.43**	**18.61**	**74.46**

Figure: Total Nitrogen in Sample Mat Roots & Shoots

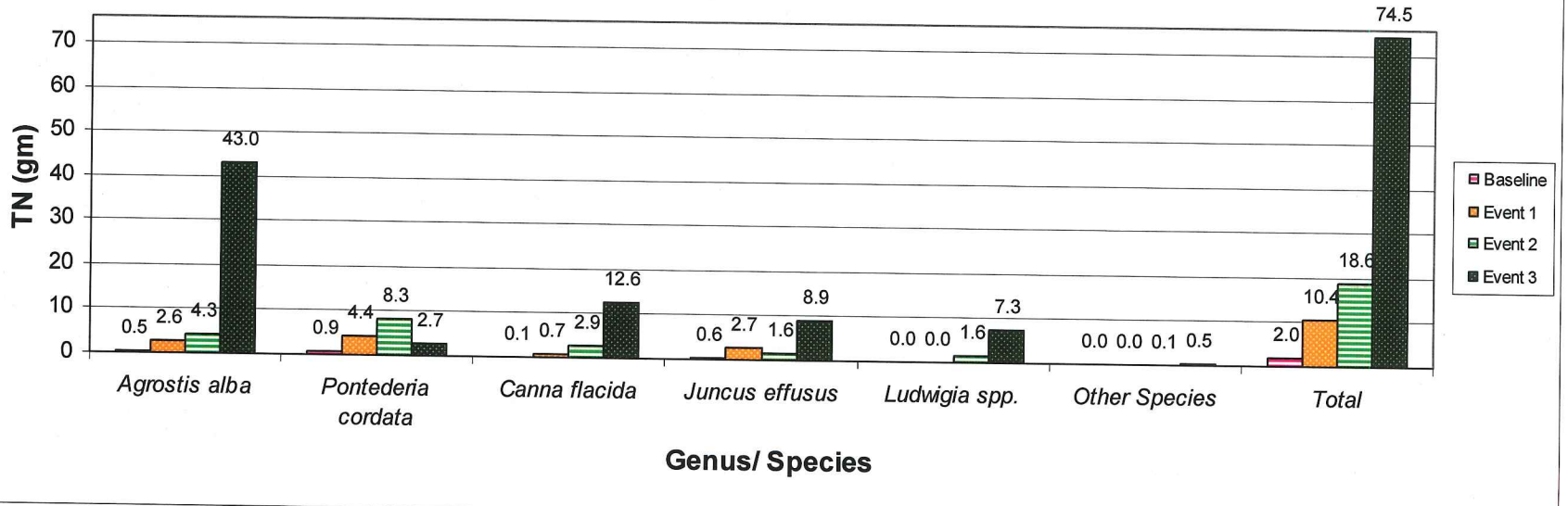

Table: Total Phosphorous (gm dwb) in Sample Mat Roots				
	Baseline	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.060	0.126	0.203	1.905
Pontederia cordata	0.022	0.284	0.320	0.040
Canna flacida	0.034	0.044	0.174	0.834
Juncus effusus	0.074	0.098	0.239	0.422
Total	**0.190**	**0.553**	**0.937**	**3.200**

Figure: Total Phosphorous in Sample Mat Roots

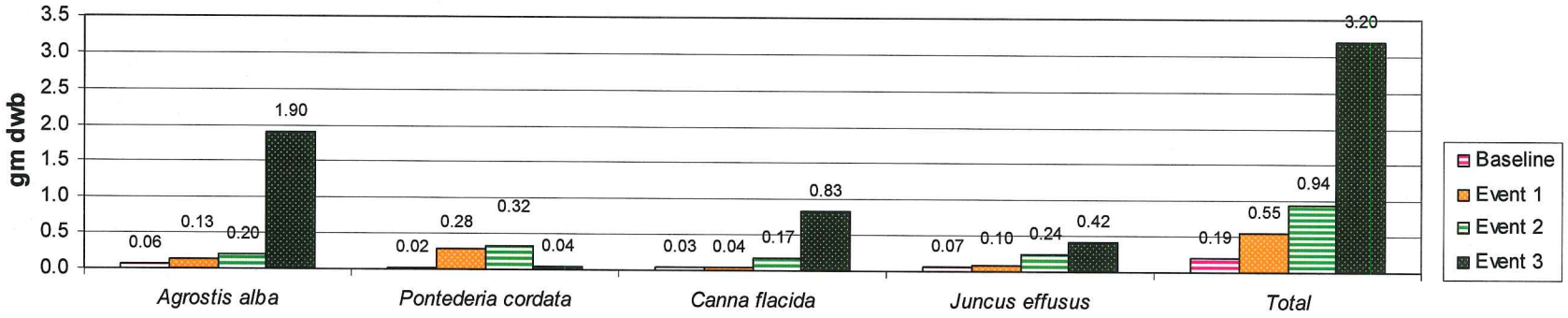

Table: Total Phosphorous (gm dwb) in Sample Mat Shoots				
Genus Species	**Baseline**	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.064	0.071	0.087	1.051
Pontederia cordata	0.114	0.048	0.019	0.008
Canna flacida	0.033	0.021	0.036	0.025
Juncus effusus	0.053	0.123	0.155	0.247
Total	**0.264**	**0.262**	**0.297**	**1.331**

Figure: Total Phosphorous in Sample Mat Shoots

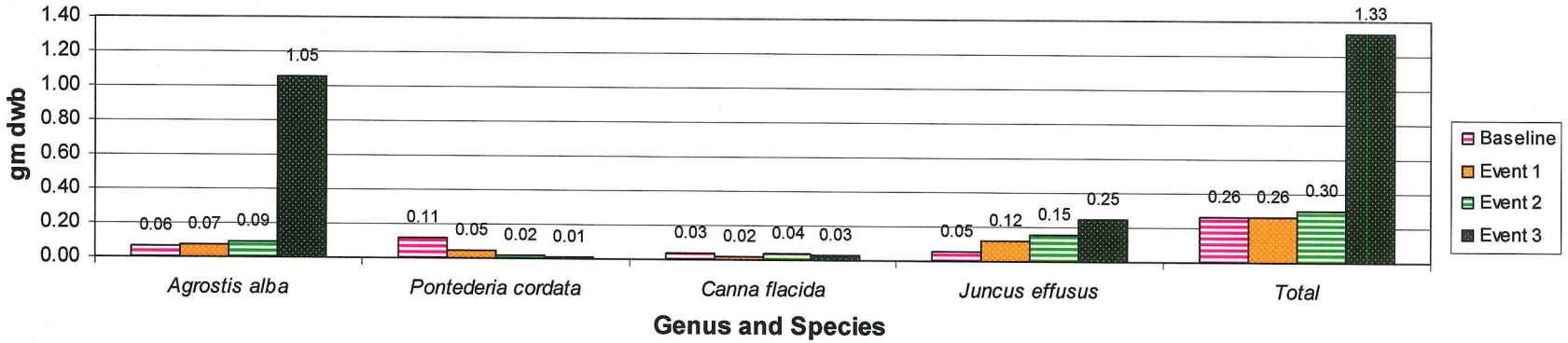

Table: Total Phosphorous (gm dwb) in Sample Mat Roots and Shoots				
Genus Species	**Baseline**	**Event 1**	**Event 2**	**Event 3**
Agrostis alba	0.124	0.197	0.290	2.955
Pontederia cordata	0.136	0.332	0.339	0.047
Canna flacida	0.067	0.065	0.211	0.859
Juncus effusus	0.128	0.221	0.394	0.670
Total	**0.455**	**0.815**	**1.234**	**4.531**

Figure: Total Phosphorous in Sample Mat Roots and Shoots