



QUEST
ecology

MEMORANDUM

TO: Natural Resources Defense Council

FROM: Mary James, PWS, Senior Ecologist

SUBJECT: Summary of March 6, 2020 Site Assessment within Burnett Oil Company's Nobles Grade 3-D Seismic Oil and Gas Exploration area, Big Cypress National Preserve, Collier County, Florida

DATE: March 15, 2020

1.0 INTRODUCTION

On March 6, 2020, Quest Ecology Inc. (Quest) assessed a portion of Burnett Oil Company Inc's (BOCI) Phase I Nobles Grade 3-D Seismic Oil Exploration area within the Big Cypress National Preserve (Preserve). The primary purpose of the assessment was to inspect BOCI's attempted reclamation of the damage it caused, including inspection and assessment of some of the monitoring stations documented in BOCI's *2019 Reclamation Monitoring Report* (Turrell, Hall and Associates, Inc., 2019) (hereinafter, THA Time Zero Monitoring Report), which describes 'Time-Zero' reclamation conditions along ~91 miles of seismic survey lines ('pathways') created in 2017 and 2018 by BOCI's seismic oil exploration activities. These activities took place within a ~40 mi² area of the Preserve dominated by sensitive marl prairie and cypress strand plant communities (FNAI, 2010) unique to south Florida.

As we previously noted in our comments dated January 3, 2020 on THA's Time Zero Monitoring Report that were shared with the permitting agencies, the National Park Service and the Florida Department of Environmental Protection (FDEP), numerous deficiencies in monitoring methodologies, data interpretation, and conclusions have been identified in the THA Time Zero Monitoring Report.

One such deficiency is the insufficient number and size of vegetation monitoring plots needed to yield statistically significant results. THA collected disturbed vegetation data from a single 1 m² (~10.8 ft²) plot placed in the center of the seismic survey lines (i.e., between ruts), to purportedly represent approximately 1 linear mile of impacted pathway or ~63,360 ft² (1.5 acres) of impacted area based on a minimum pathway width of 12 feet. Therefore, each of THA's central/disturbed plots represents a maximum of ~0.02% of the associated impact area.

More statistically robust monitoring methods were proposed in a March 28, 2019 letter from the Natural Resources Defense Council (NRDC) and partner conservation groups to the Preserve's then-Superintendent, Laura Perdices. These methods included establishment of one monitoring station for every ~0.5 mile of impacted seismic line, with one impact plot capturing the full width of seismic line and

one adjacent, undisturbed plot of equal size at each monitoring station. This recommended sampling design would capture a more representative ~5.5% of the impact area.

Other previously identified monitoring issues included questionable topographic contour profiles of impact and adjacent undisturbed wetlands that were inconsistent with observations and measurements detailed in Quest's June 2019 Inspection Report.

The methodologies used in this assessment were intended to address these specific deficiencies and inconsistencies in order to make comparisons with the THA Time Zero Monitoring Report results. Additionally, observations were made of BOCI's previously observed reclamation attempts, including a portion of Seismic Survey Line B (as described in Quest's May 2018 and June 2019 Inspection Reports), and 'reclaimed' seismic survey lines not previously inspected. This memo summarizes these methods and observations, and also reiterates why more stringent and meaningful success criteria are needed to ensure that the damaged areas are returned to "original contour conditions," as stipulated by the National Park Service's Finding of No Significant Impact and the FDEP Oil and Gas Geophysical Permit (#G-173-17).

2.0 METHODOLOGY

Quest and associates entered the Preserve on foot via the Florida National Scenic Trail (hereinafter, "Florida Trail") from the trailhead located approximately 0.4 mile east of the Collier County Rest Area near Mile Marker 63 (MM 63), south of Interstate 75. Quest walked south on the Florida Trail for ~0.1 mile, then continued south and west for ~1.25 miles to reach THA Monitoring Stations #17235 and 15940, following the 'Route Traversed' shown on **Figure 1**. Field aerials uploaded to Avenza© on hand-held devices assisted with navigation. Quest conducted topographic and vegetation monitoring at two representative monitoring stations, then returned to the starting point in a clockwise progression, primarily following seismic survey routes not previously inspected by Quest. Total distance traversed during the assessment was approximately 4.5 miles, more than 70% of which occurred along seismic survey lines located within THA Phase Work Areas 1, 2, and 7.

Topographic Monitoring

At THA Monitoring Stations #17325 and #15940, Quest conducted topographic monitoring of reclaimed seismic lines and adjacent elevations through use of modified THA methods described in Section 2.6 of the THA Time-Zero report, excerpted below:

In order to best determine elevational differences between the restored pathways and adjacent undisturbed ground, a series of relative elevations was measured across the pathways. A string was tied to a tree or shrub from at least 1.4 meters on each side of the grade adjacent to the pathway and across the pathway. A line level was attached over the centerpoint to ensure that the string was tight and level so that contour measurements were consistent across the entire cross section.

A measuring tape was laid under the string from one end to the other and a biologist with a yard stick in centimeters would call out distance from ground every 1.5 feet. Another biologist recorded those numbers and also noted where along the tape measure edges of pathway began and ended.

Once data was collected it was used to create a graphic depiction of adjacent grade and pathway contours in centimeters along the 1.5-foot measured increments. The pathway locations were also identified on the graphs to reference the differences between

adjacent ground elevations and pathway elevations. If restored pathway elevations fall below 7.62 centimeters (3 inches) of the lowest adjacent undisturbed elevation, then the reclamation in that location may be deemed unsuccessful.

Quest's modifications to the THA data collection method were minor, and consisted of using wooden stakes to anchor the string on each end for greater stability rather than using trees and shrubs, and measuring the distance to ground elevation in inches, rather than centimeters, then later converting to centimeters. Also, though methods are not explicitly stated in the THA report, it is expected that Quest's definition of the boundary between the disturbed pathway and the adjacent undisturbed wetlands differed from THA's. Quest defined this boundary as the outer limits of disturbed soils associated with the seismic lines, whether disturbed by soil displacement from vibroseis vehicles driving through wetlands to conduct the seismic testing for oil, resulting in soil rutting and/or by reclamation attempts to return displaced soils to the ruts. Based on Quest's observations since 2017, this boundary was and still is clearly defined by abrupt changes in topography, soil structure, and/or vegetation composition and abundance. It is not clear which features THA relied upon to define this boundary.

Quest's method of topographic data analysis differed significantly from THA's. Rather than comparing lowest disturbed pathway elevations to the lowest adjacent undisturbed wetland elevation, Quest compared the lowest elevations recorded in the seismic lines to the average elevation of adjacent undisturbed wetland grades. This method of analysis is consistent with Specific Condition 12 of BOCI's Environmental Resource Permit (FDEP #11-0323836-002), and it provides a relatively unbiased comparison between disturbed and adjacent undisturbed topography. Finally, Quest's interpretation of whether a 3-inch differential is an adequate measure of 'original contour conditions' appears to differ markedly from that which is implied in the THA report.

Vegetation Monitoring

Quest conducted vegetation monitoring at THA Monitoring Stations #17325 and #15940 in general conformance with the methods recommended in NRDC's March 28, 2019 letter to the Preserve Superintendent. This method consisted of assessing vegetation within paired plots that were 22 to 30 times larger than THA's 1 m² plots as follows: one impact plot, sized to capture the entire width of the impacted seismic line pathway, and one adjacent plot of equal size located ~20 feet away from the disturbed seismic line boundary at each THA monitoring station. The size of Quest's Station #17235 plots was ~30 m² based on a local impact width of 17.5 feet, and the size of Station #15940 plots was ~22 m² based on a local impact width of 15 feet.

Within each plot, all readily visible groundcover taxa were identified to the lowest practical taxon (Wunderlin et al, 2020), and the percent cover of each was estimated along with total vegetative cover. Groundcover vegetation included all herbaceous vegetation and all woody vegetation less than 18 inches tall that was rooted in the plot. All trees and shrubs (i.e., woody vegetation > 18 inches tall) rooted in plots were tallied, and general notes regarding the sizes of the tallied trees were recorded. Observations of periphyton and current water levels were also recorded, and photos were taken of impact and adjacent plots at each monitoring station.

3.0 RESULTS

THA Station #17235

Topography

Results from topographic monitoring across the seismic line and adjacent undisturbed wetland elevation grades at THA Station #17235 are depicted at the top of **Figure 2**. THA's monitoring results for this station are provided for comparison at the bottom of **Figure 2**.

Quest topographic data indicate that the width of the impacted seismic line or pathway at THA Station #17235 is 17.5 feet, compared to THA's reported width of 15.5 feet. Quest data also indicate that the maximum elevation change across the entire profile is approximately 4.0 cm (1.5 in), whereas the maximum elevation difference shown by the THA data is approximately 14 cm (5.5 in). Comparing elevation differentials between the seismic line and adjacent undisturbed wetlands, the THA data and methodology using the lowest adjacent elevation, shows the impact area as 0.1 cm (0.04 in.) lower than the lowest adjacent undisturbed elevation. Quest data and methodology using the average adjacent elevations, shows the impact area as 1.58 cm (0.6 in.) lower than the adjacent undisturbed elevation.

Vegetation

Quest's vegetation monitoring data for the impact plot and adjacent undisturbed plot at Station #17235 are summarized on **Tables 1 and 2**. Photographs of these plots are provided in **Appendix A, Photos 1 and 2**. THA vegetation monitoring data are included in **Appendix B** for comparison. THA vegetation data were derived from a single 1m² impact plot located within the center of the seismic line pathway, and two adjacent 'undisturbed' plots located ~7 feet northwest and southeast of the center impact plot. Quest vegetation data were derived from a ~30 m² impact plot that captured the full width of the impact area, and an adjacent undisturbed plot of equal size located ~20 feet perpendicular to the impact plot.

Quest and THA total groundcover vegetation estimates were similar for the impact plot, ranging from only ~16-20%, when THA's shrub/canopy vegetation cover estimates were deducted. Similarly, Quest and THA total groundcover vegetation estimates for the adjacent plots were also close, ranging from ~45.5-50% when THA's shrub/canopy cover was deducted and total groundcover estimates averaged for their two adjacent plots.

However, vegetation species richness values differed considerably between methods used by Quest and THA. Quest recorded a total of 21 taxa in the 30 m² impact plot, whereas THA recorded a total of four (4) vegetative species in its 1 m² impact plot. In the adjacent plot, Quest recorded 23 taxa, but THA only reported a combined total of 15 taxa in its two (2) adjacent plots.

Three (3) native sedges (Cyperaceae) co-dominated the groundcover in Quest's impact plot, each accounting for ~5% cover. These included Gulf Coast spikerush (*Eleocharis cellulosa*), spreading beaksedge (*Rhynchospora divergens*), and fimbry (*Fimbristylis* sp.). Spreading beaksedge was the dominant species in THA's impact plot with 7% cover, and wrinkled jointtail grass (*Coelorachis rugosa*) was sub-dominant with 5% cover.

In Quest's adjacent, unimpacted plot, 3 native grasses and 1 native sedge co-dominated the groundcover, each accounting for ~5% cover. These included Gulf hairawn muhly (*Muhlenbergia capillaris* var. *filipes*), sawgrass (*Cladium jamaicense*), creeping little bluestem (*Schizachyrium rhizomatum*), and broomsedge bluestem (*Andropogon virginicus* var. *decipiens*?), none of which were the dominant species recorded from the impact plot. The dominant groundcover species in THA's adjacent plots was spreading beaksedge with 15% cover, and the sub-dominant species was Tracy's beakrush (*Rhynchospora tracyi*) with 10% cover.

In the impact plot, Quest counted a total of 14 small pondcypress (*Taxodium ascendens*), coppicing from broken stems less than 2 inches diameter at breast height (DBH) that ranged in height from 2.5 – 4 feet. THA did not record any pondcypress trees, coppicing stems, or seedlings in its impact plot. Quest's adjacent plot also included a total of 14 pondcypress, but much larger trees than those coppicing in the impact plot, with many approaching 4 inches DBH and 20 feet in height.

Two (2) species of bromeliads, *Tillandsia balbisiana* and *Tillandsia fasciculata*, were established on mature pondcypress in Quest's adjacent plot, but no bromeliads were present within the impact plot, at least in part due to the lack of suitable host structures (pondcypress).

Quest observed recovery of periphyton in the impact plot at this station, where it occupied most of the interstitial space between recruiting vegetation. Similarly, periphyton cover occupied most of the interstitial space between existing vegetation in the adjacent plot at this station.

Soils/Hydrology

Soils were mostly saturated in both the impact and adjacent plots during Quest's 3/6/20 assessment, and no standing water was evident. Soils were reported as dry in THA's Time Zero Monitoring Report during THA's 5/19/19 monitoring event.

THA Station #15940

Topography

Results from topographic monitoring across the seismic line and adjacent undisturbed wetland elevation grades at THA Station #15940 are depicted at the top of **Figure 3**. THA's monitoring results for this station are provided for comparison at the bottom of **Figure 3**.

Quest topographic data indicate that the width of the impacted seismic line pathway at THA Station #15940 is 15 feet, compared to THA's recorded width of 12.5 feet. Quest data also indicate that the maximum elevation change across the entire profile is approximately 10.5 cm (4.1 in), whereas the maximum elevation difference shown by THA data is approximately 11.5 cm (4.5 in). Comparing elevation differentials between the seismic line and adjacent undisturbed wetlands, the THA data and methodology using the lowest adjacent elevation, shows the impact area as ~5.0 cm (~2.0 in.) lower than the lowest adjacent undisturbed wetland elevation. Quest data and methodology using the average of adjacent elevations to compare to the lowest impact elevation, shows the seismic line as ~8.8 cm (~3.5 in.) lower than the adjacent undisturbed wetland elevation.

Vegetation

Vegetation monitoring data for Quest's impact and adjacent plots are summarized on **Tables 3 and 4**. Photographs of these plots are provided in **Appendix A, Photos 3 and 4**. THA vegetation monitoring data are included in **Appendix B** for comparison.

Quest and THA total groundcover vegetation estimates were similar for the impact plot, ranging from THA's recorded 11% coverage in May 2019 to Quest's 20% coverage of groundcover vegetation in the impact plot in March 2020. This increase in coverage may be attributable to an additional growing season that benefited the growth and expansion of coverage by herbaceous species identified in **Tables 1 and 3**. Quest and THA total groundcover estimates for the adjacent plots were also similar, ranging from THA's 42.5% coverage when shrub/canopy cover was deducted and total groundcover estimates averaged for their 2 adjacent plots. Quest recorded 45% coverage of groundcover vegetation in their adjacent, undisturbed plot.

Quest recorded a total of 8 taxa in the 22 m² impact plot, compared to 4 species in THA's 1 m² plot. Gulf Coast spikerush was the dominant species according to both methods, but Quest reported 15% total coverage, while THA only reported 7% total coverage, perhaps due to expansion of this species in the time between THA's Time Zero monitoring event in May 2019 and Quest's inspection in March 2020.

In the adjacent plot, Quest recorded 15 taxa, whereas THA reported a total of 11 taxa between both adjacent plots combined, including shrubs and trees. Both Quest and THA reported many species in common and at similar abundances, however, sawgrass (*Cladium jamaicense*) was the dominant species in Quest's adjacent plot at 10% of the total vegetative coverage, whereas THA reported Chapman's beaksedge (*Rhynchospora chapmanii*) as the dominant species in both in its adjacent plots, ranging from 10% to 50% of the total vegetation cover. Contrasting the number of taxa present in the impact plot vs. adjacent, unimpacted plots in both the THA and Quest assessments, it is clear that species richness is significantly lower in both impact plots.

In the impact plot, Quest tallied a total of three (3) small pondcypress, coppicing from broken stems less than 2 inches DBH at a height of approximately 1.5 feet. Conversely, THA did not record any pondcypress trees in its impact plot. Quest's adjacent plot included a total of 31 pondcypress, three (3) of which were greater than 2 inches DBH and 15-20 feet tall, and 28 that were less than 2 inches DBH and mostly less than 5 feet tall.

One (1) species of bromeliad, *Tillandsia utriculata*, was established on mature pondcypress trees in Quest's adjacent plot, but no bromeliads were present within the impact plot, at least in part due to the lack of suitable host structures (cypress trees).

Periphyton occupied most of the interstitial space between existing vegetation in the adjacent plot. Periphyton cover in the impact plot appeared to have been recently disturbed, perhaps due to recent THA monitoring activities at this station.

Hydrology

Soils were inundated up to 2 inches deep in the impact plot, and moist to saturated in the adjacent plot during Quest's 3/6/20 monitoring. Soils were reported as dry in THA's Time Zero Monitoring Report during its 5/19/19 monitoring event.

Seismic Survey Line B

The assessment route included ~1,100 feet (Photostations F – H) of Seismic Survey Line B, an impacted seismic line pathway documented in Quest's June, 2019 and May, 2018 inspection reports (See **Figure 1**). In June 2019, after the attempt to reclaim this section of Seismic Survey Line B occurred, Quest measured differences in water depths between the impacted area and adjacent undisturbed ground ranging from 4.0 to 6.5 inches. During the current March 2020 site assessment, vegetative cover in this section was ~20-30% on average, and Gulf Coast spikerush remained the dominant species, forming a dense monoculture in places (See **Appendix A, Photos 3 and 6**) in stark contrast to the adjacent marl prairie habitat. Pronounced topographic differences similar to those measured in June 2019 between impacted and adjacent undisturbed wetland areas in this section (i.e., 4.0 to 6.5 inches) remain apparent in this section of Seismic Survey Line B. No pondcypress seedlings were observed within the impacted area, nor stump sprouts emerging from the many mature pondcypress stumps cut by BOCI's crews. Occasional small (< 2" dbh) cypress located along the edges and in the center of the seismic line were observed to be coppicing from their broken stems.

Other observations made along this section of Seismic Survey Line B during this assessment include the mortality of numerous large pondcypress trees (> 3" DBH) located adjacent to the seismic lines. These

trees appeared to have died due to secondary impacts such as root disturbance or compression or scarring by the vibroseis vehicles or other equipment used in BOCI's seismic exploration. See **Appendix A, Photo 5** for an example. Although National Park Service staff has indicated that it maintains records of the total number of pondcypress trees greater than 4 inches DBH that BOCI cut down during its seismic exploration activities, it is anticipated that these counts do not include trees that later succumbed to secondary impacts such as severe root disturbance and/or compression or scarring by the vibroseis vehicles or other equipment used in BOCI's seismic exploration.

Other Observations

In addition to the monitoring results described above, Quest also made the following observations while continuing northwest from Seismic Survey Line B toward THA Monitoring Stations #19229 and #21412 (See **Figure 1**), primarily along seismic lines that had not previously been observed by Quest during prior inspections.

- Groundcover vegetation is recruiting within the seismic lines, especially Gulf Coast spikerush in the deeper ruts that remain, however, evidence of pondcypress seedling recruitment was extremely limited in these rutted areas. See **Appendix A, Photos 6 and 7** for more representative photos of Gulf Coast spikerush forming a dense monoculture in the wetter areas that remain post-reclamation. The dense groundcover of Gulf Coast spikerush in these areas is expected to further impede the establishment of pondcypress seedlings that are essential for an eventual return to pre-survey conditions.
- Altered hydrology due to insufficient reclamation of topography also appears to have affected the behavior and/or migration of indigenous megafauna such as the American alligator (*Alligator mississippiensis*). As shown in **Appendix A, Photo 8**, Quest encountered a mature alligator lying stationary in a deep-water soil rut created by the seismic exploration in Phase Work Area 2, presumably taking advantage of the extended hydroperiod afforded by the insufficiently reclaimed topography. No standing water was present in the adjacent undisturbed landscape.
- THA concluded that "contour restoration is appropriate" at THA Monitoring Station #19229 (as they did for all other THA Monitoring Stations) because "none of the pathway measurements met or exceed the 7.62 cm (3 inch) difference between the pathway elevations and the lowest adjacent undisturbed grades which would indicate that additional reclamation work may be needed." See **Appendix A, Photo 9** for an example of the disturbed topography that remains at this station. Quest placed a PVC pole at the edge of the seismic line boundary in this photo. The angle of the PVC pole shown reveals that a significant difference in elevation (~6 inches) remains between the impacted seismic line and adjacent undisturbed wetlands at this location. As detailed in the Discussion portion of this Memorandum, the disparity between THA's conclusions and actual conditions appears to be due to inaccurate placement of the impact-adjacent boundary line at this location (See **Appendix B**, station #19229 profile).

4.0 DISCUSSION

Quest's assessment revealed that most of the vegetation data collected by THA for Monitoring Stations #17235 and #15940 were reasonably accurate based on Quest's observations at the stations monitored. However, as detailed below, the interpretation of and conclusions reached from this data fail to provide a complete picture of recovery from the extensive damage incurred from seismic survey activities.

Contour elevation measurements at both of the THA Monitoring Stations observed appear to be reasonably accurate, but interpretation of this data appears to yield erroneous conclusions on whether reclaimed topographic elevations meet Minimization and Mitigation Measure No. 18 contained in the National Park Service's Finding of No Significant Impact that requires ruts, depressions and tracks be "restored to original contour conditions". Mitigation Measure No. 22 requires that "soils will be de-compacted and returned to match the original grade". BOCI's FDEP Oil and Gas Geophysical Permit No. G-173-17, Specific Condition 13(b), requires BOCI to "perform ground contouring to restore areas with ruts, depressions, and vehicle tracks resulting from field operations under this permit, and Permit No. G-170-15, to original contour conditions in a manner so that the resulting ground topography will match the topographic elevations in adjacent undisturbed wetlands." Further, FDEP Oil and Gas Geophysical Permit Specific Condition 21 expressly states that "[t]he goal of long-term maintenance and monitoring of site reclamation areas is to return survey areas to conditions consistent with presurvey conditions."

Two variables appear to result in the unsupported conclusions. First, when comparing impact plot elevations to the adjacent plot elevations, THA calculated the difference between the lowest adjacent unimpacted area and the lowest elevation of the impacted area. By using an average elevation for the adjacent grades, there is a more pronounced difference. The use of the latter by Quest at THA Monitoring Station 15940 shows a difference of 8.8 cm (3.5 in.) in elevation between the impact and adjacent plots as opposed to THA's calculated difference of 5 cm (2.0 in.) in elevation between the impact and adjacent plots for the same monitoring station.

Second, the width of the impacted seismic line, as defined by THA's placement of the boundary between "adjacent grade" and "cut pathway" or "fill borrow limits" appears to be narrower than that determined by Quest. For the stations monitored, Quest found the disturbed area to be 2 – 2.5 feet wider than that reported by THA. This additional width occurred where the topographic disparity was most pronounced, yielding higher elevation measurements for adjacent undisturbed wetlands. This, in turn, yielded an increased differential between the elevations in impact and adjacent plots.

Based on (1) our analysis of THA Monitoring Station 15940 contour elevations, (2) past elevation measurements taken by Quest at photostations along Seismic Survey Line B (see **Figure 1**), and (3) observations of numerous other seismic survey lines that include THA Monitoring Station 19229 in this assessment, strong evidence suggests that the data and resulting calculations contained within the THA Monitoring Report cannot be relied upon to determine compliance with BOCI's state and federal permits

THA appears to assert that BOCI's reclamation of seismic lines within 3 inches of the topographic grade of adjacent undisturbed wetlands is adequate, as opposed to reclamation of the topography to pre-survey conditions as required by BOCI's federal and state permits, further reinforcing the assumption that the reclamation is "appropriate." It is expected that many of the topographic profiles deemed appropriate by THA would not be within 3 inches of the topographic grade of adjacent undisturbed wetlands if the correct elevations of adjacent undisturbed wetlands had been calculated based on the average elevation of adjacent undisturbed wetlands, as required by Specific Condition 12 of BOCI's FDEP Environmental Resource Permit, and if the boundaries between impact and adjacent undisturbed wetland topography had been appropriately defined.

Even along reclaimed seismic line sections that appear to be within 3 inches of the topography of adjacent undisturbed wetlands, significant differences in hydrology and vegetation between impact and adjacent undisturbed areas remain, confirming that a 3-inch difference between seismic lines and adjacent undisturbed topography is not a reasonable target to ensure that Preserve conditions will return to the

original or pre-seismic exploration conditions, as required by BOCI's National Park Service permit and FDEP Oil and Gas Geophysical Permit.

Reclamation of sections of the seismic lines where rutting was not as severe appears to have been somewhat successful in regrading the topography to match adjacent undisturbed wetlands. However, most of the seismic lines observed by Quest occur in less sandy, more marl soils, which do not appear to have been reclaimed to match the topography of adjacent undisturbed wetlands, as required by federal and state permits. This is evidenced by significant differences in vegetation and hydrology between the impact and adjacent undisturbed wetland habitats (See **Appendix A, Photos 6-9**) that are expected to hinder recruitment of pondcypress and other appropriate vegetative species for many years to come.

THA's decision to use 1 m² plots to assess vegetation within impact and adjacent plots and to use fewer plots instead of plots established every 0.5 mile of impact that include the full width of each seismic line, as recommended by Quest, fails to capture both the full extent of the disturbed seismic line in the impact plot, and the diverse groundcover in adjacent undisturbed plots that is representative of marl prairie and cypress strand communities (FNAI, 2010). Only by using a larger plot that includes the full width of the seismic line and a corresponding area within the adjacent undisturbed wetland habitat, will differences in vegetation species richness and similarity be captured. As Quest previously recommended, species richness and similarity are essential indicators for determining reclamation success. Reclamation success criteria that use a percentage of the pre-seismic survey total coverage of Obligate and Facultative Wetland non-nuisance and non-exotic vegetation alone to determine satisfactory vegetation recovery are considered inadequate measures of success.

Nowhere is this more obvious than within the seismic lines where the opportunistic Gulf Coast spikerush has become the dominant species. For THA Monitoring Station 15940, the THA Time Zero Monitoring Report shows that Gulf Coast spikerush is the dominant species, with 7% coverage of the seismic line monitored. Less than one year later, this coverage increased to 15%, indicating rapid colonization of the reclaimed area. While such rapid colonization could be construed as an indicator of successful recovery under success criteria arbitrarily established in the THA Monitoring Report, this "success" does not consider that such coverage consists of a vegetative monoculture, lacking the attributes of the original, pre-impact suite of plant species. Most notably, it appears that the opportunistic wetland species colonizing after reclamation do not include pondcypress, a species that is vital for the myriad of wildlife species dependent on the habitat provided by the dwarf cypress strands predominantly impacted from seismic survey activity.

5.0 CONCLUSION

In conclusion, significant differences in topography and vegetation remain between 'reclaimed' seismic lines and adjacent undisturbed wetlands. Although herbaceous groundcover vegetation continues to increase over time, and minimal, new nuisance or exotic vegetation was observed, the incomplete topographic restoration is adversely affecting and will continue to adversely affect the composition of the naturally recruiting vegetation. Most of the impacted seismic lines are dominated or co-dominated by Gulf Coast spikerush, which, although native, is not a dominant or co-dominant species in the adjacent undisturbed marl prairie and cypress strand communities. An almost complete lack of recruiting pondcypress, and the characteristic epiphytes they normally support (i.e., bromeliads and orchids), within the seismic lines amplifies the stark contrast between impacted and adjacent wetlands. Based on observations of remnant soil ruts still devoid of pondcypress within long-abandoned off-road vehicle trails in this area and in other portions of the Preserve, the damage created by the much-heavier vibroseis and other vehicles used in BOCI's seismic exploration is not expected to be fully restored for many years to come.

The National Park Service and FDEP should consider the foregoing information and prior recommendations submitted by Quest, including the January 3, 2020 memo on THA's Time Zero Monitoring Report, to determine the success of the reclamation. Specifically, modification of monitoring methods, more precise interpretation of monitoring data, and the establishment of meaningful success criteria to facilitate decisions on how to best restore resources lost to BOCI's seismic surveying activities are essential prior to moving forward with future reclamation, restoration and mitigation. Foremost in this regard is the clarification that BOCI must restore the seismic lines to match the topographic elevations of adjacent undisturbed wetlands in order to restore the elevations that existed prior to oil exploration, in accordance with federal and state permits, as opposed to allowing final reclamation elevations that differ from pre-impact elevations by as much as 3 inches.

Additionally, BOCI should be required to include the monitoring of vegetative species richness and similarity in the damaged areas, and to meet success criteria that reflect this attribute, to better determine whether the desirable native wetland vegetation that previously existed, including dwarf cypress, are naturally recruiting. Additionally, each monitoring station should be enlarged and consist of one impact plot and one adjacent, undisturbed plot established for every 0.5 mile of impact, with impact plots located to include the full width of each seismic line or pathway. This is necessary in order to assure state and federal agencies that pre-impact conditions are being successfully restored or are on a successful path to success during the maintenance and monitoring period.

References

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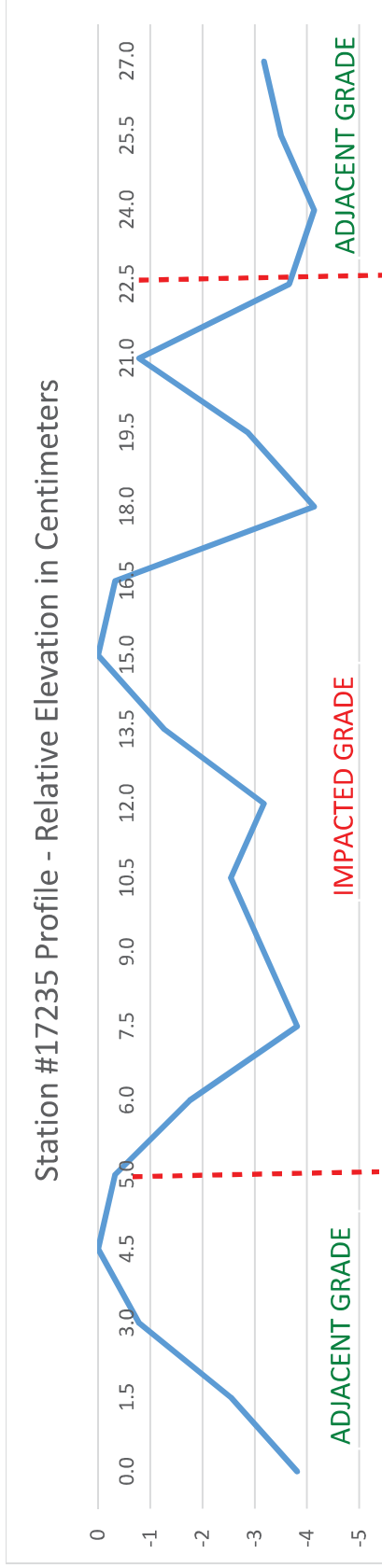


- ◆ THA Stations Observed
- ◆ THA Stations Monitored
- Quest PhotoStation
- Collier County Rest Area (MM 63)
- Route Traversed
- Shell Trail (~609 Miles)
- Florida National Scenic Trail



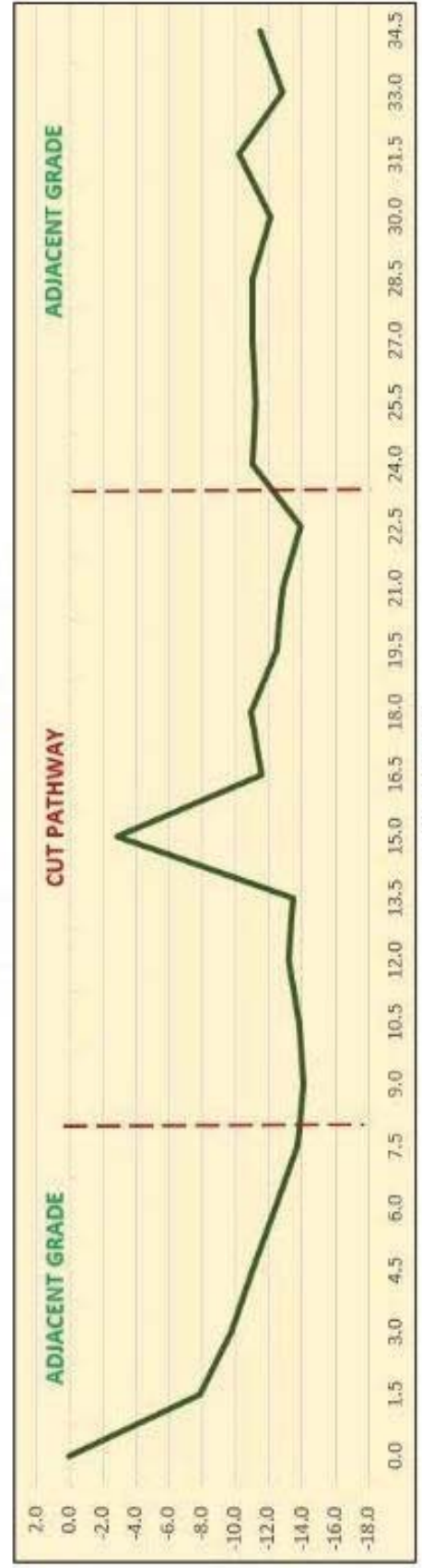
Figure 1. 3/6/20 Site Inspection
Nobles Grade 3-D Seismic Survey (Burnett Oil Co., Inc.)
Natural Resources Defense Council
Big Cypress National Preserve, Florida





Quest Profile for Station #17235

Pathway Contour Data in Centimeters

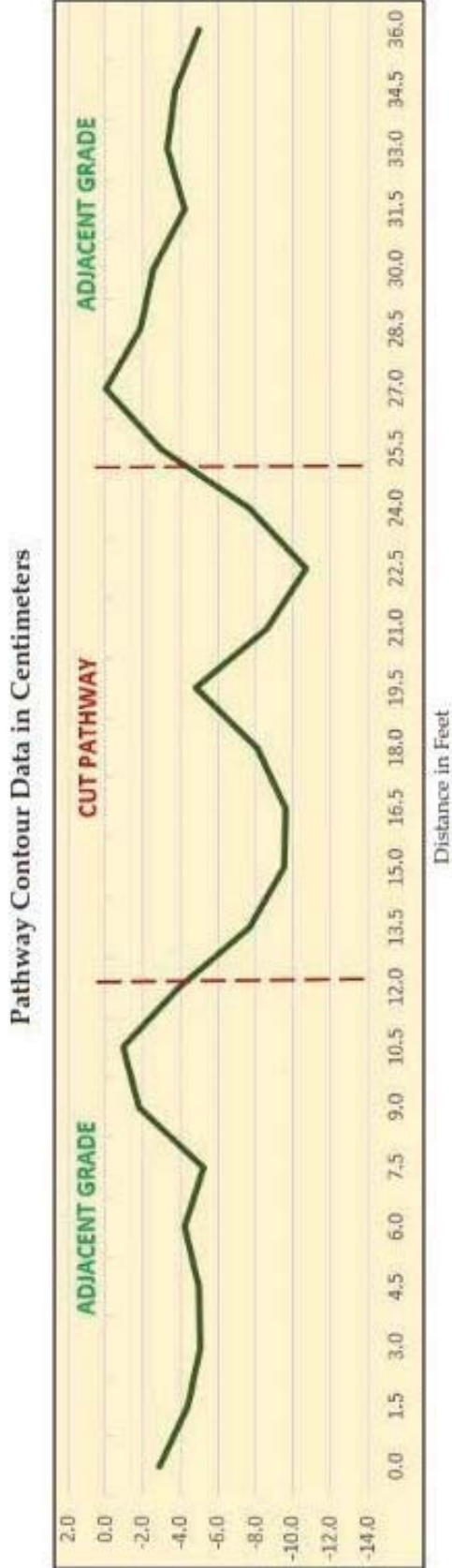


THA Profile for Station #17235

FIGURE 2. RELATIVE SURFACE ELEVATIONS AT MONITORING STATION #17235



Quest Profile for Station #15940



THA Profile for Station #15940

FIGURE 3. RELATIVE SURFACE ELEVATIONS AT MONITORING STATION #15940

Table 1. Groundcover Data for Monitoring Station #17235 (Impacted)

Scientific Name	Common Name	% Cover	FDEP	NWPL
<i>Eleocharis cellulosa</i>	Gulf Coast spikerush	5	OBL	OBL
<i>Rhynchospora divergens</i>	spreading beaksedge	5	OBL	OBL
<i>Fimbristylis sp.</i>	fimbry	5	-	-
<i>Muhlenbergia capillaris var. filipes (=M. sericea)</i>	Gulf hairawn muhly	1	-	FACW
<i>Andropogon virginicus var. glaucus</i>	chalky bluestem	< 1	FAC	FAC
<i>Cassytha filiformis</i>	love vine	< 1	-	FAC
<i>Centella asiatica</i>	spadeleaf	< 1	FACW	FACW
<i>Cladium jamaicense</i>	sawgrass	< 1	OBL	OBL
<i>Dichanthelium commutatum</i>	variable witchgrass	< 1	FAC	FAC
<i>Dichanthelium sp.</i>	witchgrass	< 1	-	-
<i>Eragrostis elliotii</i>	Elliott's lovegrass	< 1	FAC	FACW
<i>Flaveria linearis</i>	narrowleaf yellowtops	< 1	FACW	FACW
<i>Fuirena sp.</i>	umbrellasedge	< 1	-	-
<i>Ludwigia repens</i>	creeping primrosewillow	< 1	OBL	OBL
<i>Pluchea baccharis</i>	rosy camphorweed	< 1	FACW	FACW
<i>Rhynchospora tracyi</i>	Tracy's beaksedge	< 1	OBL	OBL
<i>Schizachyrium rhizomatum/S. stoloniferum</i>	creeping little bluestem	< 1	FAC	FACW
<i>Schoenus nigricans</i>	black bogrush	< 1	FACW	OBL
<i>Scleria sp.</i>	nutrush	< 1	-	-
<i>Taxodium ascendens</i>	pondcypress	< 1	OBL	OBL
<i>Utricularia sp.</i>	bladderwort	< 1	-	-
TOTAL VEGETATIVE GROUND COVER = ~20% (THA = 16%) MINIMUM SPECIES RICHNESS = 21 # PONDCYPRESS = 14 (ALL 2.5 - 4.0 FT TALL; MAX DBH = 2 IN)				

Table 2. Groundcover Data for Monitoring Station #17235 (Un-impacted)

Scientific Name	Common Name	% Cover	FDEP	NWPL
<i>Andropogon virginicus</i> var. <i>decipiens?</i>	broomsedge bluestem	5	FAC	FAC
<i>Cladium jamaicense</i>	sawgrass	5	OBL	OBL
<i>Muhlenbergia capillaris</i> var. <i>filipes</i> (=M. <i>sericea</i>)	Gulf hairawn muhly	5	-	FACW
<i>Schizachyrium rhizomatum</i> /S. <i>stoloniferum</i>	creeping little bluestem	5	FAC	FACW
<i>Cassytha filiformis</i>	love vine	2	-	FAC
<i>Pluchea baccharis</i>	rosy camphorweed	2	FACW	FACW
<i>Fimbristylis</i> sp.	fimbry	< 1	-	-
<i>Andropogon virginicus</i> var. <i>glaucus</i>	chalky bluestem	< 1	FAC	FAC
<i>Coleataenia tenera</i>	bluejoint panicum	< 1	FACW	FACW
<i>Eriocaulon ravenelii</i>	Ravenel's pipewort	< 1	OBL	OBL
<i>Dichanthelium ensifolium</i> var. <i>breve?</i>	dwarf cypress witchgrass	< 1	-	-
<i>Eragrostis elliottii</i>	Elliott's lovegrass	< 1	FAC	FACW
unknown forb	unknown forb	< 1	-	-
<i>Asemeia violacea</i>	showy milkwort	< 1	FACW	UPL
<i>Helenium pinnatifidum</i>	southeastern sneezeweed	< 1	FACW	OBL
<i>Rhynchospora divergens</i>	spreading beaksedge	< 1	OBL	OBL
<i>Rhynchospora colorata</i>	starrush whitetop	< 1	FACW	FACW
<i>Rhynchospora tracyi</i>	Tracy's beaksedge	< 1	OBL	OBL
<i>Schoenus nigricans</i>	black bogrush	< 1	FACW	OBL
<i>Morella cerifera</i>	wax-myrtle	< 1	FAC	FAC
<i>Symphotrichum bahamense</i>	Bahaman aster	< 1	OBL	OBL
<i>Taxodium ascendens</i>	pondcypress	< 1	OBL	OBL
<i>Utricularia</i> sp.	bladderwort	< 1	OBL	OBL
<p>TOTAL VEGETATIVE GROUND COVER = ~50% (THA avg = 45.5%, not including pondcypress canopy cover) MINIMUM SPECIES RICHNESS = 25 (including 2 bromeliads) # POND Cypress = 14 (MAX HT = 20 FT; DBH = 2 - 4 IN)</p>				

Table 3. Groundcover Data for Monitoring Station #15940 (Impacted)

Scientific Name	Common Name	% Cover	FDEP	NWPL
<i>Eleocharis cellulosa</i>	Gulf Coast spikerush	15	OBL	OBL
<i>Muhlenbergia capillaris</i> var. <i>filipes</i> (=M. <i>sericea</i>)	Gulf hairawn muhly	2	-	FACW
<i>Rhynchospora tracyi</i>	Tracy's beaksedge	1	OBL	OBL
<i>Rhynchospora divergens</i>	spreading beaksedge	< 1	OBL	OBL
<i>Cassytha filiformis</i>	love vine	< 1	-	FAC
<i>Dichantherium</i> sp.	witchgrass	< 1	-	-
<i>Rhynchospora divergens</i>	spreading beaksedge	< 1	OBL	OBL
<i>Taxodium ascendens</i>	pondcypress	< 1	OBL	OBL
TOTAL VEGETATIVE GROUND COVER = ~20% (THA = 11%) MINIMUM SPECIES RICHNESS = 8 # PONDCYPRESS = 3 (1.5 FT TALL; MAX DBH = 2 IN)				

Table 4. Groundcover Data for Monitoring Station #15940 (Un-impacted)

Scientific Name	Common Name	% Cover	FDEP	NWPL
<i>Cladium jamaicense</i>	sawgrass	10	OBL	OBL
<i>Cassytha filiformis</i>	love vine	5	-	FAC
<i>Muhlenbergia capillaris</i> var. <i>filipes</i> (=M. <i>sericea</i>)	Gulf hairawn muhly	5	-	FACW
<i>Rhynchospora divergens</i>	spreading beaksedge	5	OBL	OBL
<i>Schizachyrium rhizomatum</i> /S. <i>stoloniferum</i>	creeping little bluestem	5	FAC	FACW
<i>Pluchea baccharis</i>	rosy camphorweed	1	FACW	FACW
<i>Coleataenia tenera</i>	bluejoint panicum	< 1	FACW	FACW
<i>Eriocaulon ravenelii</i>	Ravenel's pipewort	< 1	OBL	OBL
<i>Helenium pinnatifidum</i>	southeastern sneezeweed	< 1	FACW	OBL
<i>Scleria</i> sp.	nutrush	< 1	-	-
<i>Taxodium ascendens</i>	pondcypress	< 1	OBL	OBL
unknown forb	unknown forb	< 1	-	-
TOTAL VEGETATIVE GROUND COVER = ~45% (THA avg = 42.5%, not including canopy and shrub cover) MINIMUM SPECIES RICHNESS = 15 (including 2 shrubs and 1 bromeliad) # PONDCYPRESS = 31 (MAX HT = 20 FT; 3 > 2" DBH; 28 < 2" DBH) # SHRUBS = 2 [1 wax-myrtle (<i>Morella cerifera</i>) ; 1 corkwood (<i>Stillingia aquatica</i>)]				



Photo 1. Monitoring Station #17235 – Impact Plot. View NW across impacted pathway from the SE corner of Quest’s 17.5 SF plot. THA’s stake indicating center of pathway is visible at right-center of the photo.



Photo 2. Monitoring Station #17235 – Adjacent Plot. View NW from SE corner.



Photo 3. Monitoring Station 15940 – Impact Plot. View W of the impact plot established within the seismic pathway. THA plot-center marker is visible in center of photo.



Photo 4: Monitoring Station #15940 – Adjacent Plot. View NW from SE corner.



Photo 5. View of dead pondcypress with large wound at base located on the edge of Seismic Survey Line B near Photostation G.



Photo 6: View W of Seismic Survey Line B at Photostation G. Gulf Coast spikerush (*Eleocharis cellulosa*) is the dominant species recruiting in the impacted seismic line.



Photo 7. View SW of seismic survey line located between Monitoring Stations #15940 and #19229.



Photo 8: View S of adult American alligator (*Alligator mississippiensis*) lying in the center of a 'reclaimed' seismic line. No ponded water was present in the adjacent unimpacted areas.



Photo 9: View NE of THA's center plot marker for Monitoring Station #19229 (Area 2). Quest did not conduct topographic monitoring at this location, however, the angle of the PVC pole visible in photo background shows that a steep gradient (~6 inches) remains at the boundary of the 'reclaimed' seismic line and adjacent un-impacted habitat.

3.7.5 Monitoring Station 17235 (Sampled 5/19/19)

Ambient & Hydrological Conditions

- Partly Cloudy
- 94+°F
- 17.78 inches rainfall for 2019 to-date

Trees & Coppicing

There were 3 measurable cypress trees outside the pathway.

Contour Data

At this time contour restoration is appropriate. None of the pathway measurements met or exceeded the 7.62 cm (3 inch) difference between the pathway elevations and the lowest adjacent undisturbed grades which would indicate that additional reclamation work may be needed.

Dominant Quadrat Sampled Vegetation

Dominant plant species included: wrinkled jointgrass (*Coelorachis rugosa*), spreading beaksedge (*Rhynchospora divergens*), rosy camphorweed (*Pluchea baccharis*), cypress (*Taxodium distichum*) and Tracy's beakrush (*Rhynchospora tracyi*)

Percent Coverage Comparisons	NE	Difference	C	Difference	SW
	Quadrat	C-NE	Quadrat	C-SW	Quadrat
Absolute Coverage (%)	62	-46	16	-30	44
Obligate Coverage (%)	37	-27	10	-17	27
Facultative Wet & Obligate Coverage (%)	53	-23	16	-21	37
Inundation/ Soil Conditions	Moist		Moist		Moist

MONITORING STATION 17235 Area 7 (5/19/19): Photo of the restoration area.



Southwest Quadrat



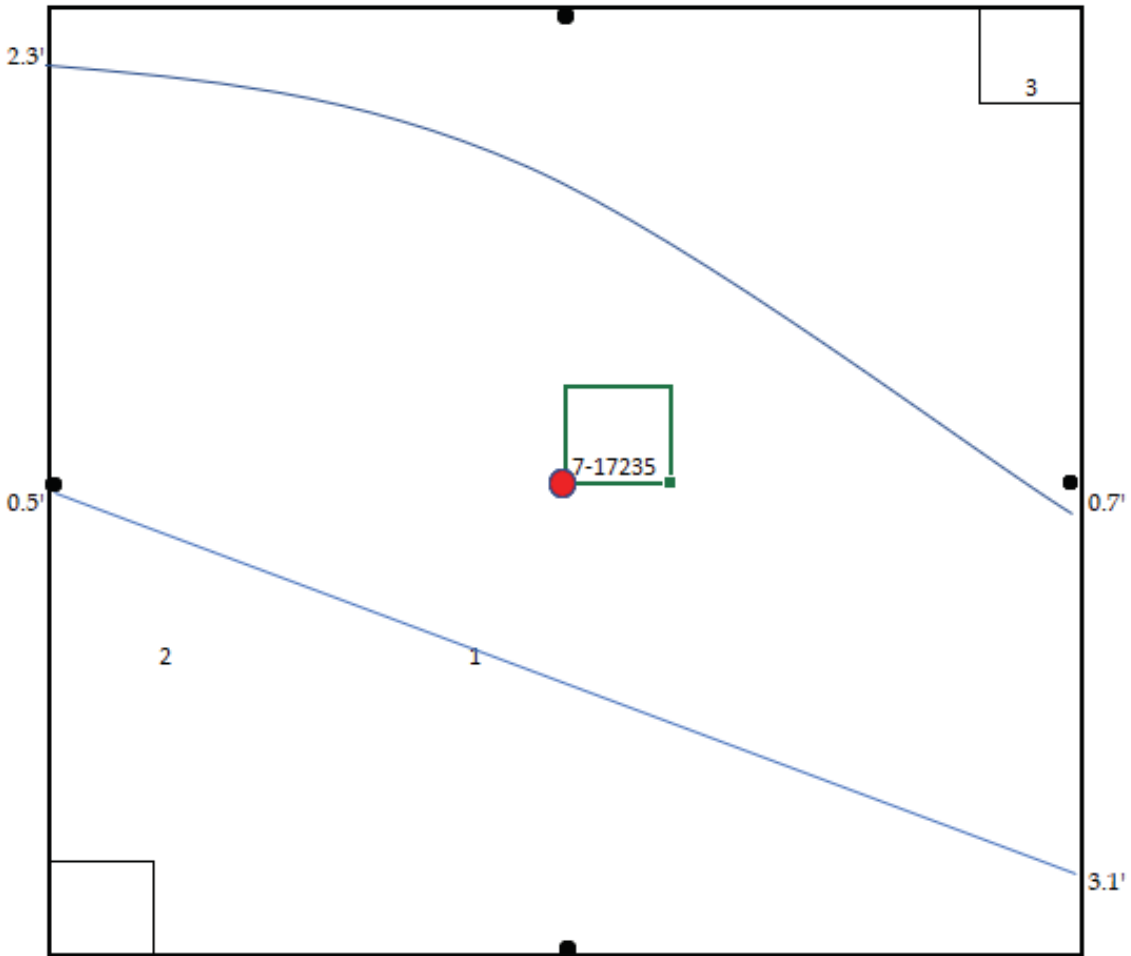
Northeast Quadrat



Center Quadrat

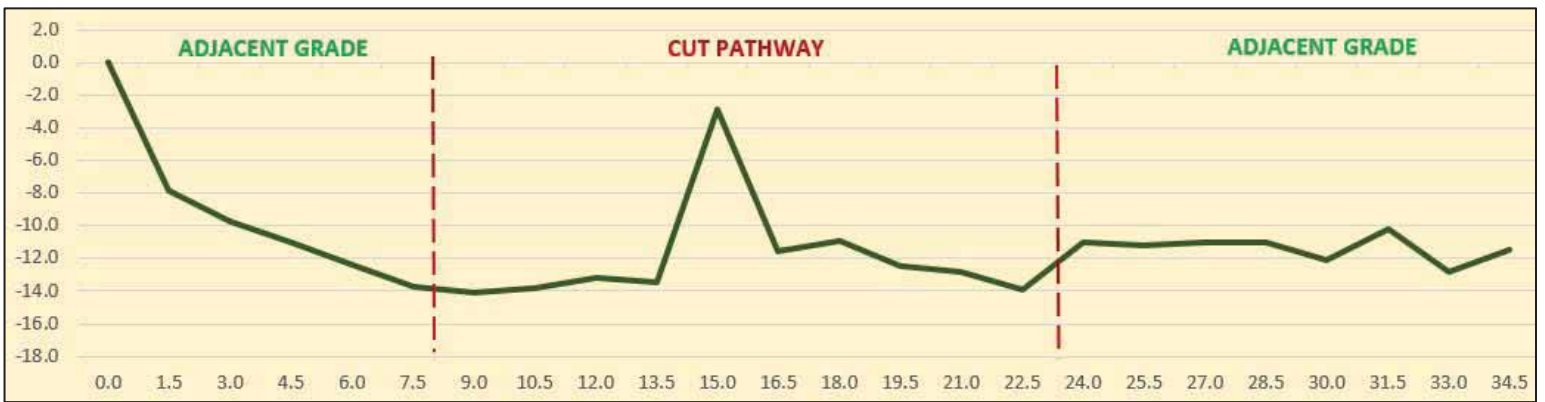


MONITORING STATION 17235 Area 7 (5/19/19): Sketch and Quadrat Locations



		(Ft.)	(°)		(cm)	(In.)
		Distance	Direction	Coppiced	Height	DBH
1	Cypress- <i>Taxodium distichum</i>	7.2	212	N		2.84
2	Cypress- <i>Taxodium distichum</i>	17.6	244	N		2.60
3	Cypress- <i>Taxodium distichum</i>	20.3	48	N		3.50

Pathway Contour Data in Centimeters



Distance in Feet

3.7.3 Monitoring Station 15940 (Sampled 5/19/19)

Ambient & Hydrological Conditions

- Partly Cloudy
- 94+°F
- 17.78 inches rainfall for 2019 to-date

Trees & Coppicing

There were 7 measurable trees outside the pathway, all *Taxodium distichum*. One orchid was found in a cypress tree.

Contour Data

At this time contour restoration is appropriate. None of the pathway measurements met or exceeded the 7.62 cm (3 inch) difference between the pathway elevations and the lowest adjacent undisturbed grades which would indicate that additional reclamation work may be needed.

Dominant Quadrat Sampled Vegetation

Dominant plant species included: Chapman's beakrush (*Rhynchospora chapmanii*), Gulf coast spikerush (*Eleocharis cellulosa*) and Tracy's beakrush (*Rhynchospora tracyi*)

Percent Coverage Comparisons	NW Quadrat	Difference C-NW	C Quadrat	Difference C-SE	SE Quadrat
Absolute Coverage (%)	27	-16	11	-55	66
Obligate Coverage (%)	23	-12	10	-50	61
Facultative Wet & Obligate Coverage (%)	27	-16	11	-54	65
Inundation/ Soil Conditions	Dry		Dry		Dry

MONITORING STATION 15940 Area 7 (5/19/19): Photo of the restoration area.



Southeast Quadrat



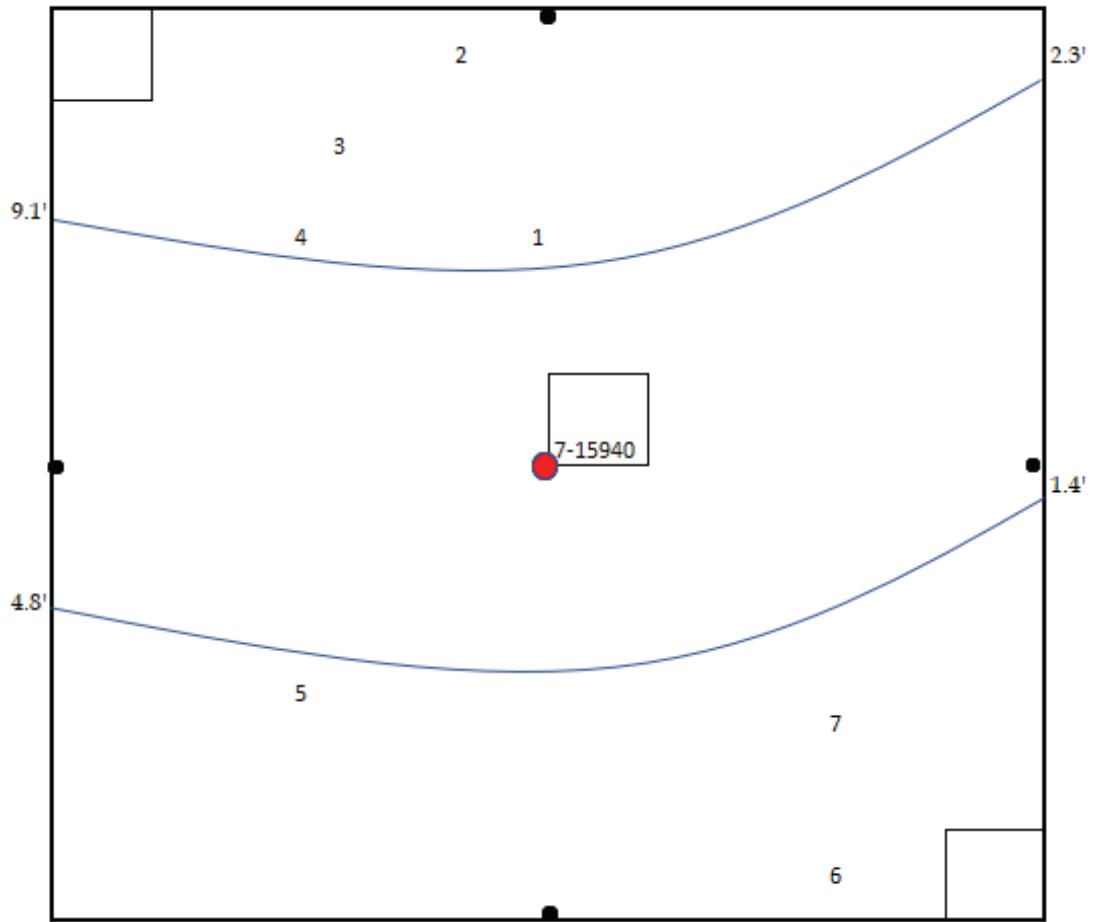
Northwest Quadrat



Center Quadrat



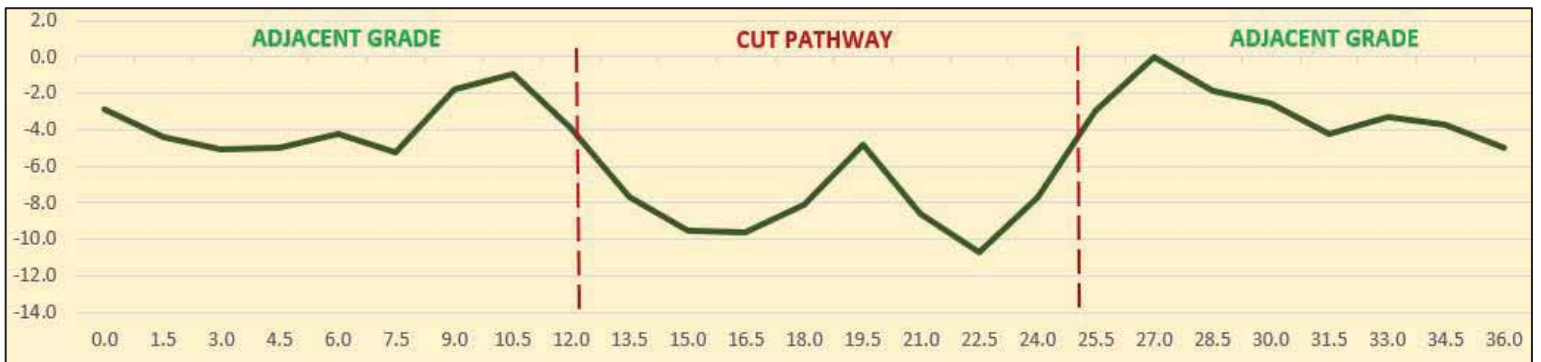
MONITORING STATION 15940 Area 7 (5/19/19): Sketch and Quadrat Locations



		(Ft.)	(°)		(cm)	(In.)
		Distance	Direction	Coppiced	Height	DBH
1	Cypress- <i>Taxodium distichum</i>	7.1	359	N		3.57
2	Cypress- <i>Taxodium distichum</i> **	15.1	350	N		2.92
3	Cypress- <i>Taxodium distichum</i>	15.9	330	N		2.84
4	Cypress- <i>Taxodium distichum</i>	11.4	316	N		2.75
5	Cypress- <i>Taxodium distichum</i>	14.2	228	N		4.83
6	Cypress- <i>Taxodium distichum</i>	19.3	146	N		3.34
7	Cypress- <i>Taxodium distichum</i>	15.3	130	N		3.83

** Denotes orchid in cypress tree

Pathway Contour Data in Centimeters



Distance in Feet

Site, Location and Date: AREA 7-15940, Northwest Quadrat, 5/19/19
 CANOPY/SHRUB/GROUND COVER

COMMON NAME (SCIENTIFIC NAME) WETLAND STATUS	VEGETATIVE PERCENT COVERAGE								
	2019		2020		2021		2022		
	June	February	June	February	June	February	June	February	
Chapman's beaksedge <i>Rhynchospora chapmanii</i>	OBL								
Tracy's beakrush <i>Rhynchospora tracyi</i>	OBL								
Cypress <i>Taxodium distichum</i>	OBL	10%							
Southern beakrush <i>Rhynchospora microcarpa</i>	OBL	5%							
Bluejoint panicum <i>Coleataenia tenera</i>	FACW	3%							
Gulfcoast spikerush <i>Eleocharis cellulosa</i>	OBL	3%							
Netted nutrush <i>Scleria reticularis</i>	FACW	1%							
Corkwood <i>Stillingia aquatica</i>	OBL	1%							
Absolute vegetation coverage		27%							
Obligate vegetation coverage		23%							
Facultative Wetland and Obligate vegetation coverage		27%							
Inundation level or soil conditions (dry, moist, saturated)		DRY							

3.2.4 Monitoring Station 19229 (Sampled 5/19/19)

Ambient & Hydrological Conditions

- Mostly Sunny
- 94+°F
- 17.78 inches rainfall for 2019 to-date

Trees & Coppicing

There were 6 measurable trees (*Taxodium distichum*) outside of the pathway.

Contour Data

At this time contour restoration is appropriate. None of the pathway measurements met or exceeded the 7.62 cm (3 inch) difference between the pathway elevations and the lowest adjacent undisturbed grades which would indicate that additional reclamation work may be needed.

Dominant Quadrat Sampled Vegetation

Dominant plant species included: flattened pipewort (*Eriocaulon compressum*), cypress (*Taxodium distichum*), saw-grass (*Cladium jamaicense*), Gulf dune paspalum (*Paspalum monostachyum*), southern beakrush (*Rhynchospora microcarpa*), love vine (*Cassytha filiformis*), rosy camphorweed (*Pluchea baccharis*), herb-of-grace (*Bacopa monnieri*), Gulf coast spikerush (*Eleocharis cellulosa*), purple lovegrass (*Eragostis spectabilis*) and narrowfruit horned beaksedge (*Rhynchospora inundata*).

Percent Coverage Comparisons	NW	Difference	C	Difference	SE
	Quadrat	C-NW	Quadrat	C-SE	Quadrat
Absolute Coverage (%)	50	-38	12	-24	36
Obligate Coverage (%)	39	-27	12	-6	18
Facultative Wet & Obligate Coverage (%)	45				25
Inundation/ Soil Conditions	Dry		Dry		Dry

MONITORING STATION 19229 Area 2 (5/19/19): Photo of the restoration area.



Southeast Quadrat

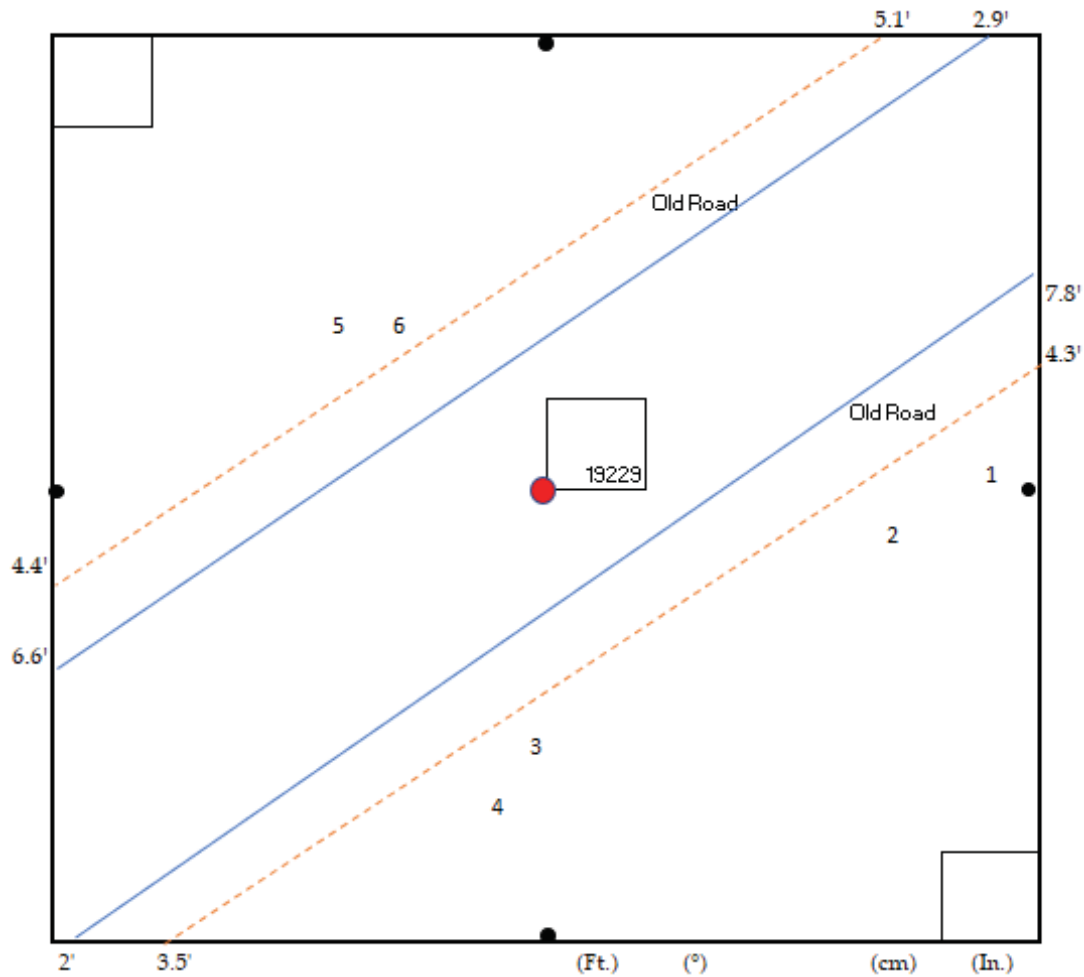
Northwest Quadrat



Center Quadrat



MONITORING STATION 19229 Area 2 (5/19/19): Sketch and Quadrat Locations



		Distance	Direction	Coppiced	Height	DBH
1	Cypress- <i>Taxodium distichum</i>	13.5	90	N		4.57
2	Cypress- <i>Taxodium distichum</i>	10.6	104	N		3.60
3	Cypress- <i>Taxodium distichum</i>	9.3	181	N		4.05
4	Cypress- <i>Taxodium distichum</i>	12.5	191	N		5.00
5	Cypress- <i>Taxodium distichum</i>	10.6	310	N		3.00
6	Cypress- <i>Taxodium distichum</i>	6.1	319	N		2.20

Pathway Contour Data in Centimeters

