Upland Xeric Reclamation

October 2013

About Mosaic Reclamation

> In carrying out its mission to help the world grow the food it needs, Mosaic couples recovery of phosphate resources with respect of the land that ultimately fuels thriving communities as well as American and global food production. While mining is a temporary use of the land, reclamation offers many benefits for generations to come. Land reclamation is the process of turning mined lands back into productive use and has been required by law in Florida since 1975. In respecting this important balance, Mosaic continuously improves its reclamation practices to create sustainable natural habitats blended with other land uses across the reclaimed landscapes.

Mosaic's dedicated team of reclamation scientists, engineers and biologists develops detailed reclamation plans for the productive use of mined lands years before any phosphate is extracted. With Mosaic reclaiming every acre or more that it disturbs, the reclamation plans focus on connecting preserved and reclaimed habitats to create a diverse and sustainable habitat network that is integrated into the larger regional ecosystem.

Navigating Emerging Reclamation

Whether it's the diversity of habitat types across the reclaimed landscape or the diversity of plant and animal species that inhabit a particular reclaimed site, variety across all is needed for an ecosystem to survive and grow on its own, which is the essence of a sustainable environment.

Further, it is important to create a balance across the entire range of hydrologic conditions — from wet to dry — to result in an ensemble of dynamic habitats for the long term. Reclaimed habitats include streams and their associated floodplains as well as connected and isolated wetland and upland natural habitats, which include unique natural systems that are vital to the ecosystem of West Central Florida.

Because streams, lakes and wetlands visibly show a watershed's hydrology in action, the important role of uplands in maintaining a watershed's broader functionality may be undervalued. Responsible for the intake, storage and delivery of water to wetlands and streams, uplands must be counted on to support the vitality of a watershed. <

Xeric habitats are unique among upland habitats. Their sandy soils and sparse vegetation make them particularly hospitable to burrowing wildlife.

Mosaic

www.mosaicco.com/florida

Critical Connections

> Freshwater marshes, coastal environments and wetlands along rivers are the natural Florida habitats that most often come to mind. However, one of Florida's most distinctive natural, upland habitats is the xeric scrub. This natural system is characterized by low-growing trees, shrubs and patches of bare sand. Xeric scrubs often harbor endangered plant and wildlife species. The plants and animals that rely on xeric communities thrive on the benefits these systems derive from periodic fires.

Because xeric communities are naturally high and dry, many have been replaced by agriculture or housing developments. This often leaves isolated patches (e.g., less than 100 acres in size) too small to sustain viable populations of wildlife that occupy these unique habitats. Reclamation offers a unique opportunity to restore these critical uplands. At Mosaic's Horse Creek and LMR8 (LMR is a reclamation abbreviation that stands for Little Manatee River) xeric scrub reclamation sites, this re-creation is exactly what's underway. <

Sparse understory on xeric sites typically include grasses, cacti, open sandy patches and scrubby species.

Xeric communities feature a variety of low-growing trees and shrubs and provide protective cover for plants and animals.

Proactive Design

When reclaiming a xeric community, there are several intricacies of habitat design that influence the long-term sustainability of the site and its inhabitants. Design components from soil composition, drainage and hydrology to species diversity, reclaiming xeric habitats requires extensive understanding of key site features and needs.

When designing Horse Creek and LMR8, the design focus centered on creating proper hydrology and placement of well-drained soils to support the needs of vegetation and wildlife. Third-party experts, scientific guidance documents and reference sites were instructive in these designs. Reference sites, which are similar habitats that are mapped and assessed in detail in terms of vegetation type, topography, water table depth and soil conditions in order to facilitate replication of similar conditions on the reclamation site, are nearby.

Mosaic continues to advance the state of the science of these methodologies — while exploring and adopting best management practices.

Xeric habitats are naturally high and dry and feature isolated patches of bare sand.

From soil composition, drainage and hydrology to species diversity, reclaiming xeric habitats requires an extensive understanding of key site features and needs.

High-Quality Upland-Xeric Design At-a-Glance

Design Components	Horse Creek	LMR8
Pre-mining Condition	• Pre-mining xeric site comprised multiple xeric patches, totaling approximately 90 acres.	• Pre-mining site was a combination of land uses that included cattle ranching and sod farming.
Project Timeline & Milestones	• Mining occurred between 1996 and 1997. • Reclamation of 100 acres of xeric habitat was completed in 2001. • Currently, the site is considered a mature-stage project and is being monitored and maintained by Mosaic.	• Mining occurred between 2003 and 2004. • Reclamation of the site was completed in 2006. • Currently, the site is being monitored and maintained by Mosaic.
Reference Sources	• Horse Creek utilized three reference sites in its designs. • Close proximity (two-mile radius) of reference sites maximized the success of local ecotypes available in the area.	• Mosaic relied on its acquired expertise in consultation with scientific guidance documents, including the county reclamation manual.
Topography & Drainage	• Design consisted of a sand blanket on top of graded overburden to provide well-drained soil and dry season seepage to Horse Creek.	• Design primarily consisted of sand fill at an elevation created to ensure the water table is 5-10 feet below the ground's surface, depending on the season.
Soil Components	• Sand backfill capped with 6-12 inches of xeric topsoil (direct transfer).	• Sand backfill capped with 6-12 inches of xeric topsoil (direct transfer).

Revegetation and Maintenance

> Once the ground surface is contoured and topsoil is added as needed, and/or available, the focus turns to establishing desirable vegetation, controlling unwanted weed species and overcoming drought during critical growth cycles.

Establishing fire-dependent vegetation is particularly critical to a reclaimed xeric site's development. Fire-dependent means the species requires fire to germinate, establish, reproduce or all three. Yet, these same plants cannot tolerate fire in their infancy. Thus, the vegetation establishment period until a site has successfully recovered from its first fire can be challenging.

Since many xeric plant species are not available from plant nurseries, Mosaic utilizes approaches such as direct seeding and topsoil relocation. At both Horse Creek and LMR8, Mosaic utilized topsoil relocation, a process whereby topsoil from a donor site (nearby land not yet mined) is directly transferred to a recipient/ reclamation site.

Within a few years of construction, xeric habitats begin to reach a level of maturity that supports wildlife native to these communities. <

Fire-dependent plant species are critical to the success of a xeric habitat because they require fire to germinate, establish and reproduce.

Xeric scrubs are unique among upland habitats because of the diverse mix of trees, shrubs and patches of bare sand.

High-Quality Upland-Xeric Execution At-a-Glance

Execution Components	Horse Creek	LMR8
Establishing Vegetation	• Monitored which plant species germinated from the relocated topsoil. • Supported the system's vegetative development with supplemental planting. • Natural regeneration begins at approximately four years. • Mosaic performed this site's first prescribed burn within eight years with documented success.	• Majority of the site's desirable vegetation grew from the transferred topsoil, including the scrub trees. • Supported the system's vegetative development with supplemental planting. • Natural regeneration begins at approximately four years. • Mosaic has already performed this site's first prescribed burn.
Managing Unwanted Vegetation	• No specific pretreatment program was employed. • Mosaic continues to perform regular site maintenance.	• Before the topsoil was transported to the reclamation site, Mosaic treated the site as part of its thorough, proactive herbicide program to prevent invasion of unwanted vegetation. • Mosaic continues to perform regular site maintenance.
Timeline for Habitat Maturity	• Approved as a gopher tortoise relocation site in approximately four years.	• Approved as a gopher tortoise relocation site in five years.

Positioned for Success

> Success is based on the site's ability to attain self-sustaining qualities, which include measurements of species diversity, vegetative cover, lack of unwanted vegetation and the site's ability to sustain a burn.

Ultimately, the true test of xeric site success is not measured by humans, but by the wildlife that inhabit it. Key indicator species that demonstrate a successful xeric habitat are gopher tortoises (and commensals), indigo snakes and Florida mice, all of which have been sighted and documented at Horse Creek and LMR8. <

The vegetative cover provided by reclaimed xeric sites play home to gopher tortoises, Florida mice, gopher frogs and other wildlife.

High-Quality Upland-Xeric Success At-a-Glance

Success Components	Horse Creek	LMR8
Connectivity	• Abuts to the Horse Creek floodplain/wildlife habitat corridor, facilitating wildlife migration.	• Connected to Howard's Prairie Preserve, which feeds into the Little Manatee River, a floodplain/habitat wildlife corridor protected by a conservation easement. • Connected to the LMR8/6 seepage slope wetland, perennial stream and palmetto prairie.
Drainage & Hydrology	• Site exhibits appropriate depth to water table.	• Site exhibits appropriate depth to water table.
Wildlife Utilization	• Serves as a successful gopher tortoise recipient site. • Because of its success, it has been earmarked by the Florida Fish and Wildlife Commission as a conservation easement site to ensure long-term protection of the tortoises and other species. • Gopher frogs and other xeric wildlife also utilize the adjacent reclaimed frog pond, providing synergy between habitats.	• Serves as a successful gopher tortoise recipient site.
Site Performance	• The site has developed a pyrogenic vegetative community. Site exhibits areas of bare sand as well as a low, shrubby component, which includes species such as wire grass, bear grass, euthamia minor along with many different shrubs and forbs. • Additionally, seedlings have sprouted from many of the site's scrub oaks, producing acorns.	• The seepage from the xeric site forms the headwaters of a reclaimed perennial stream, which has achieved a healthy stream condition index (SCI) score, a measure of water quality.

Fundamental Framework of Balance

> Xeric uplands not only have an important role in watershed function, but they are also a fundamental building block in Mosaic's reclamation designs. Reclaiming this valuable habitat supports the integration and wildlife migration from adjacent wildlife corridors or the Integrated Habitat Network, helping to preclude isolated and fragmented native upland habitat.

By working proactively to collaborate with other leading researchers to implement the state of the science, like those used at Mosaic's Horse Creek and LMR8, sustainable design becomes the rule versus the exception.

Lastly, upland xeric reclamation complements Mosaic's wetlands and other native upland habitat reclamation efforts to create a healthy balance of native habitats — xeric draining to mesic uplands draining to wetlands — as well as agriculture and potential development sites across the previously mined landscapes. This balance is achieved not only in terms of acreage, but also spatially, which illustrates that all types of uses can coexist sustainably when Mosaic reclaims the mined land. <

Many xeric plant species don't come from plant nurseries, so Mosaic utilizes approaches such as direct seeding and topsoil relocation.

All photos were taken at Little Manatee River No. 8 (LMR8), a xeric scrub reclamation site located in Hillsborough County.