The Implementation of a Key Comprehensive Everglades Restoration Project

Hubert B. Stroud, Arkansas State University

Abstract

This research examines the restoration of Southern Golden Gate Estates, a failed subdivision located within the western Everglades ecosystem. The subdivision was one of the first projects to be implemented within the Comprehensive Everglades Restoration Plan (CERP). CERP was approved in the Water Resources Development Act of 2000 and includes 60 elements (different projects) designed to restore, protect and preserve the greater Everglades ecosystem. Southern Golden Gates Estates Restoration was renamed the Picayune Strand Restoration, one of the first and most significant projects to be included within CERP. The Picayune Strand is a strategically located tract of land that is surrounded by several important refuges, preserves and parks. Its central location among several nature preserves and wildlife areas reflects its importance to the ecosystem connectivity of the entire region. The original developer installed a network of roads and constructed four large canals designed to rapidly remove surface water. The restoration will remove the roads, plug the canals, and construct pump stations to provide flood protection for residents living north of the restoration site. Some of the most important benefits of the restoration include improved aquifer recharge, reduced over-drainage, and a major reduction in point discharge of freshwater into the coastal estuaries to the south.

Introduction

Until relatively recently the Everglades and other wetland environments were widely viewed as useless swamps and there were numerous attempts to convert these delicate ecosystems to more “productive” land. The Everglades, for example, has suffered from decades of human construction prompted by misguided attempts to drain the land for development. This construction included canals that have redirected 70 percent of the freshwater that once nourished the system. The Everglades, a collection of sawgrass marshes, freshwater ponds, and prairies and forests, covered almost 11,000 square miles only a century ago. Today this “river of grass” is only half that size having suffered from drainage for agriculture, urban and suburban development, and flood control. After decades of abuse, politicians and the public alike began to realize that all the human tinkering was a big mistake (McIntosh, 2002).

In an attempt to rectify at least some of the widespread wetland degradation, the U. S. Army Corps of Engineers was given the authority to re-evaluate the performance and impacts of the Central and Southern Florida (C & SF) Project with the passage of the Water Resources Development Acts of 1992 and 1996. The C & SF Project originated in 1948 and had several authorized functions including flood control, regional water supply for agriculture and urban areas, prevention of salt water intrusion, water supply to Everglades National Park, preservation of fish and wildlife, recreation and navigation. The Project included 1000 miles of canals, 720 miles of levees, and several hundred water control structures extending across
18,000 square miles. Unfortunately, the Project had several negative effects on the Everglades ecosystem. Some of the most significant were the conversion of a sizeable portion of the Everglades to plantations and other uses and the reduction of sheet flow that compromised the integrity of the Everglades ecosystem. In fact, the reduced southward flows of water caused hyper-salinity in the southern estuaries. The changes in salinity were particularly devastating to valuable fisheries (Voss, 2000). The Corps was to recommend improvements and/or modifications to the C & SF Project that would restore South Florida ecosystems and provide for other water resource needs. The end result of these efforts was the passage of the Comprehensive Everglades Restoration Plan (CERP) (http://www.everglades.org/about/rest_plan_pt_01/aspx).

The Comprehensive Everglades Restoration Plan was approved in the Water Resources Development Act of 2000 and includes 60 elements (different projects) that are to be completed within 30 years. These projects are in various stages of implementation and completion with the vast majority in the initial planning stage. The U.S. Army Corps of Engineers in partnership with the South Florida Water Management District is currently planning, designing and constructing multiple CERP projects. The current projects are broken down into two generations: Generation 1 and Generation 2. Generation 1 projects, authorized in 2007, are currently under way and include the Melaleuca Eradication, the Indian River Lagoon, the Site 1 Impoundment, and the Picayune Strand Restoration. Generation 2 projects, authorized in 2014, are currently being designed. These projects will work in conjunction with the Foundation Projects that were authorized prior to CERP and include the Kissimmee River Restoration, Tamiami Trail (Bridge) Modifications, and Modified Water Deliveries to Everglades National Park (http://www.saj.usace.army.mil/Portals/44/docs/FactSheets/CERP_FS_August2015.pdf). The project that is the focus of this research (the Picayune Strand Restoration) is by far the largest and most significant to date, particularly for the western Everglades ecosystems.

The CERP has a number of significant components including surface water storage reservoirs, water preserve areas, improved water deliveries to coastal estuaries, underground water storage, removal of barriers to sheet flow, and improved water conservation. The CERP will help to restore, protect and preserve the greater Everglades ecosystem, a natural and national treasure that is unlike any other ecosystem in the world (Pittman, 2006). A predominant feature of the CERP is water storage that includes capturing most of the water (1.7 billion gallons per day) that is currently being discharged into the ocean. The water will be stored in new reservoirs, wetlands-based treatment areas, and in underground Aquifer Storage and Recovery (ASR) wells. The increased water storage will help to provide a reliable, adequate supply of fresh water for all use sectors including the environment, urban, and agricultural. Approximately 80 percent of the new water captured by the Plan will go to the environment and 20 percent will be used for urban and agricultural supplies (http://www.evergladesplan.org/about/rest_plan_pt_08/aspx).

The purpose of this paper is to analyze the Comprehensive Everglades Restoration Plan as a means of correcting mistakes of the past. In this particular study, emphasis is placed on a
strategically located tract of land in a major western Everglades watershed. While much research and numerous publications and technical reports on the Everglades restoration have been written by the U. S. Army Corp of Engineers and the South Florida Water Management District, the topic has not been widely researched by geographers, particularly studies that deal with the restoration of a failed or antiquated subdivision. The area within what was South Golden Gate Estates is one of the few examples in the United States where restoration of a large obsolete subdivision has taken place. As such, this work will help to fill a void in the literature.

The Setting

The Picayune Strand Restoration Project (formerly known as the South Golden Gate Estates Restoration) is one of the first CERP project to be implemented and encompasses an area of sensitive environmental land located in southwestern Collier County, Florida (Stroud and Payton, 2001). The Picayune Strand is located southwest of the Florida Panther National Wildlife Refuge, north of the Ten Thousand Islands National Wildlife Refuge, east of the South Belle Meade State Conservation and Recreational Lands (CARL) project, west of the Fakahatchee Strand State Preserve, and northeast of the Collier-Seminole State Park (Figure 1).


The central location of the project area among all of these nature preserves and wildlife areas reflects its importance to the ecosystem connectivity of the entire region. The ecological condition of the Picayune Strand affects not only the immediate area, but is significant to regional resources as well.
As a result, the Picayune Strand (SGGE) project is a unique restoration opportunity to remove the infrastructure of a 55,247-acre failed subdivision and restore its pre-drainage hydrology and ecology. There are enormous environmental benefits to completing the Picayune Strand project in part because of its strategic location. The Picayune Strand, the surrounding affected public uplands, and the affected portions of the Ten Thousand Islands estuary make up the largest restoration opportunity in southwest Florida. For future generations, the restoration of this part of southwest Florida needs one more piece of the puzzle that will tie all of these critical natural habitats together (Figure 2).

![Figure 2](image.png)


Restoration of the Picayune Strand Project Area will complete the puzzle and will generate positive effects on the hydrology, vegetation and wildlife of the Project Area and surrounding public lands (U. S. Army Corp of Engineers, Sept., 2004 and Stroud and Payton, 2001).

The need for the restoration of the Picayune Strand began shortly after this environmentally sensitive ecosystem was purchased in the late 1950s by Gulf American Corporation, an interstate land sales company that specialized in subdividing and selling lots to a distant clientele (Dodrill, 1993 and Stroud, 1995). This large land development scheme, named Golden Gate Estates, included as much as 100,000 acres and was promoted as the world’s largest subdivision. The northern portion of the property became North Golden Gate Estates, a community that grew rapidly and now has a population that exceeds 30,000. The area south of I-75 (Alligator Alley) remained largely vacant in part because most the lots were underwater during the wet season (Finotti, 1996). This portion of the subdivision, known as South Golden Gate Estates, makes up what is now the Picayune Strand Restoration Project.
Fortunately, only 12 to 15 lot owners actually built homes on their property south of I-75. The limited number of homes made the restoration much more feasible since only a limited number of houses had to be removed and relatively few permanent residents had to be displaced (Stroud and Warrick, 2004 and http://www.evergladesplan.org/pm/projects/docs_30_sggge_pir_final.aspx).

The humid subtropical climate, flat topography, marl soils and seasonal rainfall pattern were principal influences on pre-development hydrology of the project area. The gentle slopes created poorly defined first-order streams in some locations but typically resulted in sheet flow patterns. Water depth varied from 1 to 2 feet above ground surface at the height of the wet season to 3 feet below ground surface in the late dry season. The onset of the wet season quickly brought saturated conditions for habitats of the historic Picayune Strand. By July, habitats within the study area were uniformly wet with the deepest water levels occurring during the late rainy season in September and October. This typically began to change in November when there was a shift to runoff exceeding precipitation. The result was isolated pools as sheet flow receded to below the ground surface. By March, standing water was limited to depressions. The water storage within these wetlands is a part of the hydrology of the watershed. Subsurface flow, groundwater recharge and evapotranspiration are major components in the hydrologic cycle. As the wet season ended and throughout the dry season, water stored in depressions was slowly depleted as it recharged the shallow water table aquifer and was used by vegetation in the evapotranspiration process (Stroud and Payton, 2001 and U. S. Army Corp of Engineers, May, 2004).

Under pre-drainage conditions, freshwater reached the estuaries through a combination of overland sheet flow and groundwater seepage. The mangrove lined shoreline supported productivity of the creeks, bays and islands by producing large masses of leaf litter and dissolved organic matter that was exported by outgoing tides to the bays and channels. Red mangrove roots provided substrate for crustaceans, mollusks, oysters, algae, tunicates, and annelids, as well as shelter for juvenile fish. Submerged aquatic vegetation (SAV) or “seagrass,” may have covered significant parts of the bay bottoms under natural conditions. All estuarine habitats including subaquatic vegetation beds, oyster reefs, soft-bottom embayments, sand or mud shoals, and fringing mangrove forests depend upon fresh and marine water mixing. Brackish water conditions provided nutrients and dissolved oxygen enrichment, which promotes productivity. These conditions also provided a refuge from predation and an ideal setting for reproduction and juvenile growth and development (Duever, 2013 and U. S. Army Corp of Engineers, May, 2004).

The pre-development or pre-drainage characteristics were dramatically changed after Gulf American Corporation (GAC) acquired the property and constructed roads and canals. The roads blocked the natural sheet flow and the canals over-drained the area resulting in the reduction of aquifer recharge and greatly increased the freshwater point discharge to receiving estuaries to the south. Other problems include an invasion by upland vegetation and an increase in the frequency of forest fires (U. S. Army Corp of Engineers, May, 2004).
Hydrologic monitoring across the main Fakahatchee flow-way has shown seasonal pre-restoration water table drawdowns of almost six and a half feet in the vicinity of the Prairie Canal (the eastern-most canal) in the Picayune Strand near the border of the western edge of Fakahatchee Strand. The water table has been significantly lowered for a distance of over one mile from the canal during the wet season when water levels are naturally above ground and to almost three miles from the canal during dry periods when the water table is naturally below ground. Monitoring also shows positive results from the filling of the upper portion of the Prairie Canal that was completed in 2004. During the subsequent wet seasons, there was a partial restoration of wet season overland flow in the eastern portion of the Picayune Strand. A comparison of data from monitoring wells near the filled canal and from wells near unfilled canals approximately two miles to the west shows positive results. Hydro-periods have increased and groundwater levels have risen in the eastern portion of the Picayune Strand and in the Fakahatchee Strand to the east. There is diminishing positive results in the central and western portions of the Picayune Strand where canals have not yet been plugged. This points to the importance of completing the restoration project and provides an indication that full hydrologic recovery will not occur until the Merritt, Faka Union, and Miller canals have been filled (or plugged) (Duever, 2013).

The Restoration

The Picayune Strand Restoration includes spreader channels or basins, canal plugs, road removal, and pump stations along three of the four major canals to restore and enhance wetlands in the Picayune Strand (South Golden Gate Estates) and adjacent public lands. The restoration will greatly enhance estuarine water quality by reducing large freshwater inflows, and improve groundwater recharge (U. S. Army Corp of Engineers, May, 2013). The major components of the restoration are depicted in Figure 3.

The spreader basins are being constructed immediately downstream from the pump stations on the Miller, Faka Union, and Merritt canals. Spreader channels (basins) will redirect the

water flowing southward within the canals to the east and west (perpendicular to the canals). As the water rises within the spreader basins, it will overtop the southern, downstream portion of the basin and then move over the land as sheet flow (Nageon de Lestang, 2014) (Figure 4).

![Figure 4. Aerial view of the Merritt Canal Pump Station. The spreader basin is depicted in the background. Source: South Florida Water Management District, 2014.](image)

The pump stations will ensure that water continues to flow southward and will prevent water from flowing back (north) to NGGE (North Golden Gate Estates). The capacities of the pump stations, 1,250 cubic feet per second (cfs) at the Miller Canal, 2,630 cfs at the Faka Union Canal (Figure 5), and 800 cfs at the Merritt Canal are designed to be large enough so that the spreader channels and other construction features do no reduce the drainage of NGGE that has been provided by the canals. A 100 cfs pump station will be constructed for interior drainage within the private lands levee systems (U. S. Army Corp of Engineers, Sept., 2004).
Figure 5. Aerial view of the Faka Union Canal Pump Station. Source: South Florida Water Management District, 2014.

Figure 6. Ground view of a degraded road within the Picayune Strand restoration area. Source: South Florida Water Management District, 2013.
Most of the roads in the Picayune Strand are elevated from 6 inches to a few feet above the surrounding terrain. Approximately 260 miles of roads are being removed or graded to lower their elevation to the same level as the surrounding ground (Figure 6). Degrading the roads and filling the ditches will greatly increase the potential sheet flow across the landscape because the roads have served as small levees and represent barriers to sheet flow. The former roadbeds will be abandoned and allowed to re-vegetate. This will leave approximately 19 miles of roads that are to be maintained and used by forestry officials and for limited public access. Several culverts are being installed along this road to allow overland flow to continue on its path to the coastal estuaries. The non-asphalt materials from the degraded roads will be used to construct the canal plugs and the asphalt will be disposed of or recycled in accordance with State regulations. Invasive and exotic vegetation found along the abandoned roadways, particularly Brazilian pepper, are being removed. The hope is that native vegetation will return shortly after the natural hydro-period has been restored (Nath, 2013).

A total of 83 canal plugs will be placed south of the pump stations in the Miller, Faka Union, and Merritt Canals and along the entire length of the Prairie Canal (Figure 7).

![Figure 7. Aerial view of plugs along the Prairie Canal. Source: South Florida Water Management District, 2013.](image-url)
A large segment of the Prairie Canal has already been plugged. The plugs will prevent the canals from transporting water southward to the coastal estuaries. This is an important step in preventing the canals from over-draining the Picayune Strand and surrounding wetlands and greatly reduce or eliminate the problems associated with too much freshwater flowing into the estuaries of the Ten Thousand Islands. The areas near the plugged canals will become much wetter for several months during the rainy season. This more natural condition will promote the return of native vegetation and deter the spread of invasive plants (Duever, 2013).

Five levee systems are to be constructed around developed areas to prevent flooding that might occur as a result of the restoration plan. The areas to be protected include the Port of Islands Waterfront RV Resort and other structures, the Port of Islands development located south of the intersection of the Faka Union Canal and U. S. 41, agricultural land south of Belle Meade, and residential property in northern Belle Meade. Nine additional culverts will be placed under U. S. 41 to allow sheet flow to continue southward into the estuaries of the Ten Thousand Islands region. Culverts are also being built in each of the levee systems mentioned above to allow for interior drainage and along Stewart Boulevard, an internal street that is being maintained to provide access to the interior of the Picayune Strand after the restoration is completed (Potts, 2014). Monitoring of the hydrology, vegetation, fish and wildlife, endangered and threatened species, oyster reefs, fish communities, and water quality will continue. The idea is to have data on conditions before, during, and after completion of the restoration project. Monitoring will help determine the benefits of the project and help in the assessment of whether or not the major goals of the project have been met.

The cost of the restoration project was expected to exceed $550,000,000 based on 2013 dollars. Two of the largest construction expenditures are for pump stations and levees and floodwalls. The other major expenditure is associated with land acquisition and the lengthy and complicated buyback program that was implemented years ago to acquire the property from over 17,000 land owners (U. S. Army Corp of Engineers, May, 2013). Unexpected delays and additional mitigation activities have now pushed the estimated cost to over $650,000,000 (Duever, 2015).

**Summary and Conclusion**

This restoration project is an important part of the effort to restore the Everglades under the leadership of the U.S. Army Corps of Engineers and the South Florida Water Management District and the benefits are numerous and widespread. To expedite restoration, the South Florida Water Management District, the local sponsor of the project, moved ahead with an effort to plug the northern seven miles of the Prairie Canal, remove approximately 65 miles of roads adjacent to the canal, and clear exotic plant species from the canal banks. This work, completed in 2007, is already showing positive results that includes the reemergence of wading birds and native flora that has been absent in the area for decades (Figure 8).
Figure 8. Ground view of standing water and wading birds along what was the Prairie Canal. Source: South Florida Water Management District, 2013.

The most significant benefits associated with the restoration are provided in Table 1.

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restore Pre-Drainage Sheet Flow</td>
<td></td>
</tr>
<tr>
<td>Improve Aquifer Recharge to Protect Water Supply and Prevent Saltwater Intrusion</td>
<td></td>
</tr>
<tr>
<td>Restore and Enhance Habitat for Fish and Wildlife Resources</td>
<td></td>
</tr>
<tr>
<td>Reduce Over-Drainage of the Fakahatchee Strand</td>
<td></td>
</tr>
<tr>
<td>Reduce Freshwater Discharge to Coastal Estuaries</td>
<td></td>
</tr>
<tr>
<td>Maintain Flood Protection for North Golden Gate Estates</td>
<td></td>
</tr>
<tr>
<td>Provide for Better Fire Management</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. A list of the most important benefits of the restoration. Source: South Florida Water Management District, 2015.
These positive features include improvements in the flow of water which will in turn provide for conditions suitable for the return of native vegetation and a more favorable habitat for fish and wildlife. Implementation (completion) of the plan will result in restoration of the hydrology of 113 square miles, including parts of Fakahatchee Strand, to near pre-development conditions. The increased water storage (both surface and groundwater) will cause increased evaporation and recharge, which would result in an overall reduction of six inches of annual runoff basin wide. Freshwater point flow discharge of the Faka Union Canal will be reduced from an annual average of 260 cfs to 2 cfs and will be replaced by distributed runoff along a six-mile wide front through U.S. 41 culverts and bridges. Average annual groundwater levels will be one foot higher over existing conditions and will provide for additional groundwater storage amounting to 25 billion gallons. Hydro-period criteria for the upland vegetation would not be exceeded (U. S. Army Corp of Engineers, May, 2013 and Duever, 2015).

A restored Picayune Strand, when completed, will also help preserve upland habitat, control invasive exotic plants, improve water quality of storm-water runoff, and provide resource-based recreational opportunities. Because of its strategic location, a restored Picayune Strand will provide comprehensive habitat conservation for the greater Everglades ecosystem including the Florida Panther National Wildlife Refuge, Fakahatchee Strand State Preserve, Ten Thousand Islands National Wildlife Refuge, Collier Seminole State Park, and the Belle Meade Conservation and Recreational Lands. These and other benefits point to the significance of this important piece of the puzzle. It is very unfortunate that it has taken so much time and money to “remove” the legacy that was created by the Rosen Brothers and Gulf American Corporation.

References


Duever, Mike. 2013. Senior Environmental Specialist, South Florida Water Management District, Naples, Florida, personal communication, November.

Duever, Mike. 2015. Senior Environmental Specialist, South Florida Water Management District, Naples, Florida, personal communication, August.


http://www.evergladesplan.org/about/rest_plan_pt_01.aspx
http://www.evergladesplan.org/about/rest_plan_pt_08.aspx
http://www.evergladesplan.org/pm/projects/docs_30_sgge_pir_final.aspx
http://www.saj.usace.army.mil/Portals/44/docs/FactSheets/CERP_FS_August2015.pdf