

AQUIFER CHANNELIZATION

4. NEW INFORMATION

Information not available at the time an Environmental Impact Statement (EIS) is released by a federal agency or information not reviewed or evaluated by the agency during the EIS process is considered new information. Considerable and significant new information refuting the basic claims and assumptions of "aquifer storage and recovery" (ASR) in southern Florida has become available since the release of the National Academy of Sciences' (Academy's) 2000 and 2002 Committee for the Restoration of the Greater Everglades Ecosystem (CROGEE) publications and the US Army Corps of Engineers' (Corps') final EIS. Examples of some of that new information are addressed below.

Inadequacies of Model Predictions - Flow Velocities in Karst Aquifer Systems

Groundwater flow velocities in comparable karst aquifer systems

Predicting the rate or velocity of flow in a karst aquifer system using standard models, such as MODFLOW, is very difficult. This difficulty is because these models generally rely on information based on the primary porosity (or sample/core permeability) of the aquifer system. In reality, the secondary porosity (or aquifer formation permeability) is more important in controlling the velocity of groundwater flow. This aquifer permeability involves conduits, such as fractures and dissolution channels or pipes (shown in [Figure 7A](#), [Figure 7B](#), and [Figure 8B](#)), which may be connected to large underground, water-filled caverns,

Tracer studies, such as those using dyes, that have been conducted in karst aquifers like the Floridan aquifer system have documented very rapid flow of ground water and contaminants (Davies *et al.*, 2004; Hazlett *et al.*, 2004; Kincaid *et al.*, 2004; Renken *et al.*, 2004; Schindel *et al.*, 2004). This new information provides additional support to earlier reports in the vicinity of the proposed Everglades ASR wells of rapid conduit flow through the Floridan aquifer system.

Minimum conduit-flow groundwater velocities of **0.5 to 3.7 miles** (reported as between 800 and 6,000 meters) **per day** have been documented recently over minimum flow paths of up to 10 miles (16 km) long in Florida's Floridan aquifer system (Davies *et al.*, 2004; Hazlett *et al.*, 2004; Kincaid *et al.*, 2004). These groundwater velocities represent an area of the Floridan aquifer system where large-scale injections into and withdrawals from the aquifer system are not occurring and therefore provide good baseline information.

Conduit-flow in a similar karst aquifer in Texas (the Edwards Aquifer) recently documented arrival times for groundwater contaminants of 36 hours. The actual transport time was more than 2,400 times more rapid than the transport time of 10 years predicted by standard models using primary porosity/Darcy flow (Schindel *et al.*, 2004; Schindel, personal communication, 11/9/04).

Neither of the scenarios described above were associated with significant engineered alterations of groundwater flow. Flow velocities associated with large-scale aquifer injections and withdrawals like those of ASR wells in southern Florida would be expected to artificially increase the groundwater flow velocities of the surrounding area. Additionally, previous studies have addressed upward leakage of water into the upper Floridan aquifer from deeper zones where semiconfining units are thin or breached by fractures, collapse features, or other structural anomalies (Beck, 1989; Patten and Klein, 1989; Maslia and Prowell, 1990; Spechler, 1994; Spechler and Phelps, 1997).

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Groundwater flow velocities in the southern Florida ASR study area

Tracer studies using WT rhodamine dye and other tracers recently were conducted by USGS for validation of aquifer parameters used in models to predict flow in the surficial aquifer system of the southern Florida study area for the Everglades ASR wells. Velocities were significantly greater than expected. The rhodamine dye flowed from the 65-foot (20-km) deep open borehole (injection well) to the public supply wells in a matter of hours rather than weeks or months, as predicted by the model.

The extremely rapid flow with little attenuation, in contrast to that predicted by the groundwater model, turned the public water supply blood red. Requests for copies of the data and related public record documents from the senior author of that study were denied, due to the purported "politically-sensitive nature of this study" [sic] (Renken *et al.*, 2004; Renken, personal communication, 11/9/04; 12/8/04).

The dual-porosity aquifer was referenced as a "superhighway" for groundwater flow, with poor attenuation for any solutes (and *Cryptosporium*-sized colloidal particles) being transported with the ground water. The aquifer system that supports Florida's largest municipal well field in Water Conservation Area (WCA) 3 was described by the USGS as having "vertically-arranged, diffuse-carbonate and preferential conduit flow zones." The "aquifer's highly heterogeneous and anisotropic permeability is largely related to secondary porosity," with large interconnected vug (cavity) solution features forming conduit flow zones. Another important factor is the large mine pits, dredged to the same depths as the municipal supply wells (60 to 80 feet deep), which are located within 1,000 feet (305 m) of the production well head (Renken *et al.*, 2004; Renken, personal communication, 11/9/04).

The Corps is permitting significant expansion of these large, dredged mine pits, claiming they are water-supply enhancing "reservoirs" that benefit the Everglades "restoration" effort. The existing body of scientific knowledge, however, supports the conclusion that these mined pits result in significant loss of water resources as former ground water is converted to surface water, exposed to the atmosphere and evaporates. These mined pits result in a permanent drop in aquifer levels and the invasion and establishment of aggressive alien species such as melaleuca (*Melaleuca quinquenervia*).

Aquifer Drawdown/Depletion - Hydroperiod Alteration

As is the case with standard groundwater supply wells for agricultural, industrial, and municipal use, withdrawals (referenced as "recovery") from the ASR injection wells that are proposed to be constructed in the Everglades will result in drawdowns (depletion) of the aquifer system. The aerial extent, or distance from the well of a drawdown due to groundwater withdrawals, also is referred to as a cone of depression or cone of influence.

Predicting the extent of an aquifer drawdown in a karst aquifer system using standard models such as MODFLOW is very difficult, for reasons described above. The difficulty arises because these models routinely use aquifer characteristics determined from geologic samples (cores) or short-term pump tests, which cannot provide information about short-term or long-term secondary (conduit) flow responses.

ASR model predictions

Model predictions for the withdrawals of 5 and 10 Mgd proposed for ASR wells in the Everglades were included in the Corps' final EIS. At the proposed Caloosahatchee and Moore Haven ASR sites (both at the boundary between Glades and Hendry Counties) the simulated

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drawdown impacts a for a drawdown depth shown to result in environmental harm to natural wetlands - less than 1 foot (0.3 m) - was predicted to extend for a distance of ~4 miles and 6 miles (6.5 and 9.5 km), respectively, in all directions from the ASR wells. More dramatic consequences were predicted for wells at the proposed Kissimmee and Hillsboro ASR sites (at the boundaries between Okeechobee and Glades Counties and Palm Beach and Broward Counties, respectively). Drawdown levels of twice and three times that magnitude (for the same level of withdrawals) are predicted to extend for a distances of ~20 miles and 5 miles (32 and 8 km), respectively surrounding the ASR wells at the proposed Kissimmee and Hillsboro ASR sites (US Army Corps of Engineers, 2004, 180-day transient models, Figures 63, 61, 59, and 41).

The predicted drawdowns referenced above do not include any additional drawdowns from other uses, such as existing or proposed agricultural irrigation and industrial withdrawals. The minimum 1-foot (0.3-m) drawdown is predicted to extend between 7 and 14.2 miles (11 and 23 km) from the center of the proposed Port Mayaca ASR site (at the boundary between Martin and Palm Beach Counties) for the model which includes ASR pumping only for the first 90 days and ASR combined with only the adjacent irrigation/industrial wells pumping for the next 90 days (US Army Corps of Engineers, 2004, Figure 57).

Conversion of natural wetlands to invasive, alien, and nuisance species

The knowledge that groundwater withdrawals in karst aquifer systems result in the loss of natural wetlands is not new to the body of scientific literature. The conversion of natural wetlands in the Everglades watershed to invasive, nuisance, and alien species such as melaleuca was documented 15 years ago in southern Florida (Hofstetter and Sonenshein, 1990; Sonenshein and Hofstetter, 1990).

The cause of this conversion from desirable native species to harmful alien species is the result of the alteration of the natural hydroperiod, as well as the dewatering the wetlands. Additional adverse impacts of hydroperiod alterations include subsidence (*e.g.*, loss of soil) and the dissolution of the carbonate rock of the aquifer system (Hofstetter and Sonenshein, 1990; Sonenshein and Hofstetter, 1990).

The new information directly related to these problems is from the recent research of Wilcox *et al.* (2004). Their research used stable isotopes to show that more than 60% of the water being drawn from the aquifer system by Miami-Dade's West Well Field originated in the Everglades (northeast Everglades National Park), ~2 miles (3 km) west of the production wells. Their data also revealed that the ratio of Everglades water diverted into the Miami-Dade supply wells increases to 74% during the dry season, when the sensitive ecosystems are most dependent on shallow groundwater resources.

The study also documented localized rapid infiltration of rainfall, due to the pumping, that resulted in the formation of karstic-like "conduits" transporting isotopically depleted water (Wilcox *et al.*, 2004, p. 16). Therefore, the failure of the Corps to consider mandatory water reductions as an alternative to ASR - while simultaneously increasing hydroperiod alterations via ASR - will hasten the demise of the Everglades rather than facilitate its restoration.

Everglades degradation from dredged mine pits

Another aspect of the Corps' "restoration" plan for the Everglades is the expansion of dredged mine pits in the Everglades wetlands and watershed under the guise that these pits will enhance water availability and create "storage." These dredged mine pits are referenced as "storage reservoirs." Results of stable isotope research to quantify flows between the Everglades

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and urban areas in Miami-Dade County were published recently (Wilcox *et al.*, 2004).

The results of that research documented that the rock mining pits permitted by the Corps throughout the Everglades breach the semiconfining layers of the aquifer system and allow for co-mingling of shallow and deep ground water with contaminated canal water. This combination of ground and surface waters then is pulled laterally (horizontally) through the karst aquifer system and into the municipal supply (production) wells.

Their study also confirmed that some undetermined volume of water is moving upward from the deeper aquifer into the dredged pits, due to the breaches in the semiconfining layers from the dredging of the pits. The researchers recommended additional work to determine the amount of seepage from the Everglades that was induced by the combination of rock-mining and well-pumping activities (Wilcox *et al.*, 2004, p. 17).

Increased arsenic

Additional new information regarding adverse impacts of aquifer injections in Florida such as ASR is that those injections result in increased arsenic in waters surrounding the injections. Reported increased arsenic levels are in excess of 100 mg/L - **more than 10 times the current EPA drinking water standard**. This information was part of recent findings from research in southwest Florida, during analysis of water "recovered" from ASR wells (Price and Pichler, 2004).

The researchers noted that arsenic was ubiquitous throughout the Suwannee Limestone, which is the strata where fluids are injected by the majority of ASR wells in southern Florida. Under natural conditions the arsenic is bound to the limestone. The injection of water high in oxygen into the aquifer causes the arsenic to be released into the ground water.

Although various forms of treatment may be proposed for water pumped out for potable use, in an attempt to reduce the high levels of arsenic mobilized by aquifer injections, such efforts will provide no protection to marine mammals, fish and wildlife exposed to those elevated levels of arsenic once the arsenic is discharged to surface waters. Arsenic contamination of surface water will occur via induced discharge of ground water due to the co-mingling and displacement of ambient ground water resulting from those injections. The increased costs of attempting to remove the arsenic from the water to make it safe for human consumption also has not been considered.

Hydraulic fracturing, dissolution, and sinkhole formation

Other recent findings (Dobecki and Hare, 2004) support the conclusion that ASR includes many basic similarities to harmful methods used in secondary and tertiary petroleum recovery. One such method, hydraulic fracturing, reportedly was developed by Halliburton. That method is under investigation by Congress for the inadequate scientific review and regulation and the EPA's failure to require monitoring of this aquifer injection method, despite a federal court decision mandating regulation due to aquifer-related adverse impacts associated with this technique ([Legal Environmental Assistance Foundation, Inc. v. US Environmental Protection Agency, 95-6501](#)).

In the late 1980s, hydraulic fracturing caused natural gas in underground formations to co-mingle with an aquifer supplying previously potable ground water to residents. The discovery that the water supply had been contaminated by the colorless, odorless gas was not made by regulatory agencies monitoring these underground injections. Rather, the contamination was discovered when some of the local children began "igniting" lemonade made

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with water from their family's well. More information regarding that and related problems associated with conventional "extravagant energy" sources can be obtained by down-loading the file by that name from: <http://www.energyawarenessproductions.com/thefilm.html>.

Fracturing and dissolution of the aquifer formation are the two most common processes that are responsible for the ability to inject and withdraw increasing volumes of fluids into and from the aquifer formation after repeated injections and withdrawals. One technical term used to describe this process is "well development" or "performance." Both fracturing and dissolution can increase the distance that the injected fluids are able to move laterally from the point of injection. Increased "well performance" comes at a high cost to the environment.

Fracturing and dissolution associated with aquifer injections and withdrawals also can create new sinkholes and can result in the destabilization and enlargement of relict sinkholes. Relict sinkholes were formed during prehistoric times of sea-level fluctuations and subsequently filled in. The formation of sinkholes has increased in size and number throughout Florida during recent decades in response to the widespread groundwater withdrawals. Most recently, sinkholes have been forming in inland portions of Volusia County, in east-central Florida, where groundwater mining already has resulted in extensive damage to natural depressional wetlands (<http://www.news-journalonline.com/special/sinkhole/>). Southeastern Florida has not experienced that magnitude of sinkhole formation activity because groundwater withdrawals occur primarily from the surficial aquifer. The increasing number of ASR wells and deep-wells being constructed and proposed throughout southern Florida for desalination will result in similar sinkhole problems in that subregion of the regional Floridan aquifer system.

Sinkholes cause additional environmental damage, such as the damage caused to Florida's natural communities (wildlife habitat) that are intended to be "protected" in the Wekiva Springs State Park in central Florida (Orange and Seminole Counties). Groundwater withdrawals and injections as well as impervious surfaces have increased greatly in areas surrounding this park during the past few decades (**Figure 11**). Devastating damage also is done to homes, businesses, and other structures built in the areas where extensive groundwater withdrawals and injections are occurring.

None of the information provided to the public informs them that sinkhole formation is one of many adverse impacts associated with groundwater withdrawals and injections. As is the case with other environmental problems due to groundwater alterations, "drought" is suggested as the cause of the sinkholes forming throughout central and western Volusia County, where extensive groundwater mining is occurring (<http://www.news-journalonline.com/special/sinkhole/>). Currently home-owners and insurance companies carry the financial burden of the damages to these homes, which ultimately will lead to the increase in home insurance for the general public.

Taxpayers already are paying to construct and operate these environmentally damaging public works projects. One example is the subregional St. Johns River Water Management District, comparable to the SFWMD. The St. Johns River Water Management District issues permits for most types of groundwater withdrawals in Volusia County. That agency is promoting a network of ASR wells in Volusia County and throughout east-central Florida. As is the case with the proposed ASR projects in the Everglades watershed, the ASR projects and ancillary actions are proposed to be funded in part with federal tax dollars via EPA State and Tribal Assistance Grants, known as STAG funding (<http://www.surfriderpbc.org/stag.html>). Some of the proposed projects already have been funded by the EPA, without EIS review. The STAG funds for the initial projects in Volusia County, which will include ASR and other aquifer

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injections, most recently were proposed to be funded by the EPA (in applications by the St. Johns River Water Management District, "water authorities" and local governments) also without EIS review.

The "bubble" theory v. reality

Burst "bubble" - The concept of ASR is based on the theory that the injected fluids form a "bubble" that remains intact and immobile until it is "recovered" (extracted) during the "recovery" phase (see the cover illustration by the Corps). Additional new information related to ASR is based on conclusions from measurements conducted from eight wells extending 3,936 feet or 0.7 mile (reported as 1,200 m) deep into the upper Floridan aquifer in southwest Florida.

The area of focus was the Suwannee Limestone, which commonly receives fluid injections via ASR wells. Using the measurements from those wells, the distribution of injected fluids was modeled, using a three-dimensional flow (MODFLOW) and solute-transport (MT3D) model, to study the effects of bed-scale, layered heterogeneity. Their results revealed the following, regarding the dispersal of injected fluids into surrounding aquifer cavities and fractures (with considerable upward flow), rather than injected fluids remaining intact (a "bubble"), as widely claimed (Hutchings *et al.*, 2004):

The domain of the **injected water is not at all like a bubble**, but instead much like a bottle brush. Taking into account the effects of buoyancy, which we did not do in this study here, one can easily picture the inverted Christmas tree proposed by Missimer and associates for the geometry of the invaded domain. [emphasis added]

As recently as September 2004, the Corps was promoting the "bubble" theory in their final EIS for "ASR pilot projects." The "bubble" model, included here as [Figure 12A](#), was published in the Corps' final EIS as Figure 1.3-1 and was dated September 2004 (US Army Corps of Engineers, 2004a). The proceedings containing the "bottle brush"/"inverted Christmas tree" results were not published until after the release of the Corps' final EIS, thus constituting new information that was not considered by the Corps during the EIS review. The SFWMD, however, was a sponsor of the ASR conference where the results were presented in April 2004. Therefore, the SFWMD, as the local sponsor for the Everglades "restoration" effort, could have and should have advised the Corps of those findings to be considered in the EIS review process.

"Bottle brush" model - Ironically, a very constrained, abbreviated approximation of the "bottle brush" or "inverted Christmas tree" model of injected ASR fluids was created by the Florida DEP in 1991. That model was used to illustrate the response of fluids injected for the purpose of disposal via wells similar to ASR wells extending into the lower Floridan aquifer ([Figure 12B](#)). The same illustration, with a shallower ASR well extending to the upper Floridan aquifer and lacking the "bottle brush" dispersion, was included in the Corps' EIS on page 8 of the "Comprehensive Everglades Restoration Plan Aquifer Storage and Recovery Program." The "bubble" model was illustrated on the first page of that "white paper" (US Army Corps of Engineers, 2004a).

The "bubble," "bottle brush," and "inverted Christmas tree" models all imply that the ground water in the injection zone is stationary rather than flowing. In reality, groundwater flow in the Floridan aquifer system has been documented repeatedly, with examples of recent results discussed in the Flow Velocities section of this chapter, above. Historically, the natural lateral flow of ground water in the Floridan aquifer system has been toward the coasts, where it joined

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nearshore coastal waters as submarine groundwater discharge.

Any conclusion that aquifer injection of fluids into either ASR or designated waste disposal wells would halt the natural flow of ground water is not scientifically-based. In fact, the logical presumption (supported by the scientific literature) is that aquifer injections **increase** the flow of ground water because of factors explained below.

"Ambient flow and transport" model - The Academy addressed the fact that groundwater flow is occurring at these injection sites in the simplified "ambient flow and transport" model and "mixing" models included in their final CROGEE report (National Research Council, 2005, Figure 2-9c and d, respectively). In both of those models, the fluids injected via ASR well flowed away from the ASR well after injection ceased. Although that publication does not reference the data summarized in the USGS inventory ([Reese, 2002](#)), the Academy's "ambient flow and transport" model is most consistent with the **actual** "recovery" (calculated for this analysis) for all of the ASR wells described in the USGS inventory.

The illustrations of the simplified CROGEE flow models were confined to the immediate vicinity of the ASR wells where the fluids were injected. Those simplified models did not include any of the myriad conduit flow paths, such as those high-permeability zones documented by USGS in the Everglades watershed ASR injection zones in 1995 (Quiñones-Aponte *et al.*, 1996). That model is included in [Figure 12C](#) as the "conduit flow" model.

"Inland flow and discharge" model - A larger-scale, more realistic model of the ASR flow for non-coastal ASR wells in Florida is based on the Floridan aquifer cross-section prepared by Maddox *et al.* (1992) and included as [Figure 7A](#). An animated version of that model, referenced as the "inland flow and discharge" model (Figure 12D), can be seen at: <http://www.surfriderpc.org/asrgif.html>. Note how the injected fluids flow rapidly through various high-permeability conduits in the aquifer system and then discharge to various natural lakes and wetlands surrounding the injection wells. The reverse will occur during aquifer withdrawals through the ASR wells, again altering hydroperiods again in natural lakes, streams and wetlands.

"Coastal flow and discharge" model - A similar scale and realistic version of the ASR flow model for coastal ASR wells in Florida is based on the Floridan aquifer cross-section prepared by Fernald and Purdum (1998), included as [Figure 7B](#). The model based on that cross-section is referenced as the "coastal flow and discharge" model ([Figure 12E](#)). Note how the injected fluids flow rapidly through various high-permeability conduits in the aquifer system and then discharge to nearshore coastal waters, labeled in the model as the Atlantic Ocean. The "coastal flow and discharge" model also is applicable to Florida's west coast, where the same types of conduit discharges occur in the Gulf of Mexico over a much greater area because of the extensive submarine extent of the Floridan aquifer system.

Link to red tide - The numerous submarine springs throughout the submerged Floridan aquifer formation along southern Florida's coast discharges water potentially laden with injected contaminants. Those discharges are the most probable source of nutrient contaminants - particularly nitrogen from injected sewage effluent - fueling the red tide outbreaks in the Gulf of Mexico along Florida's southern coast. On January 9, 2005, the initial observation of the most recent and catastrophic red tide event - located at that time ~30 miles (50 km) offshore from St. Petersburg - was made by the National Oceanographic and Atmospheric Administration (NOAA) SeaWifs Satellite, "as an area of intensive chlorophyll." By May the bloom had begun causing problems from Sarasota north to Pasco County, including in Sarasota Bay and Tampa Bay (Richard Pierce, Mote Marine Laboratory, Sarasota, personal communication, 8/23/05).

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The red tide event expanded to encompass an area reportedly 2,100 square miles from shallow inland waters to waters 100 feet (~33 m) deep - an area slightly larger than the state of Rhode Island. It persisted through late August 2005, when Hurricane Katrina crossed the peninsula of southern Florida. The affected area was described as a "dead zone" because the entire floor of the Gulf reportedly was devoid of life or sound (summarized by Cathy Zollo, 8/12/05, "Area of Gulf floor void of life, sound," www.heraldtribune.com).

The toxic algal bloom reportedly resulted in the death of more than 100 mature sea turtles attempting to reach the beaches during the nesting season, in addition to resulting in the mass death of almost all other marine life forms in that area. Residents and tourists also reportedly were hospitalized or forced to seek medical care after exposure to the neurotoxins released by the organisms.

Neither of the agencies regulating aquifer injections in Florida and documenting the flow of injected wastes out of the underground disposal locations - the EPA and the Florida DEP - have made any attempts to initiate independent investigations by karst groundwater experts to evaluate the role of these underground injections in this or any other recent harmful algal bloom. In summary, the documented fallacy of the "bubble" theory, based on the findings of Hutchings *et al.*, 2004, constitutes new information that was not considered by the Corps during the EIS review process. The body of scientific information on groundwater responses in karst aquifer systems including the Floridan aquifer system, however, already was sufficient to refute the "bubble" theory at the time it was proposed for ASR in Florida.

Destruction of habitat critical for the survival and recovery of listed species

On April 4, 2004, the US Fish and Wildlife Service published a "Multi-Species Recovery Plan" for south Florida (US Fish and Wildlife Service, 2004). That Plan was approved by the Regional Director on May 18, 1999. A copy of that Plan can be obtained electronically, or requested as a hard copy at: <http://verobeach.fws.gov/Programs/Recovery/vbms5.html>.

The Multi-Species Recovery Plan requires their agency to consider all of the adverse impacts to the federally listed species in southern Florida, including the disturbance of or taking of those listed species, and includes adverse impacts to the habitat of those species. Adverse impacts to the habitat of these species include the adverse impacts associated with aquifer injections and withdrawals, excavation, dredging, and mining, all of which can result in adverse impacts to habitat hydroperiod and vegetation of federally listed species great distances beyond the surface footprint of those actions. That 2004 Plan addresses all of the federally listed species referenced in this report and others not referenced in this report.

Lee County, Florida recently determined that it would not initiate a ban on the mining of aquifer formations (*e.g.*, rock, shell, and sand) in that county. The county is within the Everglades watershed and includes areas associated with the habitat critical for the survival and recovery of the federally endangered Florida panther (*Puma concolor coryi*) and wood stork (*Mycteria americana*). Those mine pits degrade and destroy this critical habitat, jeopardizing the survival and recovery of the those federally endangered species, as well as the federally endangered Florida manatee (*Trichechus manatus latirostris*).

Mining in that county results in the net loss of wetlands and other habitat critical to the survival and recovery of those federally endangered species beyond the surface footprint of actual mine pits due to permanent, irreversible alterations of the natural hydroperiod. The types of wetlands affected most rapidly and severely by those mining activities are natural depressional wetlands such as wet prairies and pond-cypress wetlands.

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Those critical wetlands and other habitat are the same types that are most susceptible to destruction from altered hydroperiods due to aquifer withdrawals and injections (summarized in Bacchus, 2000b; Bacchus *et al.*, 2003). Therefore, ASR wells in the vicinity of habitat for the federally endangered Florida panther and wood stork will result in adverse impacts to the survival and recovery of those species.

In addition to destroying habitat critical to the recovery and survival of those federally endangered species, that type of mining also will result in the further establishment and spread of alien and other nuisance invasive species, such as melaleuca, as described above. The end result, tragically, will be additional requests for ASR and aquifer-injections of sewage effluent throughout southern Florida. These adverse environmental impacts underscore the fallacy of the ASR concept in southern Florida, in addition to the fact that sufficient evidence was available to refute the "bubble" theory at the time ASR was proposed for use as Everglades "restoration."

Examples of adverse impacts from aquifer injections to federally threatened and endangered species have been described previously ([Bacchus, 2001](#)). A synopsis of some of the federally and state-listed species with survival and recovery jeopardized by the aquifer injections and withdrawals associated with ASR is provided in [Table 3](#) and [Table 4](#), respectively.

The "ASR pilot projects" proposed in the Corps' EIS would be located in the vicinity of habitat critical for the survival and recovery of the federally endangered Florida panther and wood stork. That EIS failed to address any adverse direct, indirect, or cumulative impacts to those species by the proposed "ASR pilot projects," in conjunction with adverse impacts to those species and habitat critical for their survival from mining of the aquifer formation.

On February 1, 2005, in the case "[United States of America vs. Mylon L. Stockton](#)," a **US District Judge ordered two men to pay \$100,000 for the destruction of a single tree in southwest Florida used for nesting by a bald eagle.** The ruling also required the defendant to forfeit his interest in the property where the tree had been located. Ironically, no similar action has been taken in federal court regarding the destruction (known as "taking") of trees and habitat required for nesting wood storks and reproduction of Florida panthers. This lack of enforcement occurs despite the extensive destruction of these trees and other habitat critical to the survival and recovery of those species by groundwater alterations from mining and aquifer withdrawals and injections.

Road-related net loss of wetlands

Since the final EIS was released by the Corps, their agency has proposed expedited permitting of Florida's Department of Transportation road construction. The new procedure is called the "Efficient Transportation Decision Making (ETDM) Process."

That project will result in extensive expansion of impervious (nonporous) surfaces throughout southern Florida and the remaining portions of the state. The expansion of impervious surfaces result in additional net loss of wetlands - particularly natural depressional wetlands in the Everglades such as wet prairies and pond-cypress wetlands that are critical to the Florida panther, wood storks and other wildlife. This action also will lead to additional proposals for aquifer injections of contaminated stormwater runoff and sewage effluent.

The net loss of wetlands will occur far beyond the surface footprint of the proposed road projects. The net wetlands loss from this proposed "EDTM Process" would include natural depressional wetlands within critical habitat for the recovery and survival of the Florida panther and wood storks in the Everglades in part because that is where the raw materials for this and similar road projects are mined (dredged).