Natural Resource Strategies For Southeast Lee County



Planning for the Density Reduction / Groundwater Resource Area (DR/GR)

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town planning

Lee County, Florida
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PREFACE I

PREFACE

In 1990, Lee County Commissioners applied a new Density Reduction/Groundwater Resource (DR/GR) designation to most of southeast Lee County to protect the area's shallow aquifers and reduce the county's population capacity. The 82,560 acres of the southeast DR/GR host rural neighborhoods, limerock mines, and active farms. The land also contains valuable ecological and hydrological features including panther habitat and public water supply wells.

Since the designation of the area, the pressure to mine and to expand the urban area outward has been increasing. In the fall of 2007 the Board of County Commissioners initiated a 14-point Action Plan addressing critical mining, traffic, and land use issues in the DR/GR area.

A major planning effort was part of this initiative. Using detailed ecological mapping and a scenario-based land use study, a new *Prospects for Southeast Lee County* plan defined proper balances of uses for the DR/GR's future.

Dover, Kohl & Partners led the project team, with collaboration from Spikowski Planning Associates, Kevin L. Erwin Consulting Ecologist, Inc., Hall Planning & Engineering, Dan Cary, Berger Singerman, David Douglas Associates, Inc., and DHI Water & Environment, Inc.

To provide oversight and additional insight into emerging policy options, the Lee County Commission appointed a 15-member DR/GR Advisory Committee that met throughout 2008 and formulated independent recommendations on future county policy for southeast Lee County.

In September 2008 the Board of County Commissioners directed that implementation of this plan begin immediately. This implementation phase will produce five separate reports:

- ***Proposed Lee Plan Amendments for Southeast Lee County***, which contains detailed amendments to maps and policies in the Lee Plan and a summary of the data and analysis upon which they are based.

- ***Transferable Development Rights in Southeast Lee County***, which analyzes the feasibility of a transferable development rights program and provides detailed designs for potential rural and mixed-use communities.

- ***Comprehensive Hydrological Study of the Lee County Southeastern Density Reduction/Groundwater Resource Area***, which documents the creation of an integrated surface and groundwater model and analyzes land-use alternatives for this area from a hydrological perspective.

- ***Natural Resource Strategies for Southeast Lee County***, which addresses best farming practices, land acquisition and restoration, mine reclamation standards, and innovative mining approaches.

- ***Proposed Land Development Code Amendments for Southeast Lee County***, which contains detailed code amendments to carry out the Lee Plan amendments and other recommendations of these reports.

This current document, *Natural Resource Strategies for Southeast Lee County*, contains four chapters:

- Chapter 2 addresses agriculture, including best management practices for farming.

- Chapter 3 presents a land acquisition and restoration strategy for the DR/GR area.

- Chapter 4 analyzes innovative techniques that might minimize the effects of mining on surrounding ecosystems

- Chapter 5 proposes modifications to the reclamation standards in Chapter 12 of Lee County's land development code.

Agriculture 2

INTRODUCTION

Agriculture is one of the most important land uses in the Density Reduction/Groundwater Resource (DR/GR) land use category, which covers approximately 82,560 acres in southeast Lee County. It is important to understand the current and future role of agriculture within this important rural area.

Information has been gathered in this chapter on the following subjects to evaluate the importance of agricultural operations in the DR/GR:

- Current status of agriculture in the DR/GR
- The future of agriculture in Lee County
- Water resource management proposals
- Agricultural best management practices adopted by the State of Florida and other agencies
- Established programs for protecting and improving wetlands on agricultural lands

Meetings were held with agricultural interests to solicit information on these topics and share ideas and concerns directly related to the southeast Lee County study.

AGRICULTURE TODAY IN SOUTHEAST LEE COUNTY

Agriculture was one of the first land uses in southeast Lee County. Timber harvesting, turpentining, cattle grazing, row crops, and citrus groves have all been important economic uses within what is now the DR/GR; a capsule history was presented in Appendix A of *Prospects for Southeast Lee County*.[1]

In 2008, 33,689 acres of land in southeast Lee County received agricultural exemptions from the Lee County property appraiser.

The majority of the exemptions were for pastureland (18,690 acres or 55%). Orange groves comprise 9,701 acres or 29% of the agricultural exemptions. The other agricultural operations receiving these exemptions were vegetable farms (2,977 acres or 9%) and potato farms (2,321 acres or 7%). Locations of these exemptions are depicted in Figure 2.1.

Over the past ten years there has been a 40% reduction in agricultural exemptions for pastureland and a 52% reduction in vegetable farm acreage. Citrus groves and potato farms have remained relatively stable. The overall reduction in agricultural operations in the DR/GR has been approximately 32% or 16,039 acres over the past decade.[1]

About a fourth of the decrease in pasture land resulted from tax changes rather than land-use changes. Most of the remaining decrease was conversion of farmland to mining, but some was a result of farmland being acquired for residential development or purchased for conservation purposes. Most of the decrease in vegetables resulted from conversion of farmland to mining.

An increasing percentage of agricultural activities now rely on leases with landowners who are no longer agricultural operators, although many major landowners continue to farm their land, as shown in Figure 2.2. However, landowners who currently farm their own land often consider whether their land may be more valuable for other purposes. Several of these landowners are now proposing limerock mines on their land, which would displace much or all of the current agricultural uses.

There are no large tracts of land available within the DR/GR for development of additional agricultural operations. Therefore, conversion of any existing farmland to other uses will reduce agricultural activity in southeast Lee County.

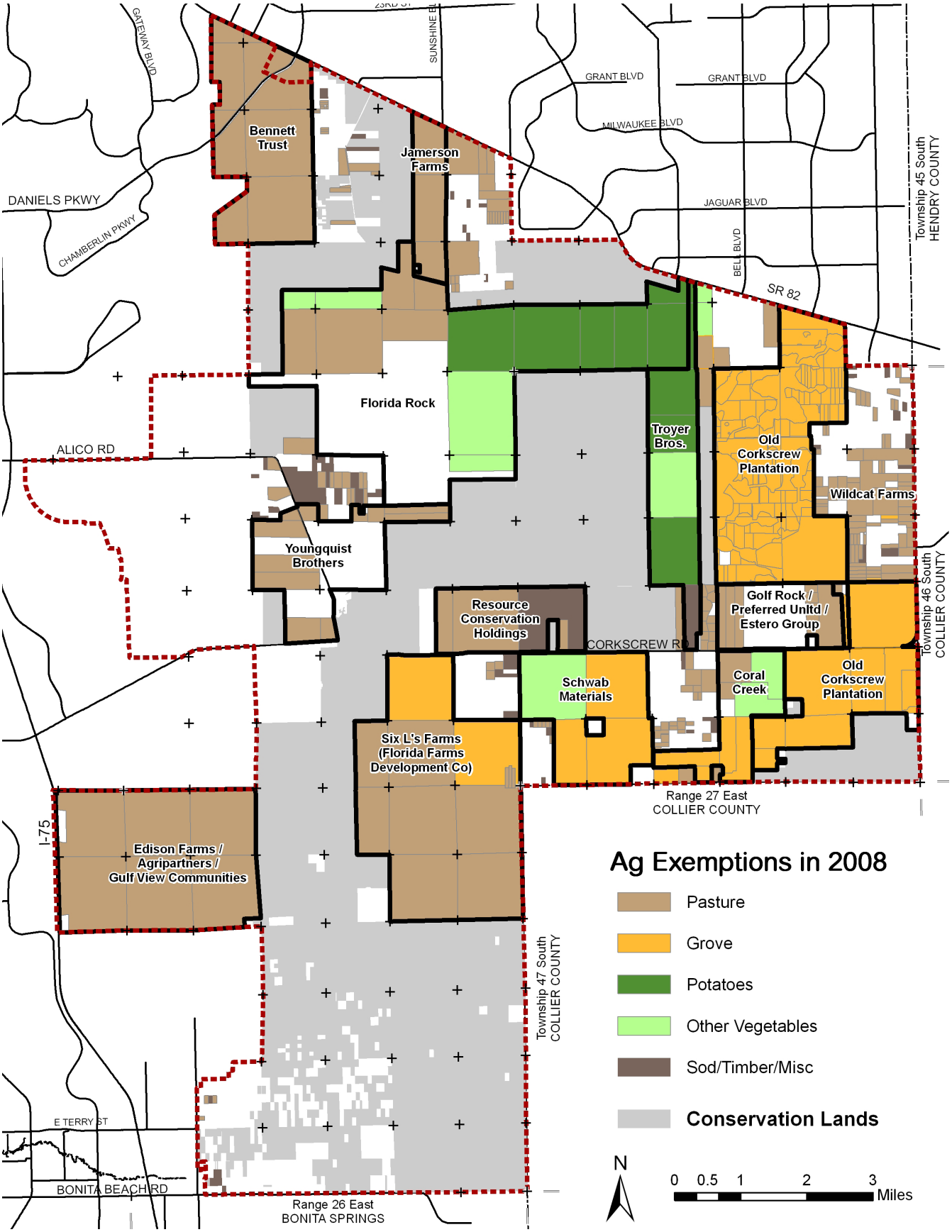

Figure 2.1: Agricultural Exemptions 2008

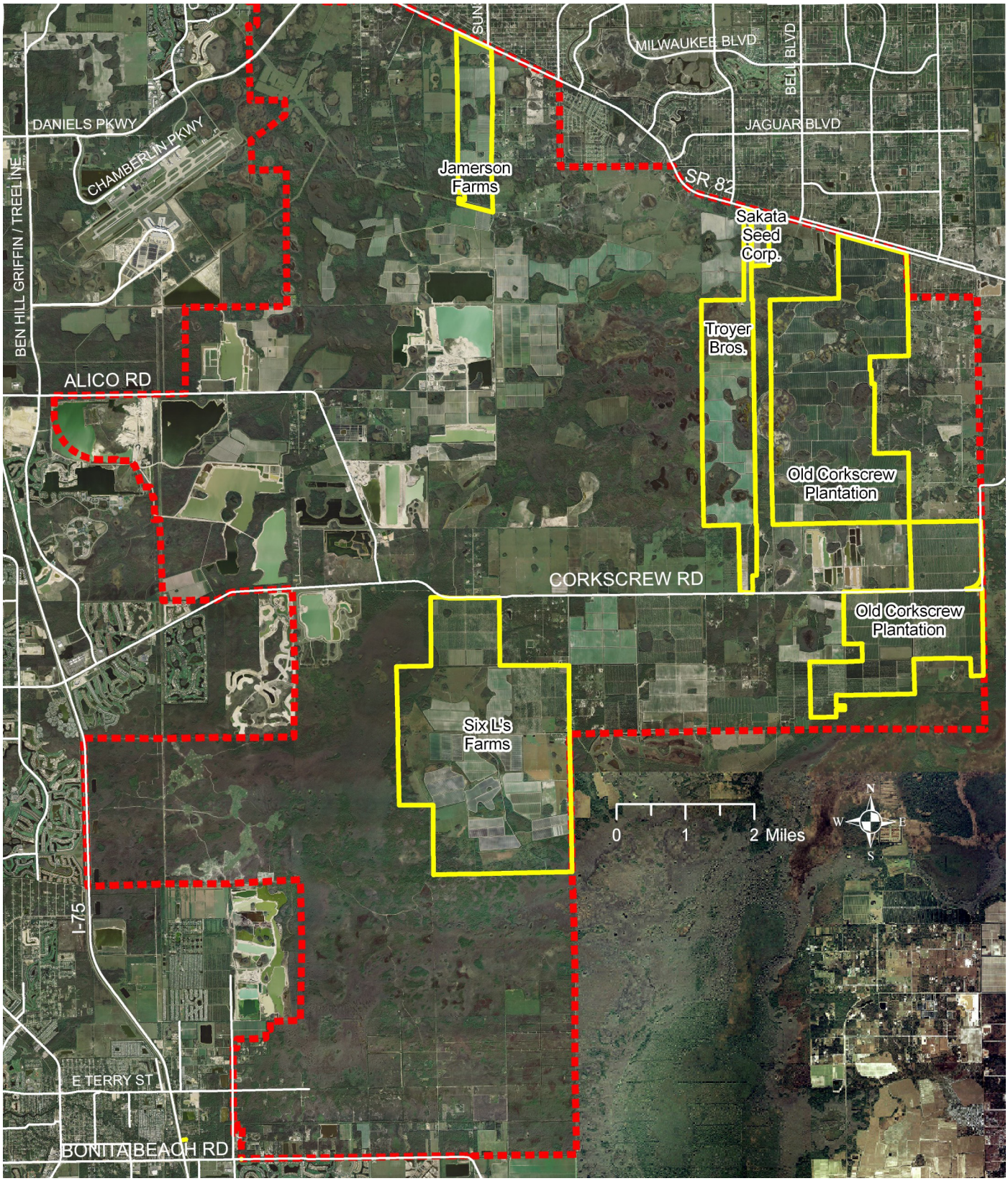

Figure 2.2: Operator-Owned Farms

Most land used for agriculture in southeast Lee County has been altered to lower groundwater levels due to the historically vast extent of wetlands. Citrus groves need to lower the surficial aquifer to a greater extent than other agricultural uses to maintain a dry root zone throughout the year. The growing season for most row crops falls outside of the wet or rainy season, allowing for the flooding of the fields during the rainy season.

Pastures may be managed to allow flooding during the rainy season or to discharge the rainfall through ditches to maintain a lower water table for livestock grazing. If pastures are allowed to flood during the rainy season, cattle owners must have drier properties available for livestock.

When irrigation is necessary, most agricultural operators now employ the best management practice of drip irrigation, a major step in conserving water. Drip irrigation is a method of providing water through a system of tubes or hoses that emits the irrigation water at a controlled rate around the root zone of the plants to maximize the uptake of water. This method reduces the loss of water to evaporation and infiltration. For example, the citrus industry has reduced the use of irrigation water by about 140,000 gallons of water/acre/year, which equated to 90 billion gallons of water savings in 2001.[2]

The authors of this report met with agricultural interests to discuss the current status of agriculture in the DR/GR area and its likely future, and to identify current issues of particular concern. Points of discussion and concerns that were raised by the agricultural community included:

- Farmers have an unfortunate image as "bad guys" degrading and using up land; the benefits of agriculture need to be better understood.
- There is now less land available for cattle grazing due to the amount of land being purchased for conservation. There should be a way to incorporate cattle grazing on some conservation lands.
- Agriculture in southwest Florida is always adapting and evolving. For instance, there are new markets for the collection of wildflower seeds and butterfly larvae, which can be done sustainably on preserved lands.
- There is an increasing demand for locally grown or raised agricultural products.
- There is a large public interest in the urban farming course offered by the extension office.
- Farming investments are too costly to allow bad farming practices to continue.
- A farmer now needs a minimum of 10 years on the land to justify the investment. In the past a farmer could farm a piece a land for a couple of years and then relocate.
- Farmers have been concerned about the impact of limerock mines and potable wellfields on the water supply available for agriculture.

The Future of Agriculture in Southeast Lee County

> *"Agriculture producers provide many ecosystem services which have historically been viewed as free benefits to society - clean water and air, wildlife habitat, carbon storage, and scenic landscapes. Lacking a formal structure to market these services, farmers, ranchers and forest landowners are not generally compensated for providing these critical public benefits. Market-based approaches to conservation are proven to be a cost-effective method to achieve environmental goals and sustain working and natural landscapes. Without financial incentives, these ecosystem services may be lost as privately-owned lands are sold or converted to development."*[3]

The environmental benefits of agricultural lands are often overlooked when land use decisions and conservation plans are formulated. However, the importance of agriculture was considered when the DR/GR land use category was developed in 1989 and limited potential land uses to agriculture, large acre residential lots, mines, and public facilities. Agricultural lands provide open space, allow for recharge of local and regional aquifers, provide a local food source, and may provide storage of flood waters during the rainy season.

"Florida's agriculturalists have the natural ability to retain water on their land for later use as well as provide critical areas for the recharge of groundwater."[2] In southeast Lee County the agricultural water sources include rainfall and groundwater, which is recharged by rainfall. The quantity of available water within the groundwater resource area of southeast Lee County may be enhanced through expanding the ability to capture and store water on agricultural properties. "One acre-inch of rainfall storage is equal to 27,154 gallons of water."[4]

It is important to develop a public-private partnership to maximize the supply and conservation of Lee County's water resources to sustain the growing population, the natural systems, and agriculture. In this manner, an integrated water resource management program may be developed. The importance of integrated water management systems to balance the water supply with human and ecological demands is becoming increasingly apparent throughout the world as the population increases and climate patterns become less predictable.[5-10] Lee County has experienced the reduction in surface and groundwater resources over the past fifty years[11], however, the opportunity exists to enhance these water resources within the DR/GR with agricultural lands being an important component of an integrated water resource management plan.

Agriculture, Water Resources, and Climate Change

Scientists worldwide are looking at the ecological and hydrological impacts resulting from climate change.[12] Since agricultural operations are dependent on the availability of an adequate supply of freshwater, it is important to consider the role of agriculture in the management of ecosystems and water resources.

Farmers may be reluctant to set aside land for surface water storage or to manage a drainage system to conserve groundwater. However, wetlands, waterways and properly managed agricultural lands have much in common when it comes to having the ability to store and treat water. Therefore, it will become increasingly more important to encourage agriculture producers to restore and manage wetland and water resources on agricultural lands to due to the warming and drying affects resulting from climate change. Properly managed agricultural lands will increase natural water storage in wetlands, floodplains, agricultural drainage systems, and other features through ground and surface water level modifications.

Balancing the demands of human needs with the natural environment is an integral part of maintaining a regional water supply. Climate change will make future efforts to manage water resources more complex due to the potential alteration in temperature ranges and rainfall event patterns. Establishing an extensive surface and groundwater monitoring network for gathering information at the mega-watershed level, such as throughout the 82,560-acre DR/GR, is important for documenting the current conditions and being able to identify hydropattern and water quality trends over time.

Maintaining high quality, low-impact, relatively sustainable agriculture is an important component of a comprehensive water resource management strategy to insure successful restoration of water and wetland resources in the DR/GR.[11] In the future, there may also be opportunities for agricultural operators and those restoring large tracts of wetlands to receive carbon credits for conservation practices.

Managing Water Resources in Southeast Lee County

Hydrologic Monitoring:

An important component of an integrated water resource management program is a series of shallow and sandstone water table monitoring wells and rainfall stations throughout the DR/GR. This site-specific data would allow water resource managers and water users to understand the current status of the water supply and determine where there are opportunities to enhance the storage of water within the soils, natural systems, and agricultural systems. The currently available hydrologic data for areas within the DR/GR is insufficient to manage the water resources within the DR/GR and the downstream rivers and estuaries.

Recommendation #1:
The county should design and implement an expanded hydrological monitoring program to understand the current status of the water resources, to document changes over time, and to identify where there are opportunities to improve water resources (both quantity and quality).

Water Budget:

A water budget details the amount of water received into a defined area from all sources and the amount of water that is discharged, withdrawn, or lost from the defined area. The water budget for a watershed is a critical component of any water resource management program.

Recommendation #2:
Utilizing the hydrologic information from a comprehensive hydrological monitoring program, the county should develop a comprehensive water budget for each major watershed within the DR/GR to include the demands on the water resources by public consumption, agriculture, and natural systems.

Best Management Practices & Conservation Practice Standards:

The Lee County Division of Natural Resource Management (DNRM) is charged with protecting and managing the water resources within unincorporated Lee County. DNRM staff needs to interface with the agricultural community to understand which state BMPs and Conservation Practice Standards are currently being used in the DR/GR, and identify opportunities for increasing or improving the use of these conservation measures.

Roy Beckford, the Agricultural and Natural Resources Agent at Lee County University of Florida IFAS Extension office, and Kendal Hicks, the District Conservationist at the local USDA Natural Resource Conservation Service office, both work regularly with the agricultural community in Lee County and would be excellent liaisons for the DNRM staff. Expanded partnerships with the agricultural community would foster cooperative relationships which could increase the likelihood of agriculture becoming an integral part of improving water management in southeast Lee County. The information gathered through such a partnership may also assist in securing funds to implement additional best management practices.

Recommendation #3:
Lee County Division of Natural Resource Management staff should develop an active partnership with the agricultural community, the Agricultural and Natural Resources Agent at the University of Florida IFAS Extension office, and the District Conservationist at the local USDA Natural Resource Conservation Service office.

Efficient Water Management Practices:

The development of efficient water management practices (EWMPs) for the DR/GR as part of a comprehensive integrated water resource management program would improve the surface and groundwater quantity.

Recommendation #4:
The county should establish and implement efficient water management practices (EWMPs) for all land uses that may be allowed within the DR/GR, including agriculture and mining.

CONTROLLED WATER TABLE MANAGEMENT SYSTEMS AS A MEANS OF "WATER HARVESTING"

Improved use of water control structures in agricultural water management systems may provide valuable groundwater recharge during the rainy season when row crop fields are fallow. "Water harvesting practices generally contribute to an increase in the recharge of water to the root zone and finally to the water table."[6] However, water harvesting can decrease the water available to downstream portions of the watershed;[6] therefore it is important to consider the entire watershed when designing or retrofitting water management systems to improve groundwater recharge.

A detailed field inventory of existing agricultural water management systems would provide information on how systems are currently designed. This information may be combined with groundwater level monitoring data, topographic information, and integrated groundwater modeling to determine if there is any opportunity to increase water storage and recharge on agricultural lands. If there is a significant amount of water storage and recharge capacity available, then the county should work in cooperation with the agricultural community and state and federal programs to implement the use and renovation of water control structures within southeast Lee County.

The use of controlled water table management systems should also include the management of the water flow from the DR/GR into the Estero River, Imperial River, and Corkscrew Swamp Sanctuary to a more natural pulsing to improve the quality of these ecosystems as well as the Estero Bay National Aquatic Preserve which is connected to the DR/GR via the river systems.

Recommendation #5:
The county should work cooperatively with the agricultural community to complete a detailed field inventory of existing agricultural water management systems to determine if there are any opportunities to increase water storage and groundwater recharge on agricultural lands in the DR/GR. If there is a significant amount of water storage and recharge capacity available, then the county should work in cooperation with the agricultural community, and state and federal programs to implement the use and renovation of water control structures within southeast Lee County as a component of a comprehensive integrated water management system.

EVALUATION OF PUBLIC LANDS IN THE DR/GR

There are 26,287 acres of land currently under public ownership within the DR/GR. The use of these lands ranges from conservation to potable water well fields. The potential for water harvesting and other means of improving the surface and groundwater resources in southeast Lee County should be evaluated in a manner similar to agricultural lands as discussed above.

Recommendation #6:
The county should conduct a detailed evaluation of the publicly owned lands within the DR/GR to identify opportunities for increasing water storage and managing water releases from the DR/GR.

PURCHASE OF CONSERVATION EASEMENTS

An integrated program could compensate landowners for management practices or for limiting uses if the result would be greater storage and managed releases of water. Landowners would have full use of the remainder of the land. Compensation could be a one-time payment in exchange for a perpetual conservation easement or could be small regular payments that could supplement farm income.

Recommendation #7:
The county should expand the protection of wetland and water sources through acquiring conservation easements over wetland systems within the DR/GR.

CONSERVATION LAND ACQUISITION

Lands that are critical to sustaining and improving the water resource supply to meet human and ecological demands may need to be purchased by the county or other conservation organizations.

Recommendation #8:
The county should consider all options to secure critical lands for protecting and improving the quantity and quality of water resources within the DR/GR.

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Sustainable Agricultural Practices in Southeast Lee County

Roy Beckford – Agriculture/Natural Resources Agent
University of Florida, IFAS, Lee County Extension

Agricultural Enterprising as a Management Tool

The use of farming systems and agricultural applications to manage sensitive lands is increasingly becoming a useful way that governments and municipalities achieve the objectives of producing food and fiber as well as conserving the environment without overspending scarce financial resources. Where lands have been managed by farmers in a manner that provides incentives to sustain the environment, there is evidence that longer-term benefits are provided, which have impacts beyond the boundaries of the managed property itself.

With historical support from the Florida Cooperative Extension Service including the spin-off benefits of applied research which has given rise to natural resources and conservation management best practices, traditional farming systems in Florida have evolved into modern concepts which utilize measures of sustainability in the pursuit of farm enterprising.

As a group, farmers, ranchers and newer agricultural enterprisers have emerged as the best available human resources to apply modern approaches in technology upon sensitive environments to yield products and services which are sustainable. The concepts upon which this argument is promulgated are offered in the definitions which follow.

Agriculture is an inclusive term which defines all activities pertaining to the nurture, development and production of plants and animals for food and fiber. This includes the actions within agricultural disciplines which when applied, are used for deriving environmental benefits from our natural resources through soil nutrient management techniques, the maintenance of native habitats, carbon sequestration from air as well as the additional derivation of multiple benefits from associated recreational activities.

Agricultural disciplines are those specialized activities of agriculture which emphasize selected enterprises. For example the discipline of silviculture is the art and science of controlling the establishment, growth, composition, health, and quality of forest to meet diverse needs and values of landowners, societies and cultures. Trees alter the environment in which we live by moderating climate, improving air quality, conserving water, and providing vital habitat to wildlife species. Climate control is obtained by moderating the effects of sun, wind, and rain. Radiant energy from the sun is absorbed or deflected by leaves on deciduous trees in the summer and is only filtered by branches of deciduous trees in winter.

Sustainable agriculture integrates three main goals – environmental health, economic profitability, and social and economic equity. Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. Therefore, stewardship of both natural and human resources is of prime importance. Stewardship of land and natural resources involves maintaining or enhancing this vital resource base for the long term.

Agricultural ecology is the study of agricultural ecosystems and their components as they function within themselves and in the context of the landscapes that contain them. Application of this knowledge can lead to development of more sustainable agricultural ecosystems in harmony with their larger ecosystem and eco-region.

Agricultural ecology as a land management strategy in the Lee County DR/GR Area

A primary goal is to understand agriculture from an ecological perspective – in terms of nutrient and energy dynamics, and interactions among animals and other organisms in agro-ecosystems – then integrate and balance that goal with farm/ranch business, community and consumer needs. Thus, an understanding of the definition of agriculture, its related disciplines, and general principle of sustainability as it applies to a particular ecosystem, are important concepts to contemplate in making the wise decision to engender a greater participation of farmers in the management of the Lee County DR/GR lands.

Sustainability indicators have the potential to turn the generic concept of sustainability into action. Proper action requires integration which will involve applying sustainability indicators found within the following approaches:

1. Rotational grazing management systems
2. Soil and water conservation measures
3. Water quality/wetlands management
4. Crop/landscape diversity maintenance

Rotational Grazing

Rotational grazing is the simple act of moving animals from one pasture or field to another on a rotational basis to reduce the impact of overgrazing on one particular area and on particular species of plant life. Tropical grasses and broadleaf weeds grow at excessive rates during the summer rainy season in Florida, requiring management intervention to keep growth spurts in check. Public land managers enact land stewardship programs where cattle farmers are provided with leases to manage grasses through grazing strategies. Recently, goats have been used to control the growth and spread of invasive species such as Brazilian Pepper where alternative control measures would have had significant monetary and environmental costs. Goats have also shown great potential in removing excess foliage and dry matter from Saw Palmetto palms which have the later effect of reducing fuel which causes wildfires.

Soil and Water Conservation

Soil conservation means reducing the amount of soil erosion and maintaining soil fertility. It relies on increasing the amount of water seeping into the soil, reducing the speed and amount of water running off, and keeping enough vegetation to protect the soil surface and to bind the soil together. For any form of land use to be sustainable, production must be combined with conservation of the resources it depends on.

Water conservation relies on trapping as much of this water as possible and storing it on the surface or allowing it to sink into the soil in order to raise the water-table and increase the soil moisture level. More water can seep in if it is spread over a large area of soil rather than being concentrated into fast-running streams. Water-conservation efforts focus on stopping the water from becoming concentrated in the first place by ensuring a protective cover of vegetation on the soil surface, slowing down the flow of running water and spreading the water out over a large area.

Water Quality/Wetlands

The greatest benefits of wetlands to maintaining and improving water quality are that they trap sediment, remove harmful amounts of nutrients (mostly nitrogen and phosphorus), and remove pesticides before they can enter streams. For all these reasons, there should be a strong effort to maintain or restore wetlands through stewardship programs which are low cost and low impact in the nature of the enterprise being practiced on the site.

Landscape Diversity

The pattern of habitats and species assemblages across a land area is called landscape diversity. This includes both plant and animal species incorporating insects, reptiles, amphibians, fish, mammals, herbs, grasses, shrubs and trees. As agricultural systems evolve and niche markets are identified which provide income for sustainable activities within the landscape, enterprises such as wildflower collection and seeding, butterfly larvae harvesting and host tree conservation have been established to address both these supply and demand extremes found within a system in equilibrium.

Summary

In order to achieve best conservation results in the Lee County DR/GR Area, farmers, conservationists and interest groups believe that the following actions are required.

Lee County decision-makers should:

1. Make the entire DR/GR Area more available to small farming operations by offering affordable tenure and land-lease term agreements with farmers and agricultural enterprisers.

2. Consider other 'conservation' land use besides 20/20 that accommodates small farming and natural resources interests.

3. Ensure that those who are allocated DR/GR land resources utilize sustainability indicators within the management system to be applied.

4. Educate county regulatory agencies to become aware of new farming and ranching systems which utilize low impact production measures but still warrant protections and incentives given to traditional agricultural production systems.

Best Management Practices for Agriculture

Florida's economy was historically based upon agricultural operations including vegetables, flowers, citrus, and cattle. Today, agriculture is still the second most important industry in Florida; however, "agriculture is under stress due to the loss of approximately 150,000 acres of productive farmland a year to urban conversion."[2] In 2003, 18 million acres or 52% of Florida lands were used for agriculture including private forest lands. About 8.2% or approximately 2 million acres, requires irrigation.[2]

Florida's growing population places a demand on land and water resources that needs to be balanced with maintaining agricultural operations and native ecosystems. The agricultural industry recognizes the importance of conserving water resources and their role in protecting the State's resources.[2, 4, 13-17] "With the development of Florida, agricultural lands have become a very important part of the landscape that allows maintenance of the hydrologic system."[2]

State of Florida Agricultural Best Management Practices

What are Agricultural Best Management Practices (BMPs)? The University of Florida defines BMPs as "management and cultural practices that allow the farmer to get the most beneficial use out of the land while preserving the purity of water bodies."[18] BMPs are designed to minimize non-point source pollution as required by the Federal Clean Water Act (FCWA).[13] The formal development and use of BMPs in Florida began in 1978, and continues to evolve with expanded knowledge, new concerns, and new legislation. The quality of water resources has always been an integral part of BMPs, and more recently there has been an added emphasis of BMPs on conserving and enhancing the quantity of surface and groundwater resources.

The development and implementation of BMPs is based upon four key principles:

1. Communicating the water resources concerns to the agricultural operators;

2. Obtaining input on solutions for water resources concerns from agricultural community, university extension staff, and other professionals;

3. Demonstrating the benefits of implementing and maintaining BMPs to the agricultural industry; and

4. Offering cost-share programs to offset costs associated with some BMPs.[4]

Florida's agricultural water policy and BMPs have been updated since 2002. The BMP documents include evaluation flow-charts and checklists to help agricultural operators identify which BMPs are appropriate for their operation, and BMP assessment checklists to record the BMPs being utilized. The Florida Department of Agriculture and Consumer Services (FDACS) combined the knowledge and concerns of the agricultural industry, government agencies, universities, and environmental groups to formulate policies and best management practices specifically for agricultural operations within Florida in relation to water quality and quantity.[2, 4, 13-16]

Agricultural BMPs originally were voluntary in Florida, however, BMPs are required in areas with Basin Management Action Plans (BMAPs).[19] BMAPs are adopted to address the Total Maximum Daily Loads (TMDLs) regulation by the Florida Department of Environmental Protection as part of the Florida Watershed Protection Act adopted in 1999. Agricultural BMPs are also required by law in the Lake Okeechobee Watershed.[19] Record keeping for a minimum of five years to document BMP implementation is now required by FDACS rule.[14] The Florida Department of Agriculture notes the implementation of BMPs generally results in a better managed operation with increased awareness of the cost and efficiency of production as well as an improved public image.[15]

FDACS Office of Agricultural Water Policy publishes detailed BMP documents for specific uses and full copies of the documents are available on-line at:

http://www.floridaagwaterpolicy.com/BestManagementPractices.html.

The following excerpts from FDACS publications provide a brief overview of Florida's agricultural water policy, and water quantity and quality BMPs applicable to southeast Lee County.

Florida's Agricultural Water Policy – Ensuring Resource Availability[2]

> "*The purpose of developing an agricultural water policy for Florida is to identify those actions needed to ensure that agriculture has access to an adequate quantity of water of sufficient quality to remain competitive in a dynamic global market*."[2]

WATER SUPPLY PLANNING POLICY STATEMENT
Water Supply Planning for agricultural water users by the Water Management Districts should identify sufficient water resources to meet projected agricultural demand, be based on accurate water use information, be developed in coordination with local agricultural water users, and consider the unique needs and constraints of the agricultural industry.

WATER RESOURCE AND WATER SUPPLY DEVELOPMENT POLICY STATEMENT
The agricultural community should encourage the development, prioritization, and funding of environmentally sound, economically and technically feasible new traditional and alternative water sources for all users in order to increase total supply and avoid competition for existing sources.

ALLOCATION OF WATER FOR AGRICULTURAL USE POLICY STATEMENT
Water allocations for agricultural use should be sufficient for efficient and sustainable crop production and should be supported by a water use permit program that is responsive to weather and market conditions.

WATER CONSERVATION POLICY STATEMENT
Agricultural water use should be as efficient as is economically and technically possible, and employ as many research based water conservation Best Management Practices as are appropriate.

WATER QUALITY POLICY STATEMENT
Agricultural production practices should be protective of surface and groundwater quality and employ as many appropriate Best Management Practices as are economically and technically feasible.

PARTNERSHIPS POLICY STATEMENT
The agricultural community should continue to expand partnerships with the Florida Department of Environmental Protection, public water suppliers, local and regional government agencies, and environmental organizations to encourage water conservation, water quality improvements, and water resource and water supply development projects.

AGRICULTURAL WATER POLICY FORUMS POLICY STATEMENT
The Florida Department of Agriculture and Consumer Services and the agricultural community should work with other partners to encourage and facilitate broad-based participation in the evaluation of existing water policies and the development and implementation of new policies as needed.

RESEARCH AND DEVELOPMENT POLICY STATEMENT
Research and technology transfer which expands water supply, advances water conservation, enhances water utilization and improves water quality should be encouraged and supported by private users, local, state, and federal agencies, the state legislature and the congress.

PUBLIC INFORMATION AND EDUCATION POLICY STATEMENT
The Florida Department of Agriculture and Consumer Services should lead an effort to educate the public regarding agricultural water use, the need for water in agricultural production, the industry's efforts to conserve water, the constraints faced by agriculture when water supply development initiatives are considered, and the contribution that agriculture makes to the economy, the environment and the water resources of the state.

Florida Agricultural Water Conservation Best Management Practices[4]

"While grower BMP adoption is entirely voluntary, certain BMPs contained in this manual will have positive environmental impacts and should help expedite the review of any regulatory requirements. They may also position a grower to qualify for longer term permits and/or 'shield' growers from competing interests."[4]

Irrigation Water Sources & Systems:

- Micro-irrigation techniques or low volume emitters (citrus; ornamental plants)
- Drip irrigation in conjunction with plastic mulch (strawberries & vegetables)
- Closed-loop irrigation systems (plant nursery): captures rainwater; recycles nearly all production water; groundwater source for irrigation is nearly eliminated
- Tailwater recovery: collecting, storing, and re-using water for irrigation
- Wastewater recycling systems
- Rainfall harvesting

Water Quantity Management Techniques:

- Shallow water table observation wells
- Real-time weather stations
- Soil moisture probes
- Irrigation system evaluation every five years
- Internal ditch: "Superimpose a one-foot drainage contour map, if available, on an aerial photograph of the farm to determine the best locations for installing flashboard riser (structures which can hold more rain water in the soil profile)."[4]
- Incorporate the seasonal high water table elevation into the design.[4]
- Determine the water balance or water budget necessary for the crop grown including time and volume of water needed/used; rainfall amounts; runoff quantity; return-flow volume; seepage; and evaporation.[4]
- Estimate the runoff discharge rate and volume under different climatological conditions (wet, normal or dry) commensurate with the crop's requirements in order to determine the design and size of the rainfall harvesting system. One acre-inch of rainfall storage is equal to 27,154 gallons of water.[4]
- Manage ditch water levels to maximize the use of rainfall.[4]

Soil Management:

- Conservation tillage techniques to minimize soil disturbance, soil compaction, and increase organic matter to increase the soil's water holding capacity.

Water Quality/Quantity Best Management Practices for Florida Vegetable and Agronomic Crops[13]

The vegetable and agronomic crops "segment of the industry has operated without a unified, state endorsed BMP manual [prior to 2005]. Similar BMP manuals for other agricultural operations have been in place for more than a decade, and have yielded a mature BMP program… It is understood that many growers are already using many of the BMPs outlined in this manual."[13]

Pest Management

- Integrated Pest Management: Identify pests specific to crop being grown; utilize a variety of techniques to control pest populations
- Pesticide Mixing and Loading Activities: Locate mixing area away from water sources and wells
- Contain Pesticide Spills
- Pesticide Application Equipment Wash Water and Container Management: Rinse equipment away from water sources including wells; high-pressure or triple rinse containers; use rinse water as dilutent for next pesticide application
- Calibrate Pesticide Application Equipment

Conservation Practices

- Well-head Protection: Carefully choose location of wells; plug flowing or abandoned wells; maintain records of constructed wells
- Wetland Protection & Wetland Avoidance: Upland buffer strips; spreader swale discharge to buffer strip
- Wetland Enhancement: invasive exotic species control; supplemental native plantings; restore wetland hydrology and function through such measures as earthen plugs placed within outfall ditch
- Use Grassed Waterways for Water Conveyance
- Use Filter Strips: Ratio of drainage area above filter strip should not exceed 50:1
- Use Field Border: A strip of permanent vegetation established at the edge of or around the perimeter of a farm field
- Contour Farming: Place tilled row direction as closely as possible to natural topography or contour

- Land Leveling: Potential to improve surface drainage, provide more effective use of rainfall, facilitate installation of more workable drainage systems, control erosion, and improve water quality. A common cultural practice in South Florida.
- Obtain a Soil Survey: Request a soil survey by contacting the local Soil and Water Conservation District, or the USDA-NRCS. Use the knowledge of the soils for managing fertilizer and watering needs specific to crop being grown.

Although not directly stated as a separate BMP in the ***Water Quality/Quantity Best Management Practices for Florida Vegetable and Agronomic Crops*** *document produced by the State, it is important for agricultural operations to maintain adequate groundwater levels to avoid over drainage of the soil and surrounding landscape that benefits both the farmer and the wetland resources. This concept is addressed in the State's BMP manual under the discussion of the BMPs associated with wetland protection in Section 7 of the manual listed above.*

Erosion Control

Nutrient & Irrigation Management
- Soil test for pH and micro-nutrient components
- Water table monitoring
- Use controlled release fertilizers
- Know the crop nutrient requirement for Nitrogen (N)

Water Resource Management
(see discussion under Water Conservation BMPs above)

Seasonal or Temporary Farming
- Grow crops in a planned, regular scheme and select crops adapted to the local climate and soil conditions. Certain crops such as watermelon, potato, and other vegetable crops are particularly suited when used in conjunction with a rotation and/or renovation of cattle pastures.

Water Quality Best Management Practices for Cow/Cattle Operations[14]

"Rangeland and pasture comprise nearly 11 million acres within Florida. This land remains essentially in a natural state, maintaining valuable water recharge areas and preserving open spaces. The BMPs in this manual help ensure that production activities do not compromise the environmental advantages of keeping the land in agriculture. The BMPs also provide ranchers with other benefits and help them remain competitive in a global economy."[14]

Maintain Adequate Vegetative Cove
- Prescribed grazing
- Adjust stocking rate in sensitive watersheds

Carefully Plan Watering And Feeding Sites
- Place supplement feeding and mineral stations approximately 100 feet from streams, lakes, wetlands, and wells
- Provide alternative water sources to attract animals away from streams, drainage canals, and lakes as much as possible
- Plan shading facilities away from water resources
- Move feeding stations, alternative water supplies, and shade structures periodically to prevent concentrated waste accumulation and denuded vegetation

Carefully Plan Temporary Holding Areas
- Place new cow pens more than 200 feet away from water resources or include a berm to prevent runoff
- Retrofit existing holding areas that cannot be relocated and are located near water resources to incorporate filter strips, grassed waterways, berms/diversions, or waste management systems

Structural Techniques To Abate Pollution
- Re-establish natural flow patterns when feasible to direct water through internal wetlands that can assimilate nutrients
- Incorporate grassed waterways, filter strips, diversions, sediment traps, swales, and retention and detention ponds

Minimize Offsite Discharge
- Use water control structures
- Plug unnecessary drainage conveyances
- Use man-made ponds or other watering facilities in upland areas to reduce cattle use of natural wetland systems

Manage Nutrients & Reduce Wastes
- Properly store, apply and dispose of fertilizer, sludge, pesticides, chemicals and fuels

Minimize Erosion Potential
- Quickly plant a vegetative cover on cleared land
- Leave vegetated buffer strips along drainage areas and wetlands
- Follow erosion and sediment control practices during any onsite construction

Develop a Conservation Plan

Train Employees
- Annual training sessions to cover conservation plan and BMPs

Water Quantity/Quality Best Management Practices for Sod Operations[15]

"Sod farms using BMPs not only protect water quality, but also provide valuable water recharge areas and create perennial open or 'green' spaces throughout Florida's production regions. Some sod farmers are also cattle ranchers and practice the age-old art of crop rotation which naturally helps maintain soil and nutrient resources."[15]

Nutrient Management
- Conduct annual soil tests to monitor pH and nutrient levels
- Conduct tissue tests on sod crop
- Avoid fertilizer application to dormant or non-growing turf grass
- Do not apply fertilizer when heavy rains are imminent
- Consider economic demand. If sales are slow, reduce fertilizer applications

Irrigation Management
- Annual water quality tests
- Design irrigation system for site specific characteristics and topography
- Know the crop specific water needs
- Regularly inspect irrigation system
- Monitor soil moisture content

Sediment And Erosion Control
- Limit amount of land cleared of vegetation
- Implement practices to limit movement of sediments
- Filter strips
- Silt screen
- Sediment traps within water conveyance structures

Integrated Pest Management
- Target problem pests
- Properly store, mix, apply and dispose of pesticides

Wellhead Protection
- Plug or valve abandoned or flowing wells
- Construct wells as far as possible up gradient from fuel tanks, septic tanks or chemical mixing areas
- Screen shallow wells and encase deep wells at least 10 feet into the aquifer bed
- Surround new wells with concrete slab and extend well casing above ground surface
- Use backflow prevention devices
- Retrofit existing wells where feasible
- Inspect well heads and concrete pads regularly
- Maintain records of well installation and maintenance

Wetlands Protection
- Use county soil survey to help identify wetland soil types and/or depressional areas
- Minimum 25-foot undisturbed upland buffer for waterways and associated wetlands
- Minimum 15-foot undisturbed upland buffer for isolated wetlands
- Pretreat stormwater and discharge using spreader swales
- Limit use of pesticides and fertilizers in and around wetlands
- Avoid spray drift of pesticides and fertilizers

Ditch Construction And Maintenance
- Design to site specific information on topography, soils, high water table elevations & natural conveyance areas
- Use temporary sediment and erosion control BMPs during construction
- Stabilize newly constructed ditch banks with sod, native grasses, or other appropriate vegetation
- Regular maintenance

Conservation Buffers

- Plant native vegetation appropriate for the site
- Inspect periodically for any maintenance needs
- Cost-share funding may be available through NRCS

Stormwater Management

- Operate and maintain system to meet design performance criteria
- Evaluate effectiveness of the system, and make adjustments as needed

Access Roads

- Develop site specific design
- Locate elevated access roads a minimum of 25 feet from wetlands and watercourses, except at crossing
- Construct during dry season
- Minimize road widths
- Balance cuts and fills
- Maintain pre-development hydrologic conditions

Mowing Management

- Establish mowing program to specific sod requirements
- Recycle, compost or dispose of clippings in an environmentally acceptable manner
- Regularly wash mowing machines and sharpen blades

Seasonal Farming Operations

- Select species adapted to local climate and soil conditions
- Certain grasses such as bahia grass are particularly suited when used in conjunction with cattle rotation
- Select cover or rotational crop that will add organic matter to soil
- Incorporate an average three-year sod rotation interval and follow minimum fallow requirements
- For abandoned fields restore agricultural surface water management system to pre-development hydrologic conditions (e.g. fill-in ditches)

Natural Resources Conservation Services Conservation Practice Standards

The USDA Natural Resources Conservation Services (NRCS) has developed conservation practice standards to protect air, water, and land resources. Many of these standards are established for agricultural operations; however, some of the standards may be useful for other land uses especially within southeast Lee County where water resource protection is a major goal. There are both national and local standards.

The conservation practice standards for Lee County may be found in the Field Office Technical Guide (FOTG) available on-line at http://efotg.nrcs.usda.gov/treemenuFS.aspx. The local NRCS field office staff will work with landowners to develop conservation plans and there may be financial assistance available for implementing conservation practice standards.[20-21] Conservation plans include strategies to maintain or improve agricultural yields while protecting the environment.[14]

The following list provides an example of NRCS conservation practice standards publications applicable to southeast Lee County:

- Drainage Water Management
- Filter Strip
- Grassed Waterway
- Irrigation Water Management
- Nutrient Management
- Prescribed Burning
- Restoration and Management of Declining Habitats
- Structure for Water Control
- Vegetated Treatment Areas
- Vegetative Barrier
- Wetland Creation
- Wetland Enhancement
- Wetland Restoration

Other Water Resource Related Agricultural Practices

Agricultural Efficient Water Management Practices[22]

In addition to having BMPs established for fertilizers, integrated pest management, soil erosion, and on-farm composting developed by the Mission Resource Conservation District, the California Department of Water Resources (DWR) was required to establish a list of efficient water management practices (EWMPs) for agricultural water suppliers through the Agricultural Water Suppliers Efficient Water Management Practices Act of 1990. The EWMPs were developed by an advisory group of state, federal, and local agencies; agricultural communities; the California university system; environmental and public interest groups; and other interested parties. The agricultural water suppliers voluntarily implement the EWMPs similar to the voluntary use of BMPs by the farmers.

The EWMPs that may be applicable to southeast Lee County include the following:

- Adopt a water management plan
- Designate a water conservation coordinator
- Provide water management services
  - On-farm irrigation and drainage system evaluation
  - Normal year and real-time irrigation scheduling and crop evapotranspiration
  - Surface water; groundwater; and drainage water quality data
  - Educational programs and material for farmers, staff and the public
  - Water user pump testing and evaluation
- Improve communication through newsletters, workgroups, and community outreach
- Improve pump efficiency
  - Evaluate efficiency of booster pumps or groundwater pumps
  - Test all pumps every two years
- Facilitate financial assistance through the development of a resource list for the financing of capital improvements for on-farm irrigation systems
- Line or pipe open ditches and canals to prohibit the evaporation, spillage or seepage of water
- Construct and operate tailwater/spill recovery systems (may not be necessary when using pipelines and micro-irrigation systems)
- During wet years, capture surplus water to recharge groundwater
- Water measurement, water use update
- Pricing and incentives to promote efficient water management
- Facilitate agricultural water conservation research

Agricultural Water Table Management Systems[23]

The Agricultural and Biological Engineering program at Ohio State University compiled a fact sheet on Agricultural Water Table Management Systems to assist the agricultural community in understanding the value in controlling soil-water conditions for better plant growth. Three basic water management systems are used in Ohio for agricultural lands: subsurface drainage, controlled drainage, and subirrigation.

Incorporating properly designed and constructed water control structures provide benefits to crop growth and the environment. Controlled drainage allows for more water to be held in the root zone during crop season than in water management systems that do not include the use of water control structures. Additionally, the use of water control structures to hold more water on the land during the non-growing season allows for groundwater recharge. Controlled drainage systems would be beneficial to managing and enhancing the water resources in southeast Lee County.

Developing a Sustainable Water Management Plan[5]

The degradation of wetlands from the intensification of agricultural operations and poor water management practices has been observed in Europe. A study was conducted in Greece to develop a sustainable water management scenario to support both the agricultural operations and improve the environmental health through the use of current technology including Geographic Information Systems (GIS), aerial photographic interpretation, and hydrologic modeling. The project resulted in a water management plan that would be implemented over three years with progress increases in soil moisture and decreases in water level fluctuations that satisfied both the human and ecological demands on the water resources.

The balancing of the natural resources and human needs in this study is similar to balancing the multiple, yet limited, uses within the DR/GR. The study demonstrated the increased demands on water resources may be managed through the use of science-based technology to develop sustainable water management plans that balance the needs of humans and the natural world. It also showed that revitalizing degraded natural wetland systems while balancing human needs is a multiple year process.

FEDERAL PROGRAMS FOR WETLANDS ON AGRICULTURAL LANDS

The federal government has established programs to protect and improve wetlands located within agricultural lands. These programs are administered by the Natural Resources Conservation Services (NRCS).

Funding for these programs has continued even during these harder economic times. The 2008 Federal Farm Bill conservation element "emphasizes conservation on working land by increasing funding for the Environmental Quality Incentives Program and the new Conservation Stewardship Program (successor to the Conservation Security Program). It continues emphasis on wetland restoration and farmland preservation with expansion of Wetland Reserve Program, Farmland Protection Program, and Grassland Reserve Program."[24] The bill allocates $280 million to the Agricultural Water Enhancement Program (AWEP) for fiscal year 2009-2012 for ground and surface water conservation.[24]

Each program has specific parameters with some programs only available to landowners whereas other programs are available to agricultural operators who are leasing the land.[25] This is important because so much of the agricultural lands in southeast Lee County are no longer owned by farmers.

The following federal programs may be applicable to agricultural operations in southeast Lee County:

Environmental Quality Incentives Program – EQIP

> "*This voluntary program addresses both local natural resource needs and national resource priorities. The funding shares the cost with farmers and ranchers for installing conservation practices to improve animal waste management, irrigation water management, grazing land, soil erosion and sediment control, and other resource concerns*."[26]

Agricultural operations that wish to improve their irrigation water management, grazing land management, and enhancement of water resources within southeast Lee County may qualify for assistance through this program. EQIP is applicable to both landowners and agricultural leases.

Florida's allocation in 2007 was $26,359,636[26]

Farmland Protection Program – FPP

> "*This voluntary program helps farmers and ranchers keep their land in agriculture. The program provides matching funds to State, Tribal or local governments and non-governmental organizations with existing farm and ranch land protection programs to purchase conservation easements*."[26]

Lee County would need to adopt a farm and ranch land program in order for agricultural operations to qualify for this program.

Florida's allocation in 2007 was $1,678,077[26]

Wetlands Reserve Program – WRP

> "*This voluntary program provides landowners financial incentives and technical assistance for restoring eligible land to its former wetland functions and values. Through WRP, the NRCS provides technical assistance to landowners to address wetland, wildlife habitat, water quality, and related natural resource concerns on their land in an environmentally sound and cost-effective manner*."[26] *This program has enabled the protection of 2,000,169 acres in the United States of which Florida is second in the amount of lands protected with 160,415 acres*.[27]

This program would be applicable to agricultural landowners in southeast Lee County who have significant wetlands and the ability to enhance surface and groundwater resources.

Florida's allocation in 2007 was $10,778,120[26]

Wildlife Habitat Incentives Program – WHIP

> "*WHIP is a voluntary program that encourages the creation of high quality habitats that support wildlife populations of National, State, Tribal, and Local significance. Through WHIP, NRCS provides financial assistance for creation, restoration, and enhancement of upland, wetland, riparian, and aquatic habitat areas on their property*."[26]

This program may be applicable to agricultural landowners or leases in southeast Lee County if they are within the Florida panther priority protection area or within the wood stork critical foraging area.

Florida's allocation in 2007 was $442,531[26]

The 2008 Farm Bill requires a minimum combined total of $15 million annually to be allocated to Florida for conservation through WHIP, EQIP, FPP, and the Grassland Reserve Program.[24] Applications for these programs are evaluated on an annual basis. The 2009 fiscal year application period closed in mid-March; however, the application period for participating in these programs varies each year, therefore, it is important to stay in contact with the NRCS office to remain informed on application deadlines.[25]

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3 Land Acquisition & Restoration Strategy

Introduction

The Ecological Technical Memorandum compiled by Kevin L. Erwin Consulting Ecologist, Inc. (KLECE) as part of the *Prospects for Southeast Lee County* report contained an initial assessment of restoration potential for land in the 82,560-acre DR/GR area.

In potential restoration areas, a combination of watershed management, sustainable agriculture, and wetland restoration and management could protect and restore southeast Lee County's water resources. In those areas there are opportunities to adjust surface and groundwater levels closer to their historic levels, even though full historic levels are unlikely to be achieved due to the alterations in the watersheds and the need to protect existing land uses.

Since the publication of those documents, the restoration strategy has been refined to reflect preliminary policy direction by the Board of County Commissioners on potential mining areas and on limited development parcels where development rights could be concentrated. Figure 3.1 presents a refined restoration strategy that should be incorporated in the Lee Plan as an overlay map.

This "Priority Restoration" overlay would contain seven tiers of land where protection and/or restoration would be most critical to restore historic surface and groundwater levels and to connect existing corridors or conservation areas, with Tier 1 and 2 being the highest priorities. These tiers that would be eligible for various means of protection; the tiers were developed based upon the ecological values that would be derived from protecting these lands, with an emphasis on water resource protection and restoration.

Tier 1 and Tier 2 lands represent key connections to existing public conservation lands including the Corkscrew Regional Ecosystem Watershed (CREW), the Lee County Port Authority Mitigation Park, and Corkscrew Regional Mitigation Bank that would insure the protection and restoration of water storage and water conveyance.

Tier 3 lands would expand the connection to existing conservation lands even further, including connectivity with the National Audubon Society's Corkscrew Swamp Sanctuary to the southeast and Conservation Collier's Starnes Preserve to the east.

Tier 4 lands represent areas within the Estero River Watershed that will require special restoration designs due to existing and potential limerock mines.

Tiers 5 through 7 delineate additional areas where the protection and potential enhancement of water resources would be beneficial in the long term.

Agricultural operations that utilize the evolving best management practices may be appropriate within any of the tiers because the agricultural lands in the DR/GR have an enormous capacity to store additional water when properly managed. Additionally, these lands provide a local source of food, connectivity to public lands, green space, and some wildlife habitat.

Figure 3.1 shows these designations along with other information that will be helpful in understanding how they relate to the proposed "Future Limerock Mining" overlay, to existing public lands, and to potential Mixed-Use Communities.

Proposed Objective 30.2 and subsequent policies would explain how the seven tiers would be interpreted:

> ***OBJECTIVE 30.2: WATER, HABITAT, AND OTHER NATURAL RESOURCES.*** *Designate on a Future Land Use Map overlay the land in Southeast Lee County that is most critical toward restoring historic surface and groundwater levels and for improving the protection of other natural resources such as wetlands and wildlife habitat.*
>
> ***POLICY 30.2.1:*** *Large-scale ecosystem integrity in Southeast Lee County should be maintained and restored. Protection and/or restoration of land can connect existing corridors and conservation areas. Restoration is also highly desirable when it can be achieved in conjunction with other uses on privately owned land including agriculture.*
>
> ***POLICY 30.2.2:*** *The DR/GR Priority Restoration overlay depicts land where protection and/or restoration would be most critical to restore historic surface and groundwater levels and to connect existing corridors or conservation areas (see Policy 1.7.6 and Map 1, Page 4). This overlay identifies seven tiers of land potentially eligible for protection and restoration, with Tier 1 and Tier 2 being the highest priority for protection from irreversible land-use changes. Lee County will evaluate this overlay map every 7 years to determine if changes in public ownership, land use, new scientific data, and/or demands on water resources justify updating this map.*

POLICY 30.2.3: *It is in southwest Florida's interest for public and nonprofit agencies to actively pursue acquisition of partial or full interest in land within the Tier 1 areas in this overlay through direct purchase; partnerships with other government agencies; long-term purchase agreements; right of first refusal contracts; land swaps; and other appropriate means. These lands would provide critical connections to other conservation lands that serve as the backbone for water resource management and wildlife movement within the DR/GR. Tier 2 lands are of equal ecological and water resource importance as Tier 1 but have better potential to remain in productive agricultural use as described in Policies 30.2.5 and 30.2.6.*

1. *The county will consider incentives for private landowners to maintain and improve water resources and natural ecosystems on properties within Tier 2 through Tier 7, including but not limited to acquiring agricultural or conservation easements; compensation for water storage that is in the public interest; and providing matching funds to secure federal and state funds/grants for improving agricultural best management practices or protection/restoration of wetlands on existing agricultural operations.*

2. *Permanent protection of land within all tiers may also occur through:*

   a. *Using resource extraction mitigation fees to acquire land;*

   b. *Establishing a Regional Offsite Mitigtion Area (ROMA); and*

   c. *Concentrating of development as depicted in the Rural Residential overlay (Map 17) as detailed in Policies 30.3.2 and 30.3.3.*

POLICY 30.2.4: *Restoration of critical lands in Southeast Lee County is a long-term program that will progress in phases based on available funding, land ownership, and water-resource priority. On individual sites, restoration can be carried out in stages:*

1. *Initial restoration efforts would include techniques such as filling agricultural ditches and/or establishing control structures to restore the historic water levels as much as possible without adversely impacting nearby properties.*

2. *Future restoration efforts would include the eradication of invasive exotic vegetation and the reestablishment of appropriate native ecosystems based upon the restored hydrology.*

POLICY 30.2.5: Lee County recognizes the importance of maintaining agricultural lands within Southeast Lee County for local food production, water conservation and storage, land conservation, wildlife habitat, and wetland restoration. The continued use of ever evolving agricultural best management practices will protect native soils and potentially improve the quantity and quality of water resources, allowing sustainable agriculture to be integrated into restoration planning for southeast Lee County.

POLICY 30.2.6: *On existing farmland, the county should consider incentives to encourage the continuation of agricultural operations that implement and maintain best management practices. Continued agricultural use may be a desirable long-term use even within land designated on the priority restoration overlay as potentially eligible for protection (see Policy 9.1.7).*

After identifying the priority restoration areas, Lee County's major conservation lands acquisition program, Conservation 20/20, was examined to determine what changes to the program would allow the county to seek out strategically important parcels for acquisition and to consider a diversity of options for achieving the conservation goals.

This chapter presents information on a wide variety of land acquisition tools and summarizes conservation lands programs in other communities in addition to Conservation 20/20. All of this information has been utilized to develop a preliminary strategy for DR/GR land acquisition and restoration.

Future activities would be necessary to implement the recommendations and findings of the study over a two to three year period.

1. Work with the Conservation 20/20 advisory committee to determine optimal methods for modifying the current program to include a new targeted approach for land acquisition.

2. Draft an ordinance for the Board of County Commissioners to establish a formal policy to implement land acquisition and water resource restoration within the DR/GR; and

3. Implement a land acquisition and water resource restoration plan within the DR/GR.

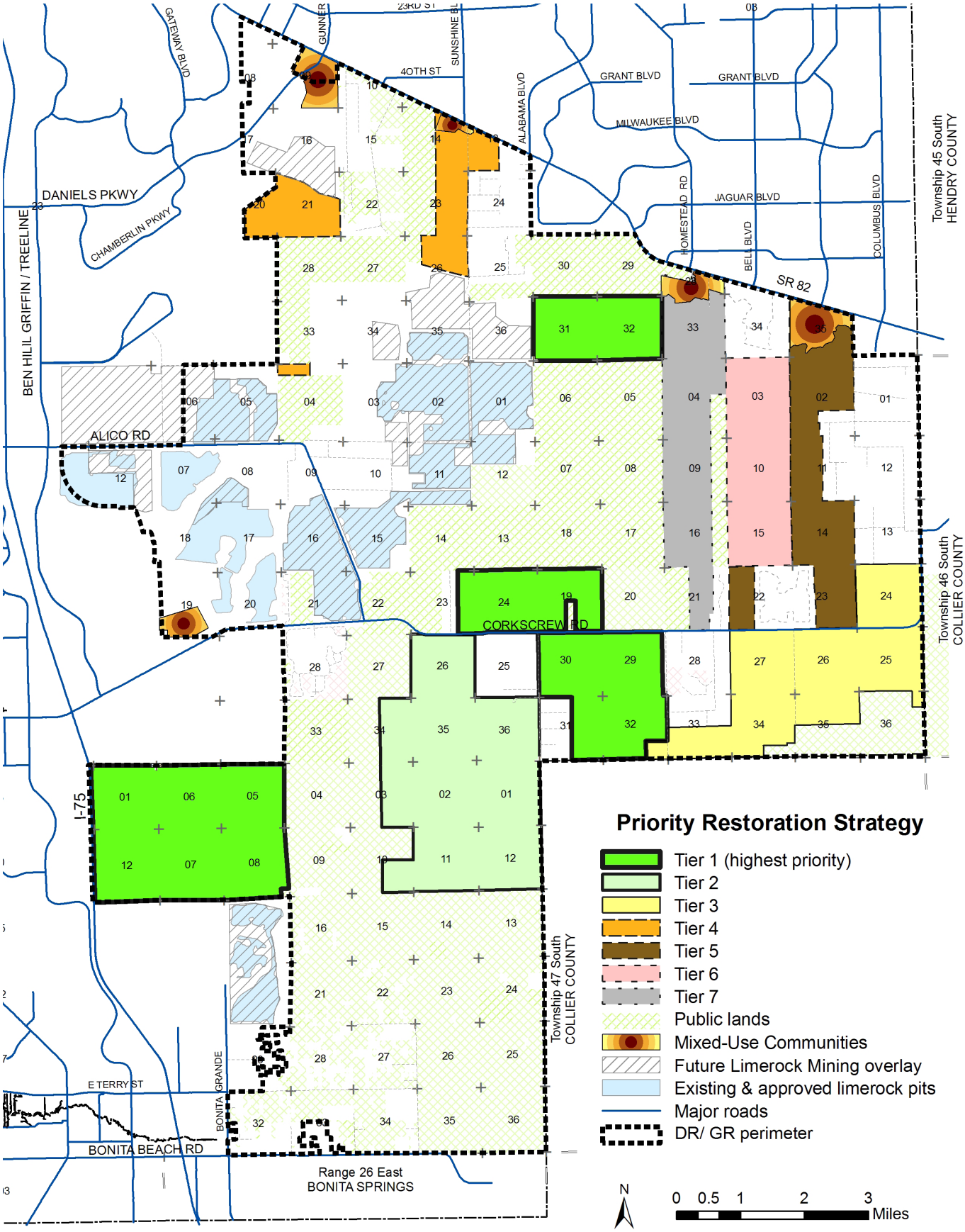

Figure 3.1: Restoration Strategy

Methods for Meeting Land Conservation Goals

Public and private organizations use a number of techniques to meet their conservation goals. Land acquisition in its purest form means purchasing the land and the associated development rights from the owner at market value. This is commonly referred to as a fee simple or fee title transaction. However, there are a variety of other methods to meet conservation goals that do not include purchasing the property. In order to maximize the funding of a conservation lands program it is important to pursue the conservation goals through options beyond fee simple ownership. Securing matching funds is one common requirement of land acquisition programs to double the funding available.

Another method to expand the amount of protected land is to pay land owners to place a conservation easement over the environmentally important portions of their property while allowing them to maintain ownership of the property and to continue using portions of the property. The conservation easement will include limiting the use of the land to meet specific conservation goals such as storing water. Purchasing conservation easements in this manner allows the land to be protected with less expenditure of program funds and requires the land owner to maintain the conservation areas, thus reducing the amount of funding needed for land management. When conservation easements are purchased, the entity purchasing the easement typically inspects the property once a year to verify that the provisions of the conservation easement are being met.

Working together with other organizations that have similar conservation goals is an excellent means of establishing partnerships to achieve these goals. Partnerships may include equal funding to purchase and manage a property which in essence doubles the power of the funds. This is the most conventional approach to partnering, yet there are many more advantages to establishing long-term working partnerships.

Partnerships lower the funding demands on any one conservation program. The combining of programs that have the same conservation goals but different restrictions on the use of funds may allow an arrangement where one organization purchases the property and another organization manages the land. Additionally, partnerships reduce if not eliminate the potential for inflating the cost of the land when multiple organizations show individual interest in a property. Establishing a partnership with one or more organizations may also increase the ability to obtain grants to augment either the land purchase or land management.

Another advantage to working partnerships is that the organizations better understand each other's conservation goals. This may lead to land swaps that are mutually beneficial. An example of a recent land swap in southwest Florida is when the South Florida Water Management District swapped a piece of pasture land with the Audubon Corkscrew Swamp Sanctuary for a parcel of conservation land. The SFWMD was interested in providing a boardwalk trail on the conservation land, and the sanctuary determined it was beneficial to their goals to have the pasture land restored. This partnership extends further with a private entity which will fund the restoration through expanding their mitigation bank to include the pasture land. When the restoration is completed, the sanctuary will take over long-term management of the property.

There are advantages to a public conservation land acquisition program that outsources the purchasing process to a private organization such as the Nature Conservancy or a local land trust. These private organizations are often able to inform land owners of various options from less-than-fee-simple programs to potential tax benefits that public employees are not able to provide. Additionally, some land owners are more willing to discuss land conservation with a private organization than with a governmental organization.

Land Conservation Program Examples

The Nature Conservancy

The Nature Conservancy (TNC) is a not-for-profit private organization focused on conservation land acquisition. TNC developed and utilizes a strategic, science-based planning process to identify the highest-priority places throughout the world that, "if conserved, promise to ensure biodiversity over the long term." This system identifies large eco-regions; however, the evaluation system also works on a more local level. TNC follows the following steps to develop a conservation project:

1. Set conservation priorities for a specific, scientifically-selected geographic location. Through data collection the sites may be prioritized within the project area that are most in need of protection.

2. Develop a strategy that will protect the conservation site while minimizing or eliminating threats to the site.

3. Organize budgets, work schedules, and develop partnerships to proactively accomplish conservation goals. "More often than not, Conservancy staff seeks out landowners who own ecologically important land rather than react to offers from landowners."

4. Measure success through regular evaluations of the conservation activities to determine if the program and biological conservation goals are being met.

TNC's expertise in land acquisition has been used by county conservation lands programs within the state of Florida. Sarasota County hired TNC to handle the negotiations on land acquisition for the first 10 years of the county's sensitive lands program. Currently, TNC has contracts with Brevard, Alachua, and Miami-Dade counties to provide land acquisition services.

In addition to providing land acquisition expertise, TNC assists in the development of local land trusts. They share their expertise and help guide the new land trusts in the land acquisition process. Once a local land trust is well established, TNC will focus its efforts and resources in another location that does not have the benefit of a local land trust.

TNC has also been actively involved in providing information to agricultural land owners on the available land conservation programs and the benefits of these programs. A major effort of TNC involves a partnership with the South Florida Water Management District and the Southwest Florida Water Management District in the Okeechobee-Kissimmee Basin Area over the past ten years. TNC and District staffs assist ranchers in understanding the wetland protection and restoration programs. They also help a rancher through the process of applying for participation in the programs. In particular, TNC is facilitating the Federal Wetlands Reserve Program within the Okeechobee-Kissimmee Basin. They secured conservation easements over 4,800 acres of wetlands in 2008, and indicated that there are 150,000 acres that could be placed under conservation easement if funding was available.

The Trust for Public Lands

The Trust for Public Lands (TPL) is a not-for-profit private organization interested in acquiring lands that will protect community character and opportunities for outdoor recreation including trail systems within urban and suburban areas. TPL projects may incorporate a conservation lands element, but conservation of natural resources is not the main focus of the organization.

TPL has been operating in Florida since 1975 protecting over 200,000 acres at a market value of more $600 million. Projects in southwest Florida have included a 1.25-acre property along the Peace River in Punta Gorda providing a key link in a linear riverfront park plan; assisting in developing a plan that would meet the budget of Collier County to purchase Caribbean Gardens; partnering with the City of St. Petersburg and Pinellas County in extending the Pinellas Trail which is now 34 miles connecting Tarpon Springs to St. Petersburg; and brokering a deal between CSX Transportation Inc. and Sarasota County after a decade of unsuccessful attempts by the county to purchase a 12.8-mile scenic rail corridor.

TPL provides services to assist local governments in forming a land acquisition program. They apply their expertise to draft an ordinance and public referendum. TPL staff is also versed in public outreach and education for promoting public support of land acquisition referendums.

Many of the publications produced by TPL provide insight and guidance on land acquisition, and are easily accessible on their website (www.tpl.com). There are also courses available through TPL such as a Conservation Finance Course.

Sarasota County

Sarasota County voters approved a referendum to establish an environmentally-sensitive lands acquisition program in 1999 through a bond program funded by an increase in sales tax. The program was initially established as a twenty-year program but was extended to a thirty-year program in 2006. Their land acquisition and management staff operate through the Department of Natural Resources. The staff does not negotiate directly with the land owners, instead, the county outsources the land acquisition. Initially TNC was awarded the contract. However, once the Sarasota Conservation Foundation (SCF) was established as a local land trust, TNC subcontracted to SCF providing guidance and expertise to the newly formed foundation for approximately three years. When the latest Request for Proposals was issued by Sarasota County for the land acquisition services, TNC did not apply and SCF was awarded the contract.

An advisory committee evaluates the applications for consistency with the parameters of the ordinance and evaluation criteria. The committee then makes recommendations to county staff on which properties should be pursued for acquisition. A county staff team consisting of a county attorney, real estate staff, land managers, biologist, and parks department meets twice each month to categorize the nominations and determine which properties should be brought forward to the Board of County Commissioners. The county staff team determines the best expenditure of county funds for meeting the program's goals. The Board makes the final decision on which properties should be sought and grants staff the authority to proceed with acquisition negotiations.

The Sarasota County program is open to all options for land protection. They have found that the use of conservation easements in rural areas is a "win, win, win" opportunity for the land owners and county. The development rights are limited in the rural areas resulting in lower cost for establishing conservation easements than within suburban and urban centers. The easement agreement places strict restrictions on uses and specifies maintenance requirements. The land owner is responsible for the land and habitat maintenance within the conservation easement limits. County staff field inspects the property once a year for compliance with the conservation easement restrictions and requirements. Compensating land owners for placing a conservation easement over environmentally sensitive portions of their property helps the county meet its conservation goals while stretching the county funds to insure greater amount of land conservation. The County has also combined fee-simple and conservation easement purchases on individual properties. The most environmentally sensitive areas are purchased fee-simple, and the other environmentally important areas are placed under a conservation easement. An example of a combined arrangement is the Ranch Reserve where 4,000 acres was purchased fee-simple and 7,000 acres were placed under a conservation easement.

Sarasota County has been successful with securing matching funds for land acquisition, with approximately 28% of their funding coming from other sources. The Florida Community Trust Fund and the Southwest Florida Water Management District are the two main partners in funding.

In 2006, the Sarasota County land acquisition program was revised to add neighborhood parks. The program now splits the funding with 60% applied toward environmentally sensitive lands and 40% for neighborhood parks as part of a comprehensive open space program to meet the demands of county residents.

Volusia County

The Volusia Forever land acquisition program was established through a voter-approved referendum to levy an ad valorem tax for a twenty-year period (2000-2020). The program does allow the use of bonds to purchase an exceptional property; otherwise the county policy is to "Pay-As-You-Go." The purpose of the Volusia Forever program is "to acquire and improve environmentally sensitive, water resource and outdoor recreation lands" with a goal to "conserve, maintain, and where necessary, restore the natural environment and provide access for the enjoyment and education of the public."

The ordinance adopted in 2000 recognizes that population growth and economic expansion places pressure on the groundwater and surface waters of the county, and the need to establish resources "to ensure that sufficient quantities of water are available to meet the current and future needs of the natural systems and citizens of the state." The program includes both the acquisition and management of the lands. The ordinance also establishes the policy that "it is the intent of the program to achieve maximum impact by partnering with other entities through award or acceptance of grants, joint projects and other cooperative efforts…to maximize the use of public monies to benefit Volusia County."

In 2004, the program was amended in part to clarify policies implementing the program. At that time the county emphasized the desire to maximize the local funding by using these funds to leverage available funds from federal, state, municipal, private non-profit, and water management district sources. The county also deemed it appropriate for the County Council to be able to designate Volusia Forever funds as matching funds for federal, state, municipal, private non-profit, and water management district land acquisition projects when the project meets the county's site ranking criteria or serves to achieve the overall goals of the Volusia Forever program.

The policy also recognized the significance of alternatives to traditional fee simple acquisition in achieving conservation goals. An additional policy was established allowing the county the option to contract with a qualified not-for-profit agency, government entity, or other professionals to oversee and complete property appraisals, surveys, environmental audits, title insurance, negotiations, and other related acquisition activities.

Nominated properties are reviewed during two cycles each year. Anyone may nominate a property including county staff. If a property passes the initial review criteria conducted by staff, then county staff contacts the land owner to determine if the owner is a willing seller. Only properties with willing sellers are advanced to the secondary review. A citizen advisory board reviews the nominations for meeting the land acquisition criteria.

The qualifying properties are grouped into high priority and important conservation lands. The high priority lands must qualify for matching funds from sources outside of county funding and be located within an approved Preservation 2000 or Florida Forever program area. The Volusia County Conservation Corridor delineates lands that are within a Florida Forever program area. The properties classified as important are not required to have matching funds and may be located anywhere within the county, but receive lower priority standing.

The advisory board makes recommendations to the County Council based upon a prioritized list. The negotiation with land owners for purchasing the property is handled by county staff. Both fee-simple and less-than-fee simple acquisition are utilized. Volusia County has purchased conservation easements and agricultural easements as part of their land acquisition program.

Volusia County has successfully established partnerships resulting in nearly a 1:1 ratio of county funds to other funding sources, doubling the monies available for land acquisition. St. Johns River Water Management District (SJRWMD) is a major partner in acquiring and managing lands within Volusia County. The agreements between the county and SJRWMD cover the spectrum of acquisition and management, with some properties being purchased by one entity and managed by the other. The focus is on achieving the conservation goals and not on who owns or manages the land. Volusia County relies on well-founded and maintained partnerships to achieve the combined conservation goals.

The Volusia Forever program is a state and nationally recognized, award-winning program which received the Better Community Award in 2008 from 1,000 Friends of Florida and the County Leadership in Conservation Award in 2006 from the Trust for Public Lands.

Martin County

Martin County has had three land acquisition programs. The Lands for You program was established as a bond referendum; the Healthy Rivers program was funded through a one cent sales tax increase for three years; and the Parks and Conservation Lands program is funded through a half-cent sales tax for five years. Martin County has been exceptionally successful in securing additional funding. Charles Barrowclough, the Environmental Lands Administrator, has been quoted as stating that a land acquisition program is "all about partnerships." They have been able to add $280 million in State and Federal funds to $70 million in local funds through the Lands for You and Healthy Rivers programs.

The programs target specific areas including those identified in the US Army Corps of Engineers Restudy of the Everglades, and areas within the City of Stuart that are important for storm water management projects. A land acquisition advisory committee makes annual recommendations on properties the county should pursue to the Board of County Commissioners.

Collier County

The Conservation Collier program was established in 2002 as a voter-approved $75 million bond program funded through an ad valorem tax levy over a ten-year period.

Properties are evaluated by an advisory board that makes annual recommendations to the Board of County Commissioners. A list of properties is compiled dividing the lands into an A, B and C List. 'A' properties include lands the county should buy. 'B' properties are lands the county is interested in but not ready to purchase. 'B' list properties are automatically carried over into the next review cycle. 'C' properties are lands the county is not interested in purchasing.

The county has a "no negotiation" policy for purchasing lands and bases its offers to land owners on an average of appraised values. This policy reduces the ability to receive matching fund grants from some Florida Forever-funded programs. However, this purchase policy mirrors the federal policy and Collier County has received federal funding for land management.

A transfer of development rights program has also been established to conserve lands within North Belle Meade by "sending" development rights from this area to other portions of the county more suitable for development. It is important to note that Conservation Collier does accept donated lands which have had development rights removed when they have been cleared of exotics, already have an approved management plan, and have management funding.

Collier County is currently working with the US Fish and Wildlife Service to establish Panther Habitat Units on the county's preserved lands. These Panther Habitat Units would be sold for an estimated $372 per unit for purchase by other county departments to offset habitat loss for county projects which could save the county a substantial amount of mitigation fees. Private mitigation banks sell the units for $1,500 each. The monies will fund the federal mitigation requirements for monitoring, reporting and land maintenance above the normal costs of managing the county's conservation lands.

Table 3.1 provides a summary of county-level land acquisition programs across the state of Florida plus several notable program outside the state.

Table 3.1: Land Acquisition Programs

PROGRAM	LOCATION	FUNDING SOURCES	FUNDING AMOUNT	ADDITIONAL FUNDS	ACRES CONSERVED
Conservation Collier (e, f, l)	Florida (Collier County)	Bond (funded thru ad valorem tax)	$103 million	–	3,800
Preservation Project Jacksonville (c)	Florida (Duval County)	General Obligation Bonds; General Budget Appropriation; State, Federal & Private sources	$21 million	$291 million	–
Better Jacksonville Plan (c)	Florida (Duval County)	Bonds (funded thru sales tax increase)	$50 million	–	–
Preservation Project Jacksonville (c)	Florida (Duval County)	–	$17.8 million	$71.2 million	20,093
Environmentally Sensitive Lands Program (c)	Florida (Flagler County)	Bond (funded thru ad valorem tax); other sources	$4.8 million	$8.7 million	3,019
Environmental Lands Acquisition and Protection Plan (c, j)	Florida (Hillsborough County)	Bond (funded thru ad valorem tax); other sources	$300+ million	–	–
Environmental Lands Acquisition and Protection Plan (c, j)	Florida (Hillsborough County)	Bond (funded thru ad valorem tax); other sources	$130 million	$76 million	44,700
Conservation 20/20 (g, k)	Florida (Lee County)	Ad Valorem Tax "Pay-as-you-go"	$249 million	$6.4 million	26,476
Lands for You (a)	Florida (Martin County)	Bond Referendum	$20 million	$30 million	–
Healthy Rivers (a)	Florida (Martin County)	Sales Tax	$50 million	$250 million	42,000
Parks & Conservation Lands (a)	Florida (Martin County)	Sales Tax	$60 million	–	–
Environmentally Sensitive Lands Program (c, d, m)	Florida (Sarasota County)	Bonds (funded thru sales tax increase)	$100.6 million	$44.6 million	27,465
Volusia Forever Program (h, i)	Florida (Volusia County)	Ad valorem tax "Pay-as-you-go"; Partnerships	$191 million	Approximately 1:1 (county funds: matching funds)	30,000
Park County Land & Water Trust Fund (a)	Colorado (Park County)	Sales Tax; Donations; Grants	$4 million	$16 million	23,000
Regional Open Space & Natural Resource Management Plan (j)	Nevada (Washoe County)	Bonds	$50.3 million	$14 million	10,000
Truckee River Flood Project (j)	Nevada (Washoe County)	Sales Tax	$45 million	–	40,000
Southern Nevada Public Lands Management Act (j)	Nevada (Washoe County)	Sale of Public Land	$183 million	–	40,000
Open Space Program (a, b)	New York (Suffolk County)	–	–	–	–

PROGRAM	LOCATION	FUNDING SOURCES	FUNDING AMOUNT	ADDITIONAL FUNDS	ACRES CONSERVED
Save Open Space (a, b)	New York (Suffolk County)	Serial Bonds	$75 million	–	443 acres ($30 million)
Save Open Space Extension (a, b)	New York (Suffolk County)	Sales Tax	$322 million	–	14,000 ($243 million)
Landscapes 21st Century Preservation Program (a, b)	Pennsylvania (Chester County)	Local (source unclear); County Commissioner Budgets; State Grants	$50 million	$153.5 million	20% of County
Landscapes 21st Century Preservation Program (a,b)	Pennsylvania (Chester County)	Local (source unclear)	$60 million	–	–
Rural & Critical Lands Preservation(j)	South Carolina (Beaufort County)	Property Tax; Bonds	$63 million	$19 million	16,751
Harris County Flood Control District (a, b)	Texas (Harris County)	Dedicated Ad Valorem Property Tax; Federal Funding	$150 million annually	–	20,000

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Evaluation of the Conservation 20/20 Ordinance & Program

Background on Ordinance Establishing Conservation 20/20 Land Acquisition Program

On November 5, 1996, Lee County residents approved the levying of designated millage to raise ad valorem taxes for acquiring and managing environmentally critical or sensitive lands. The ballot initiative read as follows:

OFFICIAL BALLOT

Conservation 20/20 non-binding referendum to acquire and manage lands critical to Lee County Environment.

Do you approve Lee County purchasing and managing conservation lands critical for water supply, flood protection, open space, wildlife habitat and passive recreation by the county levying an ad valorem tax of up to 0.50 (1/2) mil annually for a period not to exceed seven (7) years; pursuant to Lee County Ordinance 96-12?

Lee County Ordinance 96-12 established the framework for the Conservation 20/20 program and the Conservation Lands Acquisition and Stewardship Committee (CLASAC). The key parameters set forth in the ordinance for acquiring conservation lands are:

1. The property must contain environmentally critical or sensitive lands for the protection of natural flood plains;
2. The property must contain marshes or estuaries;
3. The property must be important for surface water management and water supply;
4. The property is suitable for the restoration of altered ecosystems;
5. The property provides wildlife management areas; and
6. The property provides recreation opportunities.

The program is restricted to a "willing seller" basis, and no eminent domain will be used to acquire lands for the program. The lands need to be purchased in a legal interest sufficient to meet the objectives of the conservation lands program. Another component of the ordinance allows the county to receive off-site mitigation credits from appropriate agencies for county projects which impact environmentally sensitive lands or listed species.

CLASAC is a fifteen-person citizen advisory committee appointed by the Board of County Commissioners (BOCC). The committee is charged with evaluating applications submitted to the Conservation 20/20 program and making recommendations to the BOCC as to which properties meet the criteria for acquisition.

The Conservation 20/20 program became operable in 1997 as a seven-year program. However, the program has been extended on a year-by-year basis by the Board of County Commissioners after a year-long study by CLASAC including public surveys and workshops that concluded there was overwhelming public support for continuing the land acquisition program. There have been revisions to the ordinance through BOCC public hearings and approval.

In 2001, CLASAC and staff recommended revisions to the criteria selection and ranking system resulting from their experiences and increased knowledge of implementing conservation lands program. Then in 2004, the site review and selection process was revised to reduce the time involved in processing an application. Clarifications were made to the ordinance in 2005 to allocate a minimum of ten percent of the funding to a management trust fund, and to establish criteria for using Conservation 20/20 lands for off-site mitigation credits for County projects and other public projects. Two additional revisions to the land acquisition criteria were approved in 2007 which added eco-archeological resources to the list of environmentally-sensitive lands, and added parameters for improving the ranking of a proposed property if the property was within the designated areas on the county's Master Mitigation Map.

Conservation 20/20 Land Acquisition Procedures

Properties that are nominated to the Conservation 20/20 program are reviewed through a two-tier evaluation by CLASAC, the Criteria Ranking Subcommittee (CRSC) and county staff. Nominated properties must meet a minimum of four the initial criteria questions to qualify for a secondary review. Once the property enters the secondary review phase, CLASAC members and county staff may conduct site visits for a more thorough understanding of the property.

The secondary review process includes an evaluation matrix to rank how the property meets the conservation goals established in the Ordinance. However, no minimum score is required for the property to be recommended for purchase. A higher score only means the property is more likely to be forwarded to the BOCC for approval to proceed with negotiations for purchasing the property. The secondary review does not currently include a defined procedure for ranking or prioritizing the nominated properties. The evaluation system is operated upon a first-come first-served basis.

Lee County has acquired over 26,000 acres for approximately $256,000,000 through February 2009. The majority of the lands have been acquired solely with funds provided by Lee County. All the conservation lands have been purchased through fee simple means.

The acquisition of Six Mile Cypress Slough Preserve and Hickey's Creek Mitigation Park were acquired through partnerships with state agencies; South Florida Water Management District, and Florida Fish and Wildlife Conservation Commission respectively. County staff conducts the negotiations and purchases with the land owner or land owner's representative. The county does not utilize a third party such as The Nature Conservancy in the negotiation process.

The following policies regarding the implementation of the Conservation 20/20 Ordinance have been established by CLASAC and county staff:

- Purchasing conservation easements for the protection of conservation lands does not meet the intent of the Conservation 20/20 program. The County needs to acquire the full ownership of the property.

- The "willing seller" clause within the Ordinance means that only property owners can nominate their lands for review and potential purchase through the Conservation 20/20 program. County staff cannot contact owners of land that has conservation value to inquire if they would be willing to sell their property or a portion of their property for conservation purposes.

Preliminary Strategy for DR/GR Land Acquisition and Restoration

A well developed conservation lands program for southeast Lee County needs to be diversified, integrated, and adaptive. There are two basic formats: expanding the current Conservation 20/20 program beyond traditional land acquisition and management, or developing a new conservation lands program focused on protecting and improving water resources within the DR/GR.

Clearly defined conservation goals are a prerequisite for a diversified program that can be thoroughly integrated into other county, state, federal, and private conservation programs. The goals need to be based upon the best available scientific knowledge and be adaptable as additional data and knowledge is obtained. Specific strategies for achieving these goals can then be formulated

Conservation goals within southeast Lee County should include the following to protect and enhance the natural resources within the DR/GR:

1. Maintaining and enhancing the surface and groundwater resources;

2. Avoiding further loss of wetlands, and requiring any loss of wetlands within the DR/GR to be mitigated within the DR/GR;

3. Expanding the existing shallow and sandstone aquifer monitoring well system to be used as a resource management tool;

4. Restoring historic flow-ways;

5. Providing connectivity between larger, regionally significant preserves for mammal and herpefaunal movement;

6. Planning for public potable water well withdrawals to insure natural systems are not harmed;

7. Restoration of historic ecosystems;

8. Maintaining and enhancing wood stork foraging areas; and

9. Maintaining and enhancing agricultural operations.

Strategies for achieving the conservation goals should consider interim goals for periods of 5 years, 10 years, and 25 years. These strategies should be refined with representatives from a variety of county programs including natural resources, county lands, parks and recreation, utilities, transportation, planning, environmental sciences, port authority, and county attorney.

The current Conservation 20/20 program is restricted through policy to traditional fee-simple ownership of land. The high cost of this approach limits the county's ability to stretch available funds as far as possible. The county's ambitious land protection goals for the DR/GR, which include the conservation and enhancement of water resources, native habitat, agriculture, and wildlife, are simply not attainable if fee-simple ownership is the only tool available.

There are a variety of methods that may be used individually or in combination on a property to maximize the funds available for the conservation of natural resources. A number of these methods are discussed in Table 3.2. Conservation easements, partnerships, and transferable development rights will be important tools in reaching the conservation goals within southeast Lee County.

Another drawback of using the Conservation 20/20 program to carry out the county's DR/GR goals is that the current program does not give adequate weight to water resources, which are of critical importance in southeast Lee County. A single set of selection criteria apply county-wide, with no provision (at least at present) for implementing a geographically specific strategy such as the DR/GR priority restoration strategy described at the beginning of this chapter.

The county should either amend the Conservation 20/20 program to mitigate these drawbacks or create a new land acquisition program that is more flexible as to types of ownership interests in land and more specific as to DR/GR conservation goals.

Lee County needs a diversified approach to meeting its various conservation goals. In the DR/GR it must focus on enhancing surface and groundwater quantity and quality to insure the availability of potable drinking water, agricultural irrigation water, and water needed to maintain healthy native ecosystems from the DR/GR through rivers and streams to the Estero Bay.

Recommended Actions

1. Expand the Conservation 20/20 program or develop a new program to include a diversified system of land conservation and acquisition techniques within the next three to five years.

2. Use the Priority Restoration Strategy (Figure 3.1) as an interim guide to prioritizing protection and restoration efforts with the DR/GR. Tier 1 lands are the highest priority for acquisition and should be actively pursued for purchase, including the use of purchase agreements for future acquisition. Tiers 1 and 2 are the highest priorities for protection from irreversible land-use changes. Criteria utilized for evaluating the conservation value of lands submitted to the Conservation 20/20 program for acquisition should be revised to place a significant weight on the lands located within Tiers 1 and 2. All seven tiers should be considered potentially eligible for acquisition or protection.

3. Establish clearly defined conservation goals for the natural resources within the DR/GR by 2010 and establish a natural resource conservation plan for achieving specific components of the DR/GR conservation goals within 5 years (2015), 10 years (2020) and 25 years (2035).

4. Dedicate a staff member to facilitate an integrated natural resources conservation plan for the DR/GR including the development and expansion of partnerships within the county government; with other government agencies; with the agricultural community, the mining community, and the residential community within the DR/GR.

5. Expand the methods of insuring long-term protection and enhancement of the natural resources with the DR/GR by 2012

Table 3.2: Methods to Meet Conservation Goals

PROGRAM	ADVANTAGE	DISADVANTAGE
Fee Simple or Fee Title Acquisition The purchase of land including all property rights for highest and best use at market value.	• Complete ownership of land and development rights.	• Higher purchase price.
Bonds Funding the purchase of land through a bond that is paid off over a set number of years.	• Allows for purchase of lands during favorable market pricing while paying for the lands over time.	• Dependent on bond availability. • Bonds include interest.
Bargain Sale Part donation/part sale – property is sold at less than market value.	• Complete ownership of land and development rights. • Lower purchase price. • Potential tax benefits for seller who may be eligible for a tax deduction for the difference between the sale price and fair market value.	• Can be expensive.
Property Donations Property owner donates all or part of his land.	• No cost for acquiring the land. • Potential tax benefits for seller who may be eligible for a tax deduction for charitable contribution in the amount of the fair market value for the land.	• Very few landowners willing to consider.
Purchase of Conservation Easement The land owner agrees to place a conservation easement over the environmentally important portions of his property that limits the use of the conservation area in exchange for monetary compensation.	• The environmentally important land is protected. • The cost is lower than fee-simple purchase. • Potential tax benefits for the land owner. • Land owner is responsible for land management.	• Potential enforcement issues with the land owner being responsible for land management. • Existing mortgage may prevent establishment of conservation easement; it would require the lending party to agree to subordinate its rights in the property to the rights of the easement.
Lease Short or long term rental of land.	• Low cost.	• Temporary offering only limited control of the property.
Bequest Landowner retains ownership until death.	• Management responsibility usually deferred until owners death.	• Uncertain date of acquisition. • No tax benefits to donor. • Landowner can change will.
Donation with Reserved Life Estate Landowner donates during lifetime but has lifetime access.	• Landowner retains use and receives tax benefits from donation.	• Uncertain date of acquisition.
First Right of Refusal/First Option to Purchase Agreement An agreement between the landowner and county (or buyer), that if the landowner decides to sell his property the county would have the first option to make a purchase offer.	• County has the right to place first bid on the property when listed for sale.	• Uncertain date of acquisition. • Landowner may not accept purchase offer. • Landowner may require a payment to secure first right of purchase.
Transfer of Density Rights Program Areas that are best suited for conservation are identified as “sending areas” where the development rights may be used on a more suitable site in exchange for the protection of the “sending” property	• Land is conserved with no public fund expenditure.	• Need a market for selling the development rights.
Purchase of Development Rights The landowner receives monetary compensation for selling and extinguishing certain development rights, while retaining the ability to continue to live on the property and/or operate agricultural uses on the land.	• Less expensive than fee-simple ownership. • Provides a means to conserve agricultural operations. • Development rights are extinguished. • Potential tax benefits to landowner, such as a reduction in inheritance taxes with the property is transferred to a family member upon death of the landowner.	• Does not provide for public access. • Limited ability to manage the land for ecological conservation purposes.

PROGRAM	ADVANTAGE	DISADVANTAGE
Land Swap Exchange of developable land for land with high conservation value. Exchange of conservation lands to benefit the goals of each program.	• Minimal or no public funds required. • Landowner may defer capital gain recognition.	• Properties must be of comparable value. • Complicated and time consuming.
Cost-Sharing Partnering with one or more, private or public organizations that have funding available and share conservation goals.	• Provides government with a tool to acquire desired properties if other acquisition techniques are not viable.	• Landowner & public opposition. • Potentially expensive & time-consuming litigation.
Eminent Domain The right of the government to take private property for public purposes upon payment of just compensation	• Provides government with a tool to acquire desired properties if other acquisition techniques are not viable.	• Landowner & public opposition. • Potentially expensive & time-consuming litigation.
Third Party Purchase A private or public organization with ample funding purchases an important environmentally sensitive property with an agreement with a third party to buy the property at a set future date.	• Secures an important property for conservation when the property becomes available.	• May be difficult to locate an organization with ample funding to secure a third party agreement. • Agreement may include interest payments.
ROMA – Establish a Regional Offsite Mitigation Area A government run program that establishes targeted properties for acquisition and management to offset or mitigate impacts to specific natural resources within a defined area of jurisdiction.	• Mitigation for impacts to natural resources occurs in close proximity to the impact.	• May be costly and time consuming to establish the ROMA. • Requires government agency approvals.
Lease Conservation Lands for Specific Uses A conservation land owner may lease or rent the land for specific uses including pastureland or low-impact agricultural operations such as apiaries.	• Secures funds for future restoration or land management. • Provides a means to continue certain agricultural operations.	• May result in unforeseen impacts to the property. • A need for agricultural land leases must be existing.
Conservation Buyer Program A conservation land owner places a conservation easement over the environmentally critical portions of a property, and then sells the property with the conservation easement to buyer who understands the ecological value.	• Land is conserved at a lower cost to both the conservation program and buyer. • Long term management of the property is the responsibility of the new landowner. • "Recycles" funds for additional land purchases.	• Public opposition to selling conservation lands to private individuals. Need to locate conservation-minded buyers. • Unknown time frame for selling acquired lands.
Agricultural Easements The placement of an easement over the property limiting the use of the property to specific agricultural operations. Similar to a conservation easement, but the focus is on preserving the agricultural operation.	• Prevents development of the property. • May reduce inheritance taxes. • Provides compensation to the landowner for eliminating development rights.	• Does not provide full conservation of the natural resources. • Public may not support a locally funded program to conserve agricultural lands by compensating the landowners. • Agricultural lands must still be owned by agricultural operator.
Greenbelt Initiative Government established program to limit land uses within an area to provide protection of environmentally sensitive lands; agricultural lands; and renewable and non-renewable natural resources as a part of an overall smart growth plan.	• Provides a comprehensive plan for protection of important ecosystems, agricultural operations, and natural resources. • May improve ability to receive land acquisition or restoration grants.	• Potential litigation issues. • Opposition of landowners within the Greenbelt designated area.
Partial Development Agreement Splitting a parcel and selling a minor portion for development.	• Funds may be generated to protect the major portion of the property.	• Potential public opposition to selling a portion of the land for development.

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4 Groundwater Modeling of Innovative Mining Concepts

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Introduction

SDI Environmental Services, Inc. (SDI) was contracted by Dover, Kohl & Partners (DKP) to investigate and assess the hydrological value of innovative mining concepts and mine lake configurations that have been suggested to help minimize the effects of mining operations on groundwater levels in the Density Reduction/Groundwater Resource (DR/GR) area of Lee County. These concepts include, but may not be limited to, techniques such as grout curtain walls, slurry walls, or other underground hydraulic barriers as well as regulatory fixes such as mining separation requirements between mine lakes. For purposes of this study, slurry walls are considered impermeable to the flow of water, while grout curtains are not considered 'water tight' and will allow some water to pass. The area separating adjacent mine lakes will be known as terraces.

As part of this study, SDI created a MODFLOW groundwater model utilizing and incorporating parameters and data from an existing MIKE SHE model (DHI Water & Environment, Inc., Draft, 2009) of the DR/GR area as well as data from previous models of the area and reference literature. This MODFLOW model was used to simulate and evaluate the effects of selected innovative mining concepts on groundwater levels in the vicinity of a proposed mine.

General Setting

The DR/GR area shown on Figure 4.1 occupies a strategic position between developed urban areas to the north and west and pristine environmental preserves to the southeast. The DR/GR lands immediately adjoin the Corkscrew Swamp in adjacent Collier County (DKP, 2008). Also shown in Figure 4.1 is the area that will be simulated in a groundwater flow model as part of this study. The focus area inside the groundwater flow model is the area where water level effects of the mining concepts will be assessed.

The DKP project team identified the existing Florida Rock Mine property as a representative mining area within the DR/GR for this investigation. The Florida Rock Mine property includes several existing rock mine lakes, which are north, east, and south of an area proposed for evaluation during this study, an area which has already been permitted for mining. The proposed study mine lake was originally defined as a 55-acre mine lake simulated as a rectangular area 1,600 feet by 1,500 feet located approximately in the middle of the Florida Rock Mine property. However, initial model evaluations indicated that a small mine lake might not be adequate to illustrate potential water level changes that might result from the innovative mining concepts. Therefore, SDI arbitrarily increased the size of the proposed mine lake to a rectangular area 3,500 feet by 6,175 feet encompassing approximately 500 acres. To accomplish this, an existing mine lake south of the proposed mine lake was moved southward to allow simulation of the larger mine lake. Another smaller existing mine lake was moved eastward to allow simulation of the larger proposed mine lake. The proposed mine lake and the simulated nearby mine lakes in the focus area are shown in Figure 4.2.

Modeling Objectives

The objective of the groundwater simulations of innovative mining concepts in the DR/GR was to assess the effects of selected proposed mining concepts and to evaluate and rank their potential for helping minimize the effects of proposed mining on groundwater levels in the vicinity of the simulated mine lake.

Conceptual Hydrologic Model

Aquifer System Framework

The water table aquifer (WTA) consists of the Ochopee Limestone unit of the Tamiami Formation of Pliocene age and the overlying Holocene and Pleistocene age undifferentiated sediments for most of the central and northern part of the study area. In the southern portion of the study area, the Ochopee Limestone of the Tamiami Formation begins a transition to a semi-confined aquifer. An analysis of reported leakance values indicates that in the southern DR/GR area there is minimal confinement between the Tamiami Formation and the overlying undifferentiated deposits. As a result, the Ochopee Limestone of the Tamiami Formation is simulated as part of the WTA within the DR/GR area for this study.

The WTA is hydraulically separated from the underlying Miocene age Sandstone aquifer by the upper confining units within the Peace River Formation. Any change in the hydraulic interaction between the Sandstone aquifer and a mine lake is assumed to be negligible for purposes of this study. It was assumed that any permitted groundwater pumping will not change due to the addition or expansion of a mine lake. Therefore, it is not necessary to include pumping wells in this model because the model is only being used to predict water level changes that might result from innovative mining concepts.

Groundwater Flow System

Within the WTA, groundwater in the DR/GR area is derived from rainfall recharge and generally flows laterally from a groundwater ridge located in the east-central portion of Lee County to the southwest. Some groundwater also moves vertically downward in the WTA through the semi-confining units to recharge the Sandstone aquifer. However, as noted in the previous section, this movement of groundwater was considered negligible for purposes of this study and was not simulated in the model.

Groundwater Flow Model Construction

This section describes the set-up and parameterization of the SDI DR/GR groundwater flow model. The SDI DR/GR groundwater model is a finite difference numerical model that was developed to evaluate the effects of selected innovative mining concepts on groundwater levels in the DR/GR area. The groundwater model was developed using the USGS MODFLOW 2000 code (Harbaugh, et al, 2000) and constructed with the Groundwater Vistas version 5.33 (build 20) preprocessor software.

Model Structure

The extents of the DR/GR groundwater model were chosen to be large enough so that water level changes likely caused by simulating a proposed mine lake would not extend to or be influenced by boundary conditions at the perimeter of the model. The DR/GR model consists of a rectangular grid approximately 17 miles by 13 miles (see Figure 4.1). The grid spacing is variable and ranges from a minimum of 25 feet in the DR/GR focus area to 750 feet at the edges of the model, a spacing that coincides with the MIKE SHE grid. The focus area that includes the simulated proposed mine lake is shown on Figure 4.2. The only surface water features represented in the SDI DR/GR groundwater model were the existing mine lakes that were represented in the MIKE SHE model.

The groundwater flow model is comprised of two layers simulating the WTA. Layer 1 represents the undifferentiated sediments of Holocene to Pleistocene age that occur at land surface in the area and overlay the Tamiami Formation. Layer 2 simulates the Ochopee Limestone of the Pliocene age Tamiami Formation. The lateral extents of the Ochopee Limestone were modified to agree with a previous investigation (Water Resource Solutions, Inc., 2005).

Hydraulic Parameters

SDI was provided with a set of electronic MODFLOW files extracted from the MIKE SHE groundwater model by DHI at the request of DKP. DHI had previously extracted a MODFLOW model set-up and parameters from the saturated portion of MIKE SHE. Hydraulic conductivity for layer 1 of the SDI DR/GR model was the same as used in the DHI model. Hydraulic conductivity for layer 2 in the SDI DR/GR model was revised from the DHI values in portions of the DR/GR area based on a review of aquifer performance test data and hydraulic conductivities in several earlier models of the area (Montgomery, Inc., 1988; Water Resource Solutions, Inc., 2005; and Rawl and Voorhees, Draft, 2005). Hydraulic conductivities in the focus area are approximately 76 feet/day (WTA) and 250 feet/day (Ochopee Limestone) for model layers 1 and 2, respectively. Horizontal to vertical hydraulic conductivity ratios are 20:1 and 10:1 for model layers 1 and 2, respectively. In the focus area, model layer 1 averages approximately 20 feet thick and model layer 2 averages approximately 42 feet thick.

Boundary Conditions

Topography for the MODFLOW 2000 model was imported using the USGS National Elevation Dataset with a consistent projection (Geographic), resolution (1 arc second), and elevation. The vertical datum is measured in feet relative to NAVD88. Topography for the area of the Florida Rock Mine property was imported using a LIDAR topographic dataset with a fundamental vertical resolution of 0.6 foot. Boundary conditions at the edge of the model were simulated using MODFLOW General Head Boundaries (GHBs) in both model layers 1 and 2. Water levels in the GHBs were set as a subdued replica of topography. Water levels in the northernmost Florida Rock mine lake and the southernmost lake were arbitrarily set at fixed levels using constant head boundary conditions to impose a fixed groundwater gradient in order to evaluate the selected innovative mining concepts uniformly under a controlled set of boundary conditions.

Rainfall enters the soil layer of the unsaturated zone through infiltration. Water enters the saturated zone from the unsaturated zone after surface water runoff and evapotranspiration (ET) occurs from the unsaturated zone. This resultant quantity is input to MODFLOW as recharge. ET from the saturated zone is simulated within MODFLOW when the water table exists in the root zone of plants. A rainfall rate of 49.36 inches/year was calculated using the average annual rainfall for Lee County for the period 1999 through 2008 from the Lee County rainfall online database.

The average evaporation rate for open water in the Everglades is 52.95 inches/year (Abtew, 2004). Maximum groundwater ET is simulated in MODFLOW 2000 with the ET parameter and was estimated to be 26 inches per year with an extinction depth of 4 feet. Simulated net recharge to the aquifer is calculated within the model by the difference between the applied recharge rate and the actual groundwater ET derived from the maximum ET rate and the relationship of the simulated water level and the ET extinction depth.

Model Parameter Adjustments

Selected model parameters were adjusted to ensure that the model could replicate the shallow regional flow system, groundwater flow direction, and representative groundwater gradients. The uniform groundwater recharge and ET rates were adjusted to produce groundwater levels and depths to groundwater appropriate for the area. A uniform groundwater recharge rate of 18 inches/year and a uniform maximum groundwater ET rate of 26 inches/year were applied throughout the model except for simulated mine lakes. Mine lakes were simulated using high hydraulic conductivities, with the average Lee County rainfall rate and Everglades open water evaporation rate applied to the mine lake areas.

Groundwater levels in the water table are generally a subdued reflection of the topography of the area. Simulated depths to the water table from land surface range from approximately 1 foot above ground in the Corkscrew Swamp area to 5 feet below ground in an area of higher topography along the eastern boundary of Lee County. Depths to water over most of the model area range from 1.5 to 2.5 feet below land surface.

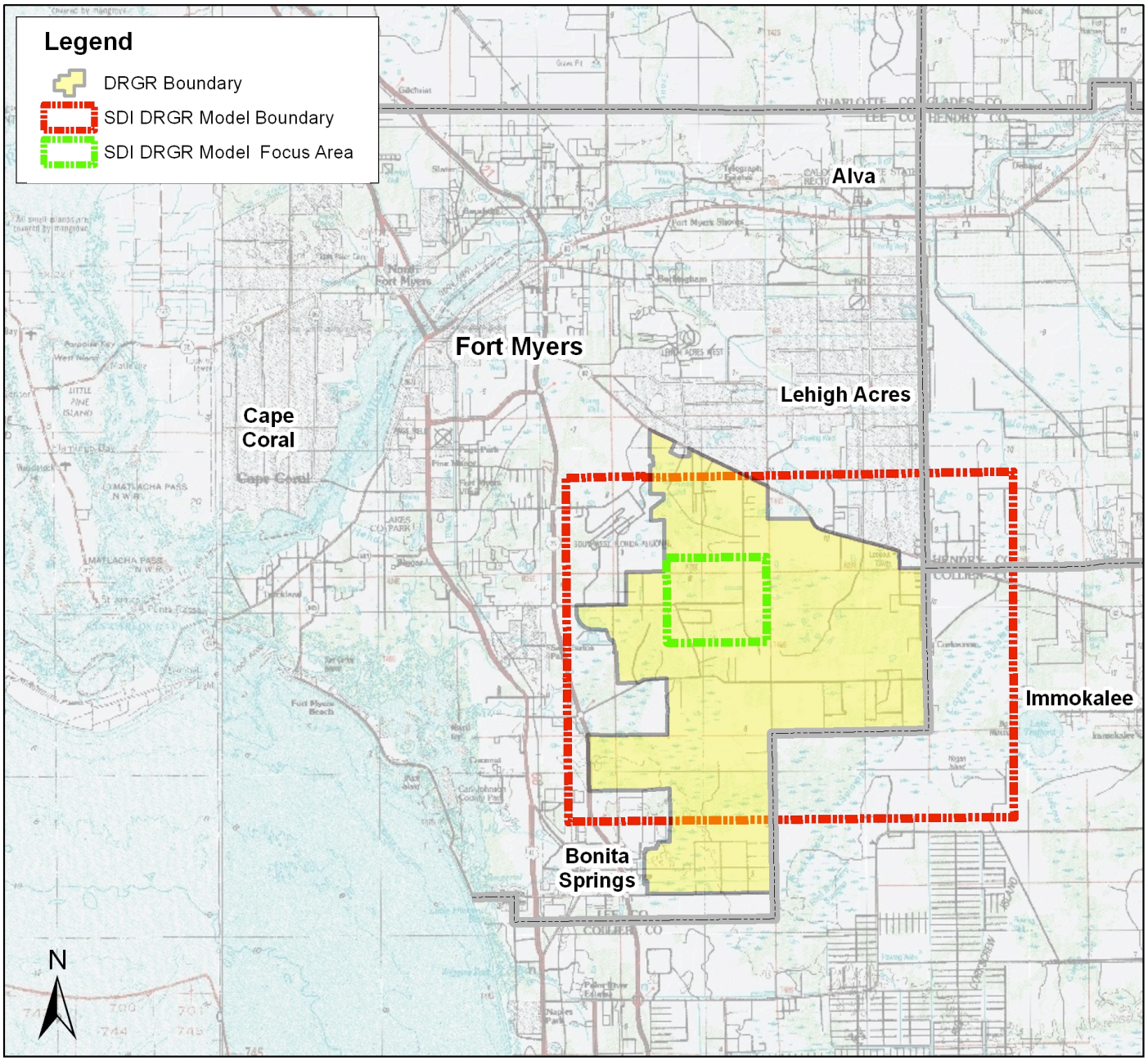


Figure 4.1: Location of DR/GR Area and SDI Innovative Mining Approaches Groundwater Model Boundary

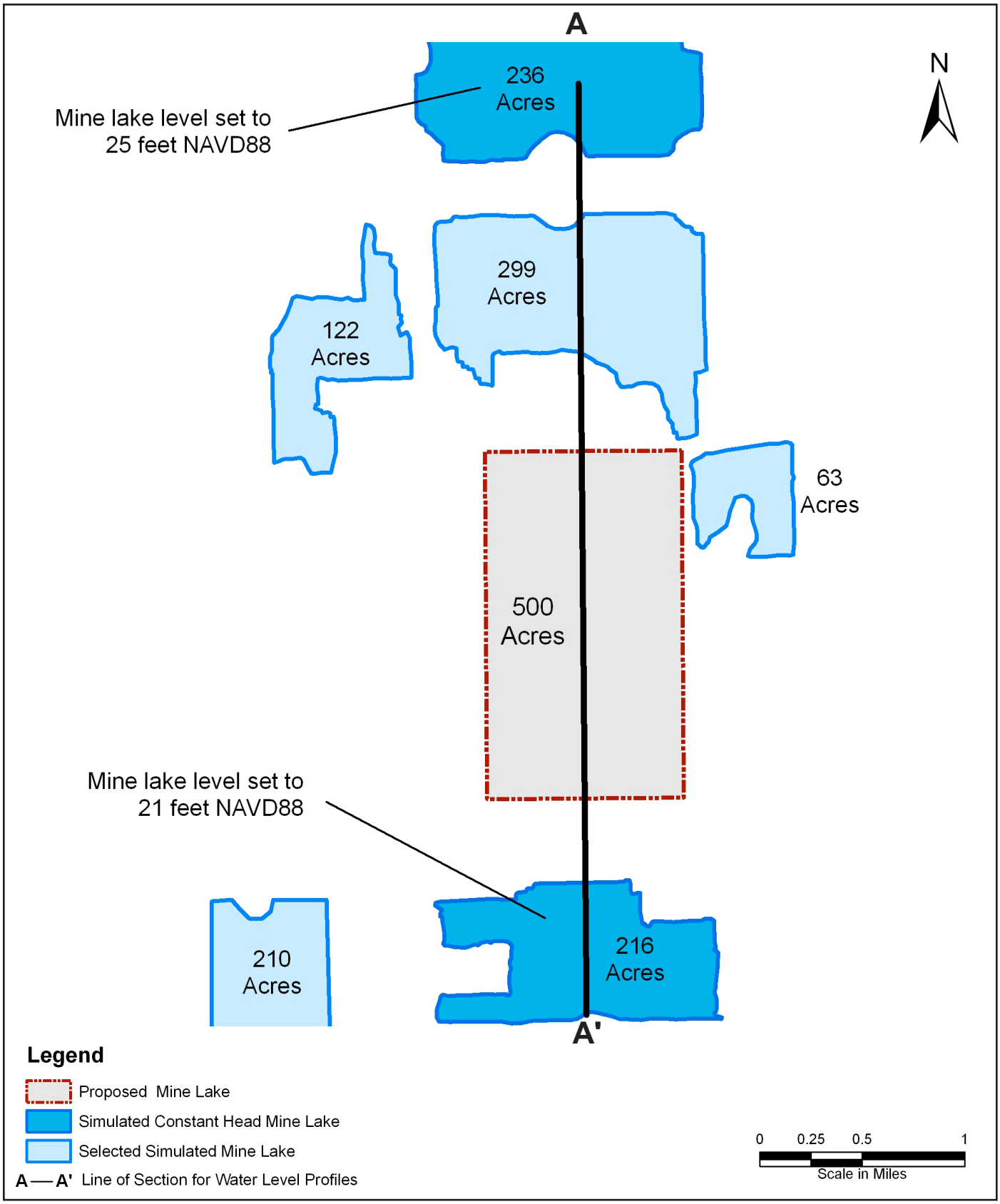


Figure 4.2: Innovative Mining Approaches Focus Area and Simulated Mine Footprint

Predictive Simulations of Innovative Mining Concepts

The construction of a mine lake, irrespective of other operations, results in a flat water table over the surface of the mine lake. This imposes a change on the natural, or pre-mine, water table gradient. If the mine lake or if the groundwater gradient is large, then the flat water surface combined with the higher effective transmissivity of the mine lake causes a decrease in groundwater levels at the up-gradient end of the mine lake and an increase in groundwater levels at the down-gradient end of the mine lake. This unintended movement of groundwater may have undesirable effects on WTA water levels and nearby wetlands.

A series of model scenarios were evaluated to compare the effects of the type and location of selected innovative mining concepts. Simulations evaluated the potential groundwater level changes due to proposed mine lake size using the location of native aquifer terraces and various engineered slurry walls to separate a single proposed mine lake into multiple proposed mine lakes. Five scenarios were formulated to evaluate the potential effects of selected innovative mining concepts. Whether or not the innovative mining concepts tested herein would be attainable during actual mining practices was outside the scope of this study. Schematic illustrations of the five mining scenarios are shown in Figure 4.3.

1. Scenario 1: Add a proposed mine lake to baseline simulation.

2. Scenario 2: Divide a proposed mine lake using a native aquifer terrace (i.e., unmined area) 300 feet wide.

3. Scenario 3: Divide a proposed mine lake using a slurry wall constructed in an area 25 feet wide and extending the full depth of model layers 1 and 2.

4. Scenario 4: Modified slurry wall location based on Scenario 3 result.

5. Scenario 5: Proposed mine lake with encapsulating slurry wall.

A baseline simulation was made with only the simulated (i.e., existing) mine lakes and not the proposed mine lake to generate simulated water levels for comparison to scenarios using none or some of the selected innovative mining concepts. Figure 4.4 is a color map of the simulated baseline groundwater levels with 1-foot contour intervals. For the baseline case, water levels were fixed in two of the existing mine lakes to establish a larger hydraulic gradient in the area of the proposed mine lake (see Figure 4.2). A fixed water level of 25 feet NAVD88 was set in the existing northern mine lake and a fixed water level of 21 feet NAVD88 was set in the existing southern mine lake that was moved approximately 4,000 feet to the south. Groundwater is simulated to flow from the north-northeast to the south-southwest across the focus area. Groundwater would decline approximately 2.5 feet, with a larger hydraulic gradient expected in the southern portion of the focus area than in the northern portion. All changes in water levels for the various scenarios are based upon the difference between water levels in this baseline simulation and each of the scenarios.

Also provided on Figure 4.4 is a north-south profile graph showing the simulated baseline groundwater level compared to an approximate "pre-mining" topography. The profile graph also shows the fixed water levels in the extreme northern and southern mine lakes. The water level in the other existing mine lake can fluctuate based on surrounding hydrologic conditions. As noted earlier, simulated groundwater levels are typically one to two feet below ground.

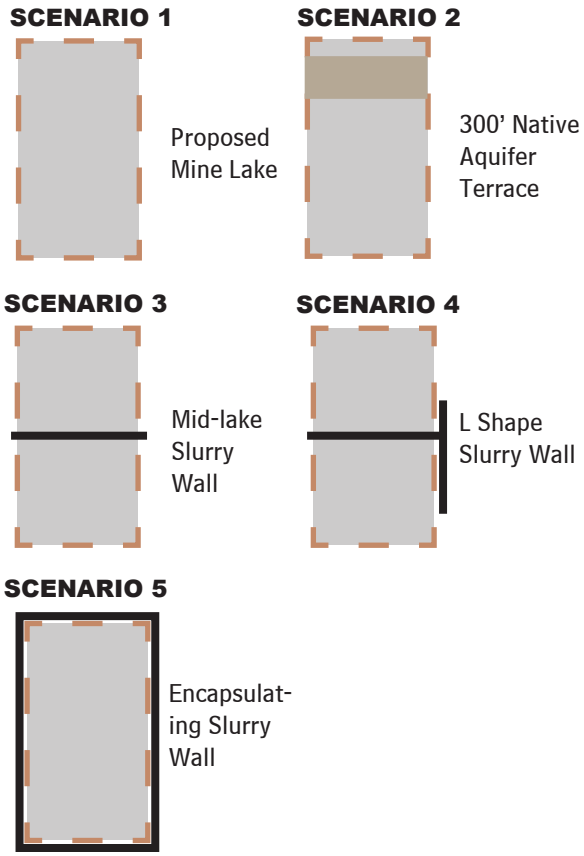
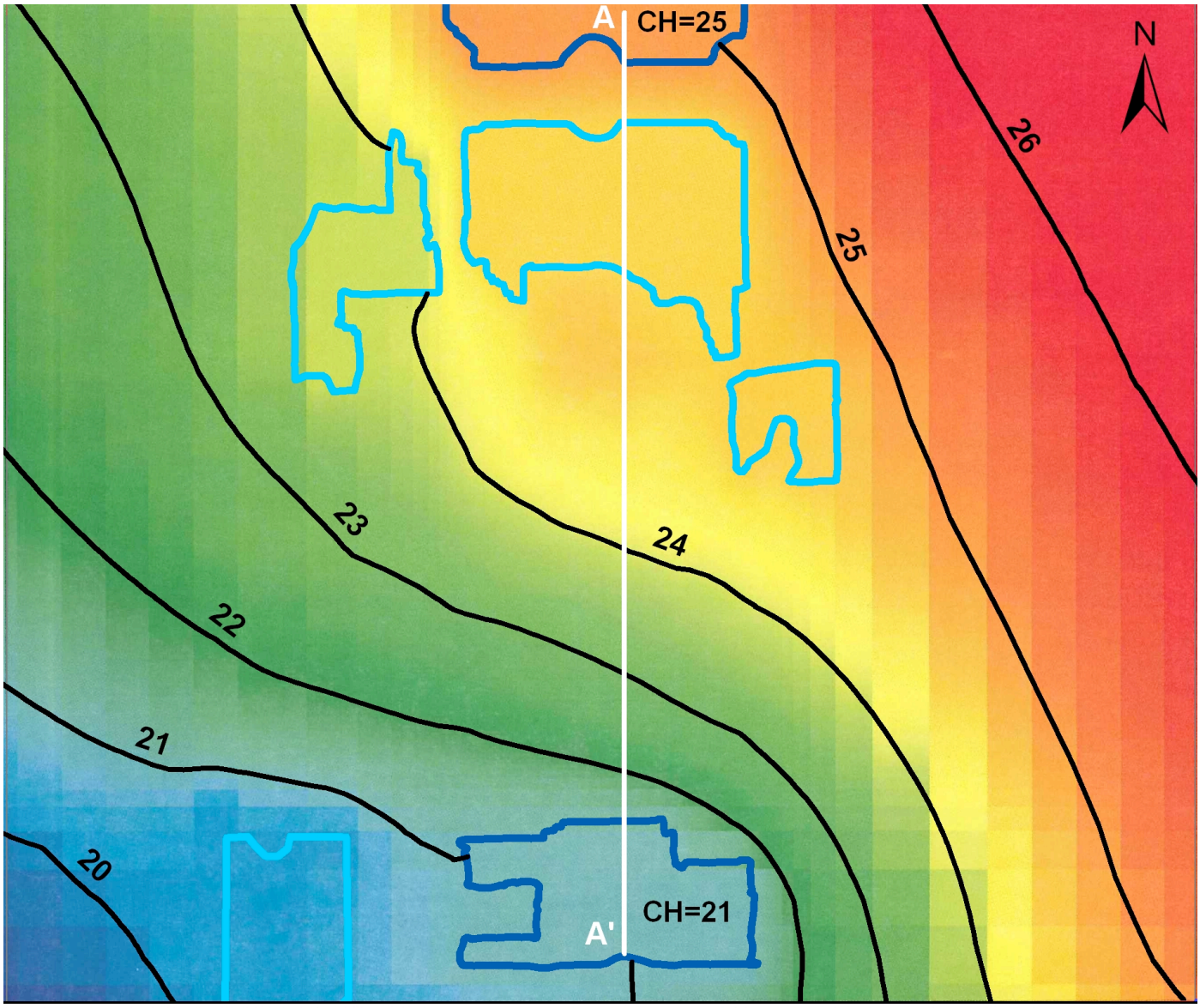


Figure 4.3: Schematic of Innovative Mining Concepts



Legend

Simulated Groundwater Contour, Feet NAVD88

Simulated Constant Head (CH) Mine Lake

Selected Simulated Mine Lake

0 0.25 0.5 1

Scale in Miles

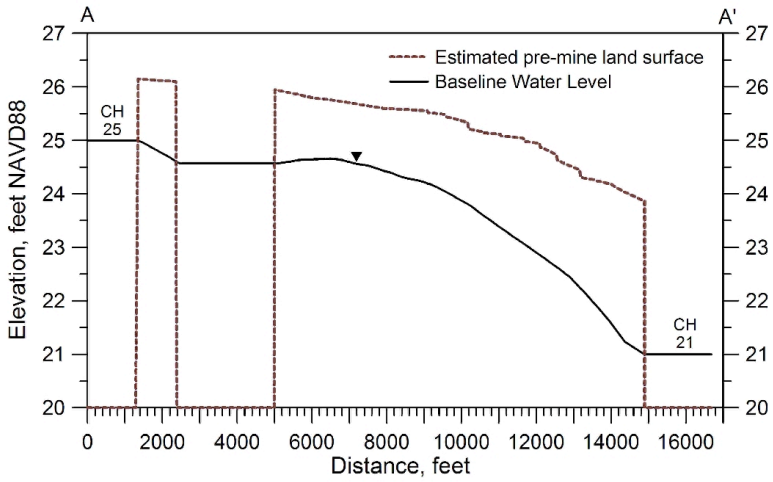


Figure 4.4: Simulated Contours and Water Level Profile of Groundwater Elevation for Baseline Conditions

Scenario 1 Results

Scenario 1 was used to evaluate the effects of the proposed 500-acre mine lake on the groundwater levels and hydraulic gradient in the vicinity of the proposed mine lake. Figure 4.5 is a color map of groundwater levels for Scenario 1 with 1-foot contour intervals. As shown in Figure 4.5, the introduction of the proposed 500-acre mine lake flattens the water table across the area of the proposed mine lake, inducing changes in water levels around the entire perimeter of the proposed mine lake.

Also provided on Figure 4.5 is a north-south profile graph showing simulated Scenario 1 groundwater levels compared to the simulated baseline groundwater levels. The profile graph shows that groundwater levels north of the proposed mine lake are below the baseline water levels, with higher groundwater levels south of the proposed 500-acre mine lake. The water level in the existing mine lake north of the proposed mine lake is lowered by approximately 0.25 feet.

Scenario 1 water levels were compared to those from the baseline simulation to determine the simulated water level changes due to the proposed 500-acre mine lake. A color map of water level changes with contours of water level changes is shown on Figure 4.6. As illustrated, the proposed mine lake would lower the water table at the up-gradient (northern) end of the mine lake by approximately 1 foot. Water levels are also lowered to the northwest of the proposed mine lake by approximately 0.7 feet and to the northeast of the proposed mine lake by approximately 0.8 feet, including the small simulated mine lake to the east. Water table increases are simulated around the down-gradient (southern) end of the proposed mine lake, with the maximum increase occurring at the southwestern end of the proposed mine lake by approximately 1.3 feet. Note that groundwater levels are still approximately one foot below land surface at the southern end of the proposed mine lake. The extent of the water level increase south of the proposed mine lake is reduced by the fixed head set in the simulated mine lake to the south.

Scenario 2 Results

For Scenario 2, the proposed 500-acre mine lake in Scenario 1 was divided into two proposed mine lakes (each approximately 250 acres) by a single native aquifer terrace 300 feet wide (see Figure 4.3). Scenario 2 was used to evaluate the potential of a natural aquifer terrace to minimize water level changes caused by mine lakes. Figure 4.7, a color map of groundwater levels for Scenario 2 with 1-foot contour intervals. The profile graph shows that the water level in the northern proposed mine lake is 0.45 feet higher than the water level in the southern proposed mine lake.

Scenario 2 water levels were compared to those from the baseline simulation to determine the simulated water level changes due to the proposed mine lake divided by a native aquifer terrace. A color map of water level changes with contours of water level changes is shown on Figure 4.8. With the incorporation of the native aquifer terrace, the maximum water level changes at both the northern and southern ends of the proposed mine lakes are reduced approximately 0.2 feet when compared to Scenario 1. Water level declines in the simulated mine lake to the east are reduced by approximately 0.1 feet when compared to Scenario 1. The simulated 300-foot wide native aquifer terrace is only moderately effective as a hydraulic barrier in mitigating water level changes due to the high hydraulic conductivities of layer 1 (76 feet/day) and layer 2 (250 feet/day) in the native aquifer terrace.

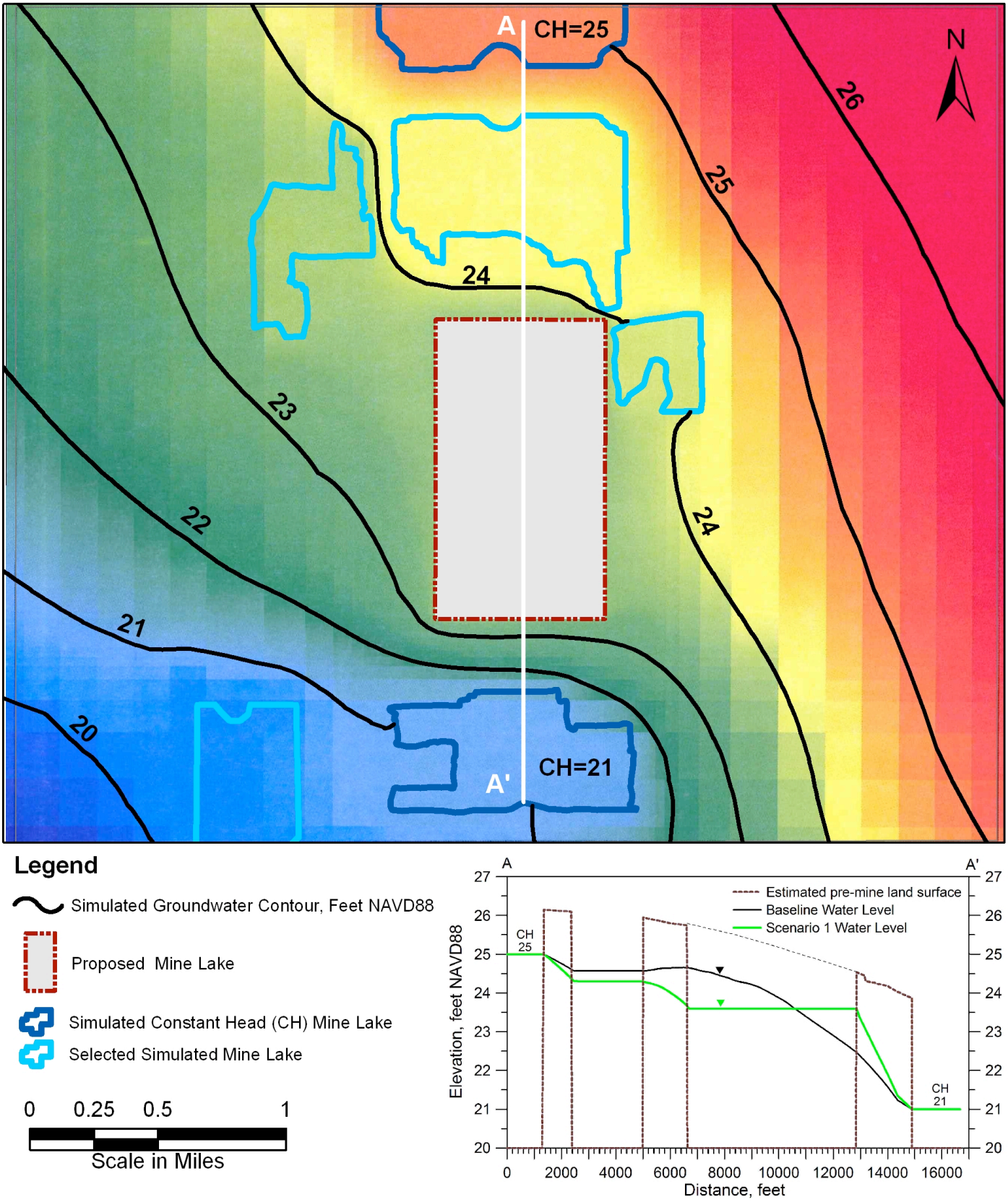


Figure 4.5: Simulated Contours and Water Level Profiles of Groundwater Elevation for Scenario 1

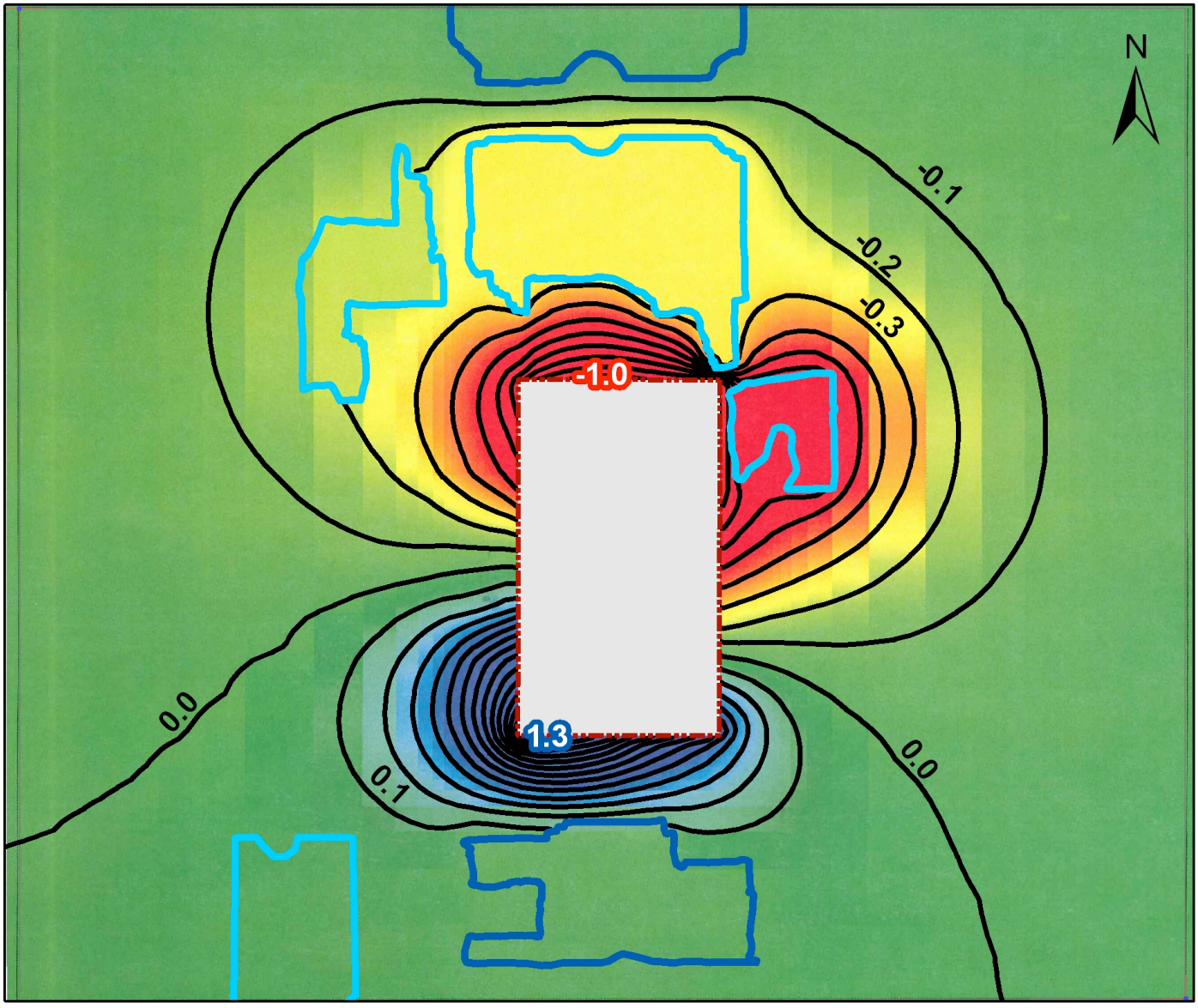
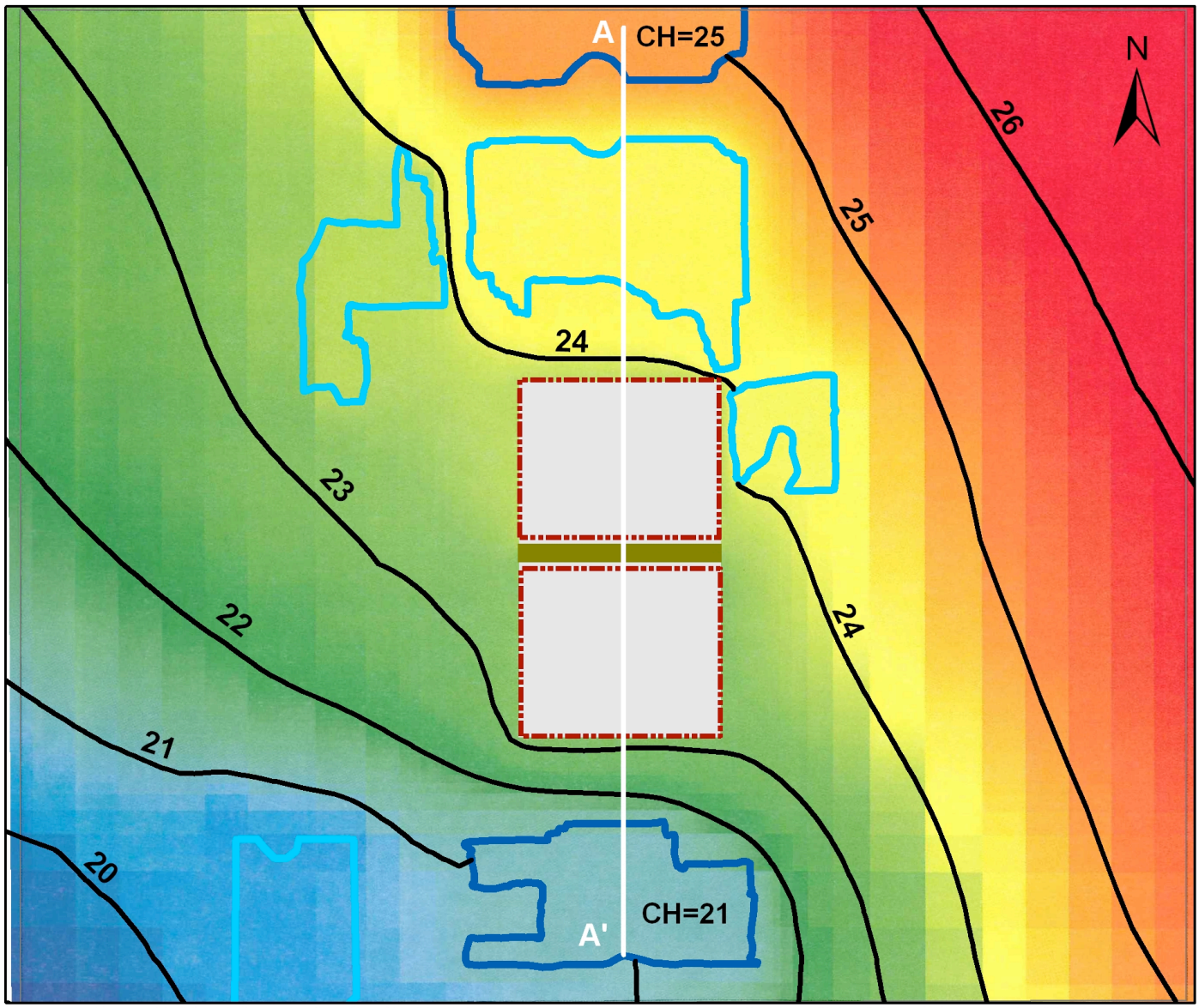


Figure 4.6: Simulated Contours of Water Level Changes for Scenario 1



Legend

Simulated Groundwater Contour, Feet NAVD88

Proposed Mine Lake with 300' Native Aquifer Terrace

Simulated Constant Head (CH) Mine Lake

Selected Simulated Mine Lake

0 0.25 0.5 1

Scale in Miles

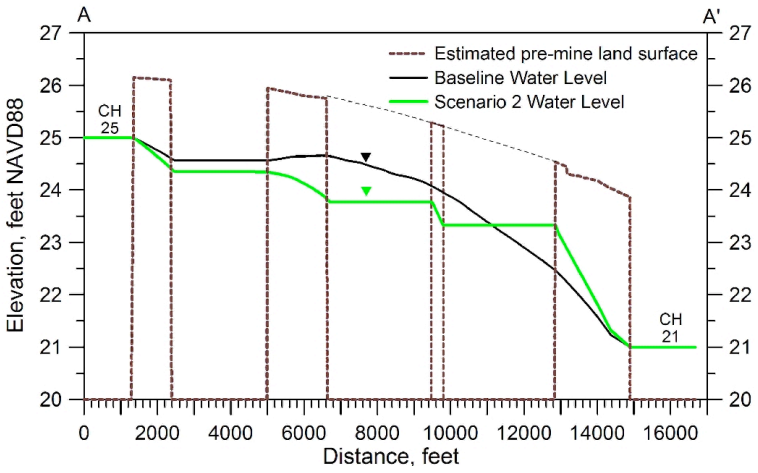


Figure 4.7: Simulated Contours and Water Level Profiles of Groundwater Elevation for Scenario 2

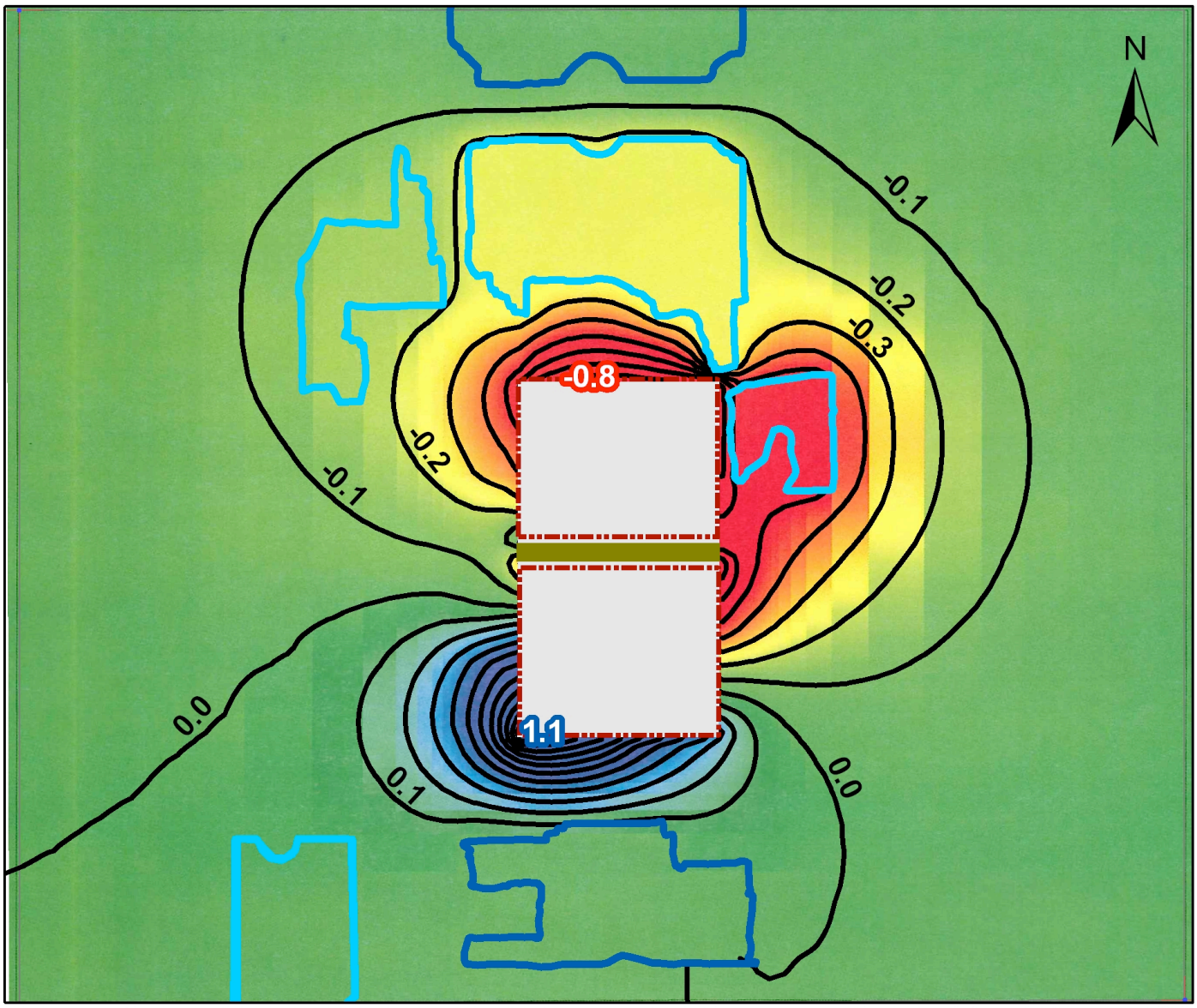


Figure 4.8: Simulated Contours of Water Level Changes for Scenario 2

Scenario 3 Results

In Scenario 3, the native aquifer terrace in the proposed mine lake in Scenario 2 was replaced by a slurry wall in a 25-foot-wide terrace (see Figure 4.3). The effective hydraulic conductivity of the slurry wall is 0.05 feet/day, which effectively eliminates groundwater flow through the barrier. Scenario 3 was used to evaluate the potential of an engineered slurry wall to minimize water level changes caused by proposed mine lakes. Figure 4.9 is a color map of groundwater levels for Scenario 3 with 1-foot contour intervals. The difference in water level between the northern and southern portions of the proposed mine lake shown on the profile graph is now 1.17 feet, which is 2.6 times larger than the simulated head difference across the two proposed mine lakes with a native aquifer terrace simulated in Scenario 2. Notice that groundwater flow occurs from the northern proposed mine lake around the slurry wall back into the southern proposed mine lake. This flow pattern was not apparent in Scenario 2.

Scenario 3 water levels were compared to those from the baseline simulation to determine the water level changes due to the proposed mine lake divided by a slurry wall. A color map of water level changes with contours of water level changes is shown on Figure 4.10. With the incorporation of the slurry wall, the simulated water level changes caused at the northern and southern end of the proposed mine lakes are generally less than simulated in Scenarios 1 and 2. However, water level declines east of the proposed mine lake, including the simulated mine lake to the east, have expanded over a larger area. Figure 4.10 does illustrate the effect that an existing nearby lake (like the one at the northeast corner of the proposed mine lake) has on reducing water level impacts when those lakes are close enough to act as hydraulic boundaries.

Scenario 4 Results

Based on the results of Scenario 3, a modified slurry wall concept incorporating an additional slurry wall along the eastern edge of the southern half of proposed mine lake was simulated in Scenario 4 (see Figure 4.3). Scenario 4 was used to evaluate the potential of the more than one slurry wall to minimize water level changes caused by the proposed mine lake. Figure 4.11 is a color map of groundwater levels for Scenario 4 with 1-foot contour intervals. As shown on the profile graph, the water level in the northern half of the proposed mine lake is now 1.91 feet higher than the water level in the southern half of the proposed mine lake, which is approximately 1.6 times larger than the simulated head difference across the single slurry wall simulated in Scenario 3. The addition of the slurry wall along the eastern side of the southern half of the proposed mine lake reduced the quantity of groundwater flowing into the southern proposed mine lake, thus lowering its simulated water level.

Scenario 4 water levels were compared to those from the baseline simulation to determine the water level changes due to the proposed mine lake divided by a slurry wall and the southern half of the proposed mine lake bordered by a slurry wall to the east. A color map of water level changes with contours of water level changes is shown on Figure 4.12. As shown in Figure 4.12, placing a second slurry wall along the eastern edge of the southern proposed mine lake decreases the water level declines east of the southern mine lake and lessens the water level declines east of the northern proposed mine lake. However, water levels now decline greater than 1 foot on the western side of the southern proposed mine lake. The simulated water level in the southern proposed mine lake experiences a greater lowering of water levels due to reducing the inflow of groundwater along the eastern side of this proposed mine lake.

Scenario 5 Results

In Scenario 5, the proposed mine lake was completely surrounded by a simulated slurry wall (see Figure 4.3). The simulated slurry wall represents an encapsulating hydraulic barrier extending to the full depth of the WTA (model layers 1 and 2). Scenario 5 was used to evaluate the potential of an encapsulating engineered slurry wall to minimize water level changes caused by the proposed mine lake. Figure 4.13 is a color map of groundwater levels for Scenario 5 with 1-foot contour intervals. As shown on the profile graph, groundwater levels south of the proposed mine lake are lower than the baseline water levels because up-gradient groundwater inflow has been cut off. The simulated encapsulating slurry wall prevents normal groundwater flow and hydraulically isolates the proposed 500-acre mine lake from the groundwater system. The simulated water level in the proposed mine lake was approximately six to seven feet lower than the surrounding groundwater levels. This lower lake level determined by the model allowed enough groundwater to flow through the simulated low permeability slurry wall to balance the difference between simulated lake evaporation and rainfall.

Scenario 5 water levels were compared to those from the baseline simulation to determine the water level changes due to a proposed encapsulating slurry wall around the proposed mine lake. A color map of water level changes with contours of water level changes is shown on Figure 4.14. The encapsulating slurry wall causes changes in down-gradient groundwater levels south and west of the proposed mine lake, which is the opposite effect of a lake without encapsulating slurry walls. As shown in Figure 4.14, an encapsulating slurry wall causes a small increase in groundwater levels on the eastern (up-gradient) side (0.2 feet) of the proposed mine lake and causes declines in groundwater levels of approximately 0.5 feet and more around the southern and western sides of the proposed mine lake. The extent of the decline in water levels south of the proposed mine lake is reduced by the fixed heads set in the simulated mine lake to the south.

Analysis of Proposed Mine Lake Water Level Profiles

SDI utilized the proposed mine lake to assess the differences between different widths of a native aquifer terrace and an engineered slurry wall. Figure 4.15 is a profile of simulated water levels through the proposed mine lake illustrating these differences. Plotted on Figure 4.15 are the baseline water levels and the simulated water levels from Scenario 2 (a 300-foot wide native aquifer terrace) and Scenario 3 (an engineered slurry wall). The slurry wall resulted in a greater water level difference between the northern and southern portions of the proposed mine lake, with a small reduction in water levels changes.

An evaluation was made to determine what width of a native aquifer terrace would yield results similar to the engineered slurry wall. Testing indicated that a 1,500-foot wide native aquifer terrace would yield similar water level results, which are also plotted on Figure 4.15.

Ranking of Scenarios Evaluated

The evaluations of the various scenarios described in the previous sections have been based on a comparison of water level changes from the baseline scenario. An additional evaluation criterion was made using the area adjacent to the proposed mine lake where the simulated water level changes exceeded 0.25 feet of water level decline. The 0.25-foot water level decline criterion was developed in conjunction with other members of the DKP project team. The 0.25-foot decline is considered a reasonable indicator of non-cumulative potential impact, and its use herein is not intended to imply any water level declines less than 0.25 feet may be acceptable. That decision is a regulatory decision, which is outside the scope of this study.

The area evaluation was conducted in GIS using the simulated water level changes determined for each scenario. The approximate area of the proposed mine lake(s) was subtracted from the total area inside the 0.25-foot water level decline contour. The results of this evaluation are provided in Table 4.1.

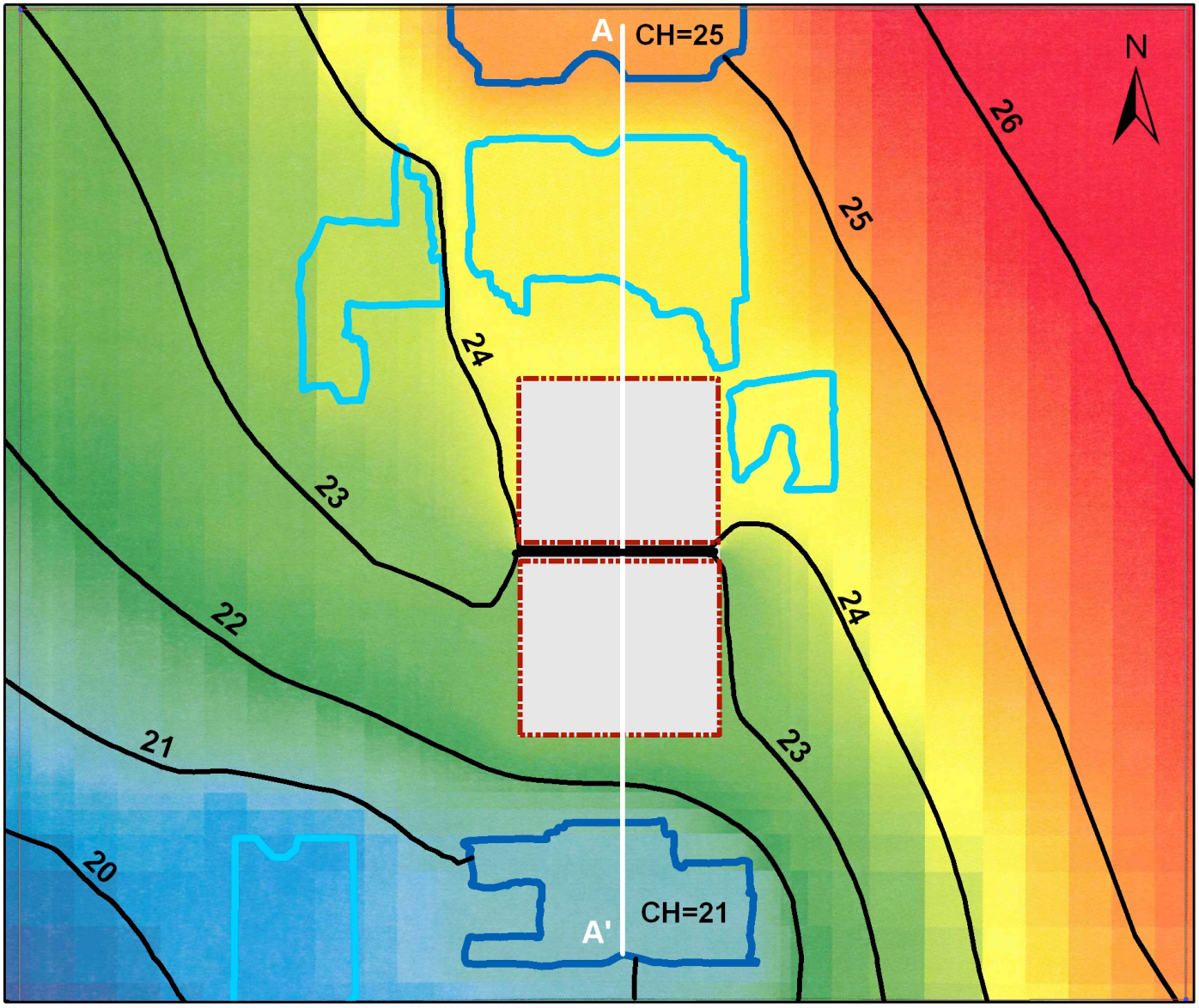
Table 4.1: Relative Areas of Non-Cumulative Potential Impact Using Water Level Criterion

Scenario Description	Area Mined (Ac)	Land Area[1] With Water Level Decline Exceeding 0.25 Feet. (Ac)
1. Proposed Mine Lake	~ 500	~ 655
2. 300-foot Native Aquifer Terrace	~ 475	~ 510
3. Slurry Wall	~ 475	~ 360
4. L-Shaped Slurry Wall	~ 475	~ 145
5. Encapsulating Slurry Wall	~ 500	~ 340
1,500-foot Native Aquifer Terrace	~ 375	~ 460

[1] Excludes area of adjacent mine lake(s) with water level declines exceeding 0.25 feet.

The results shown in Table 4.1 can be used with the water level change contour maps presented for each scenario to develop a relative ranking of the selected innovative mining concepts. Scenario 1 has the greatest potential impact, followed by the scenarios with a native aquifer terrace. The scenarios with an engineered slurry wall tend to have less simulated impacts; however, the slurry wall simulations are dependent upon the hydraulic conductivity assigned to the slurry wall. It was beyond the scope of this study to conduct sensitivity testing of the slurry wall hydraulic conductivity.

Other factors not considered in the relative ranking of the scenarios are the locations of any adjacent surface water features or adjacent water users that would affect an actual impact methodology analysis.



Legend

Simulated Groundwater Contour, Feet NAVD88

Proposed Mine Lake with Mid-lake Slurry Wall

Simulated Constant Head (CH) Mine Lake

Selected Simulated Mine Lake

0 0.2 0.4 0.8

Scale in Miles

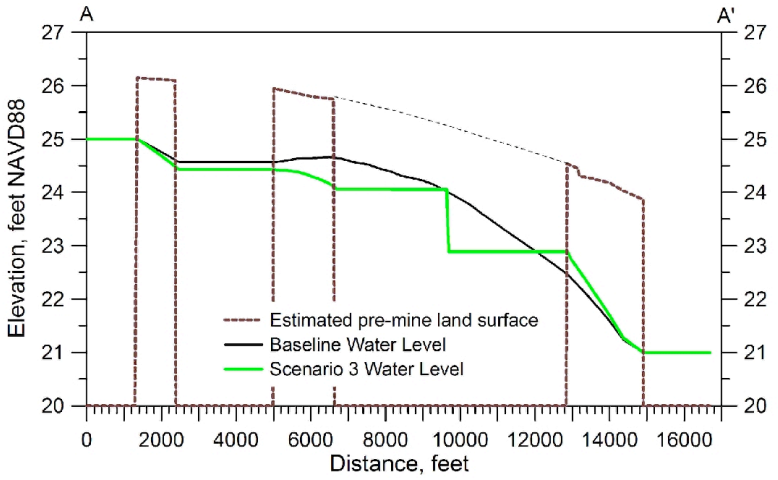


Figure 4.9: Simulated Contours and Water Level Profiles of Groundwater Elevation for Scenario 3

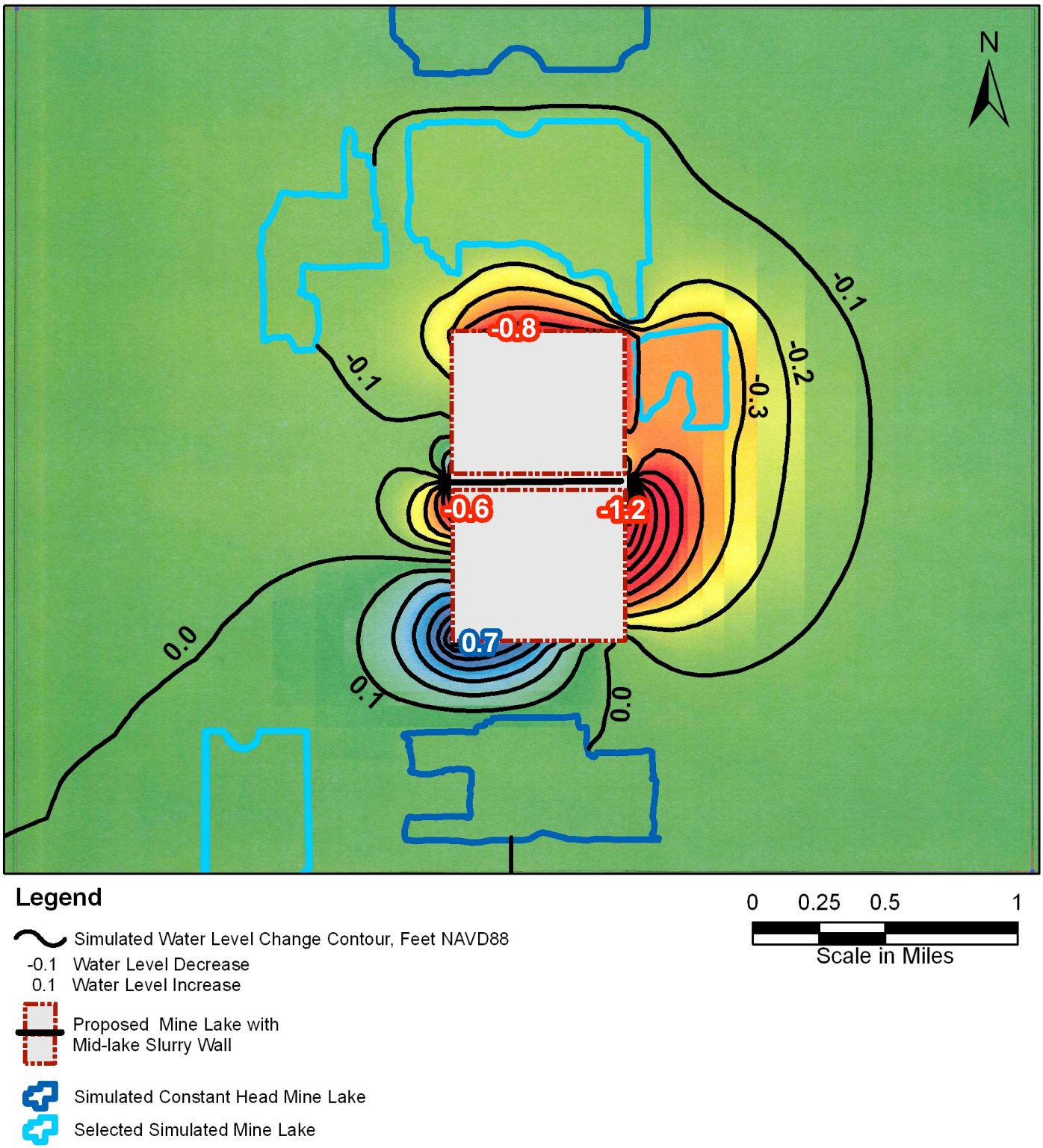
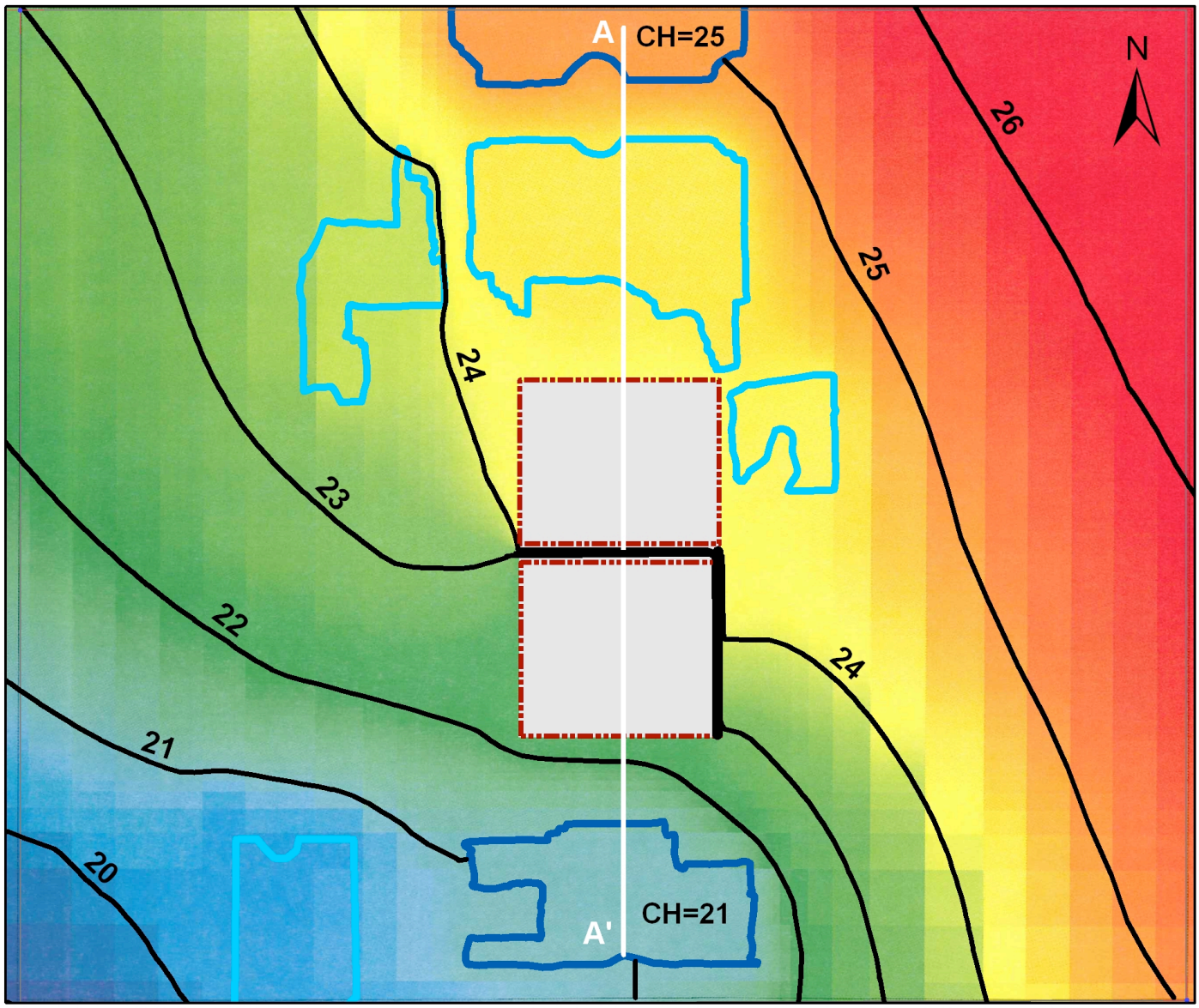


Figure 4.10: Simulated Contours of Water Level Changes for Scenario 3



Legend

Simulated Groundwater Contour, Feet NAVD88

Proposed Mine Lake with L Shape Slurry Wall

Simulated Constant Head (CH) Mine Lake

Selected Simulated Mine Lake

0 0.25 0.5 1

Scale in Miles

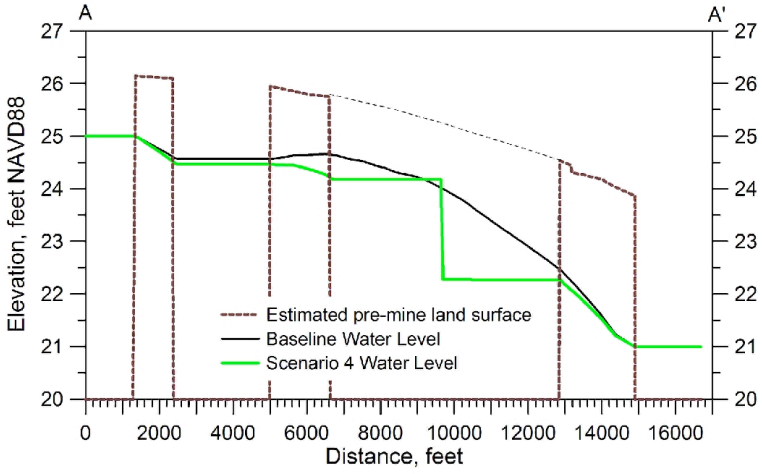
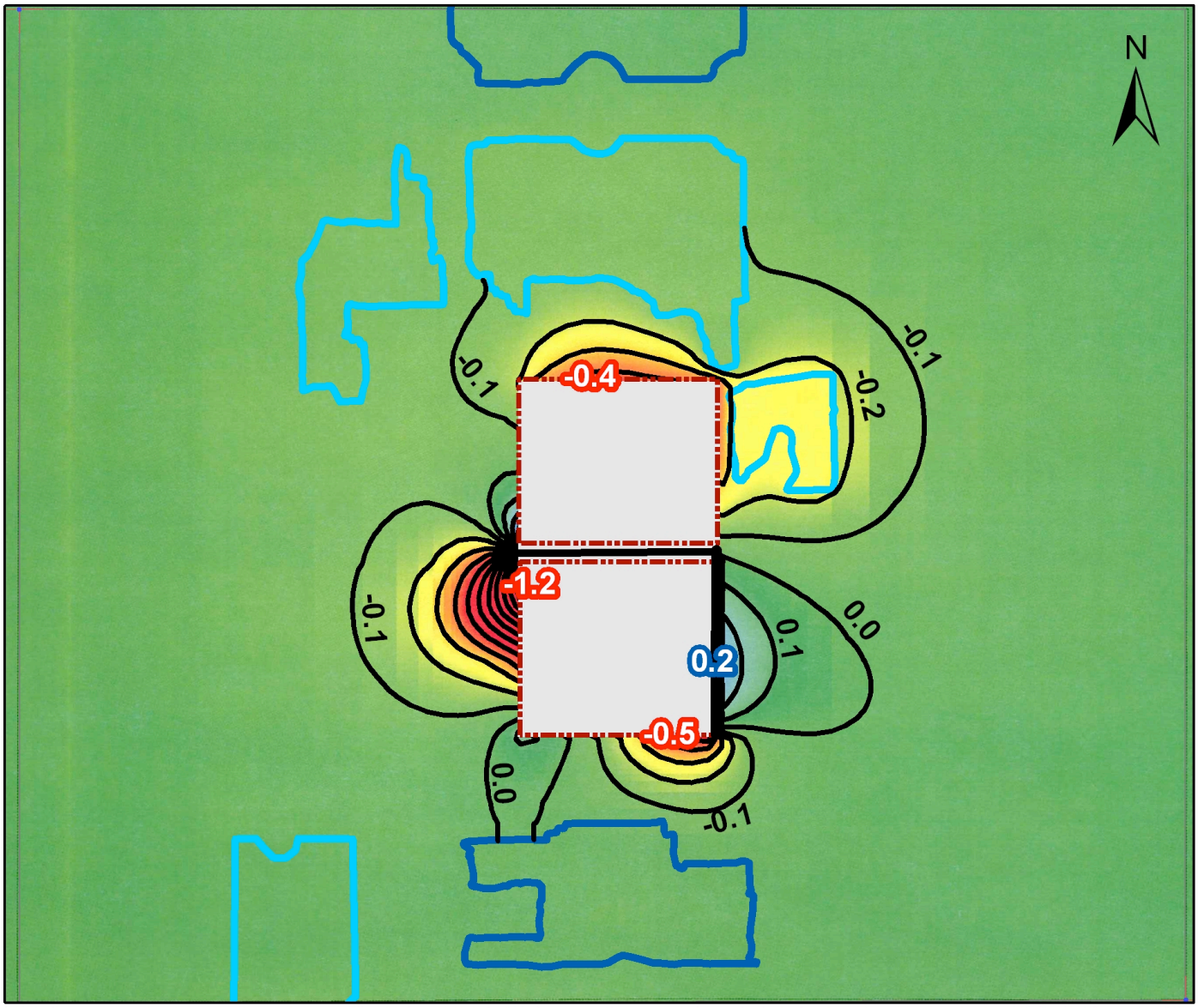


Figure 4.11: Simulated Contours and Water Level Profiles of Groundwater Elevation for Scenario 4



Legend

Simulated Water Level Change Contour, Feet NAVD88
-0.1 Water Level Decrease
0.1 Water Level Increase

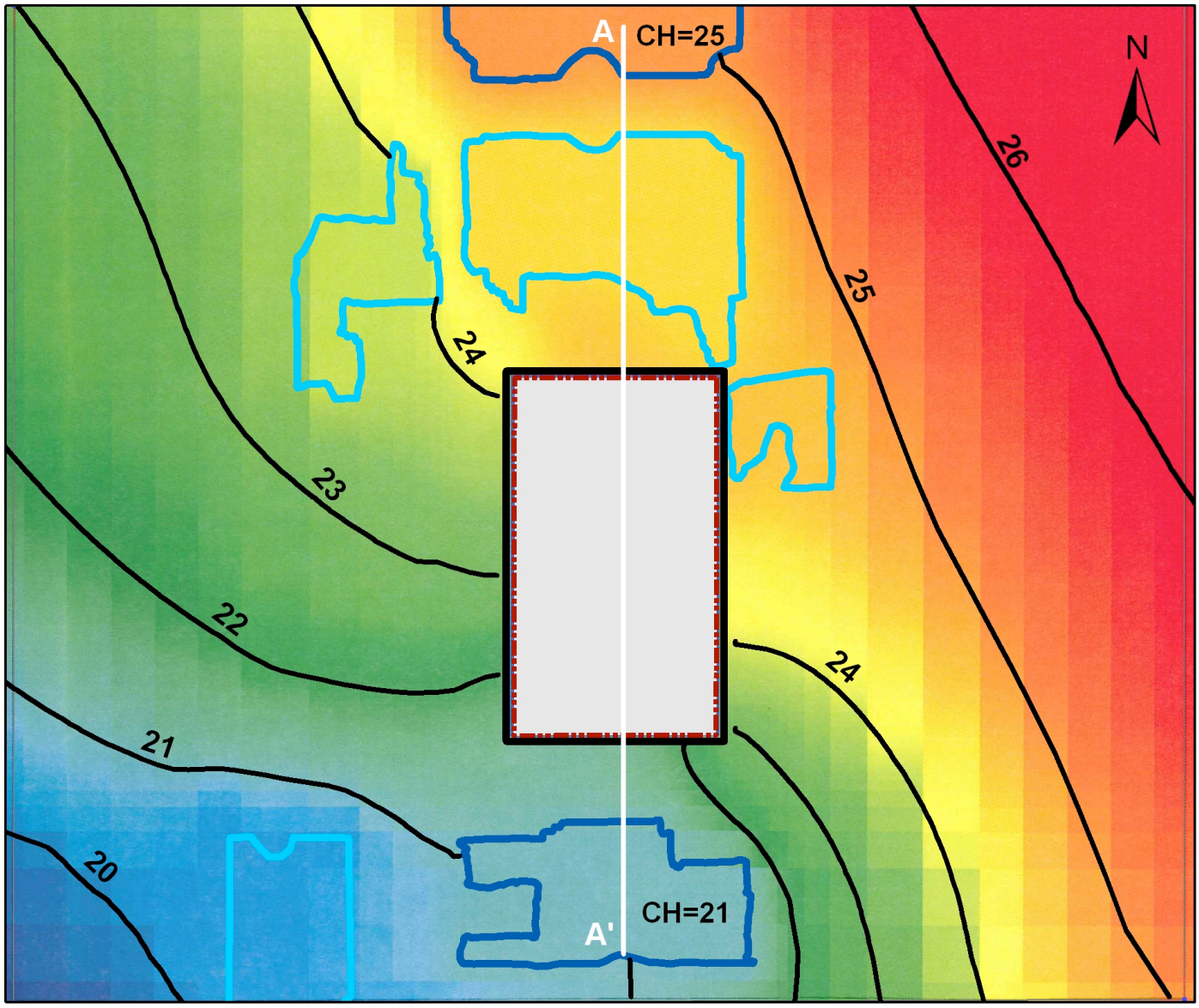
Proposed Mine Lake with L Shape Slurry Wall

Simulated Constant Head Mine Lake

Selected Simulated Mine Lake

0 0.25 0.5 1
Scale in Miles

Figure 4.12: Simulated Contours of Water Level Changes for Scenario 4



Legend

Simulated Groundwater Contour, Feet NAVD88

Proposed Mine Lake with Encapsulating Slurry Wall

Simulated Constant Head (CH) Mine Lake

Selected Simulated Mine Lake

0 0.25 0.5 1

Scale in Miles

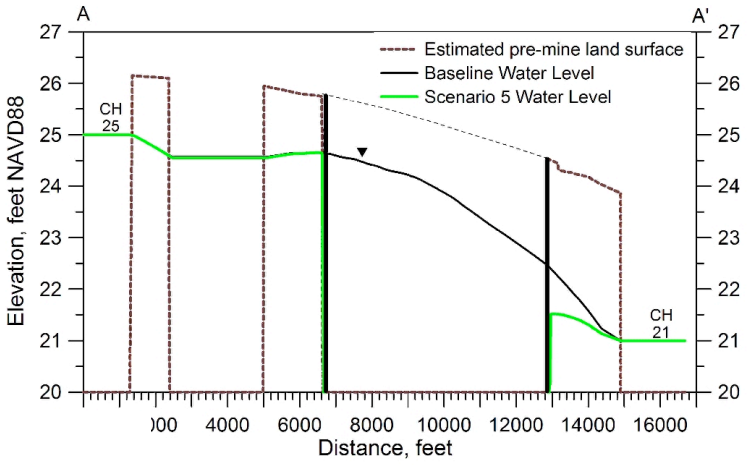


Figure 4.13: Simulated Contours and Water Level Profiles of Groundwater Elevation for Scenario 5

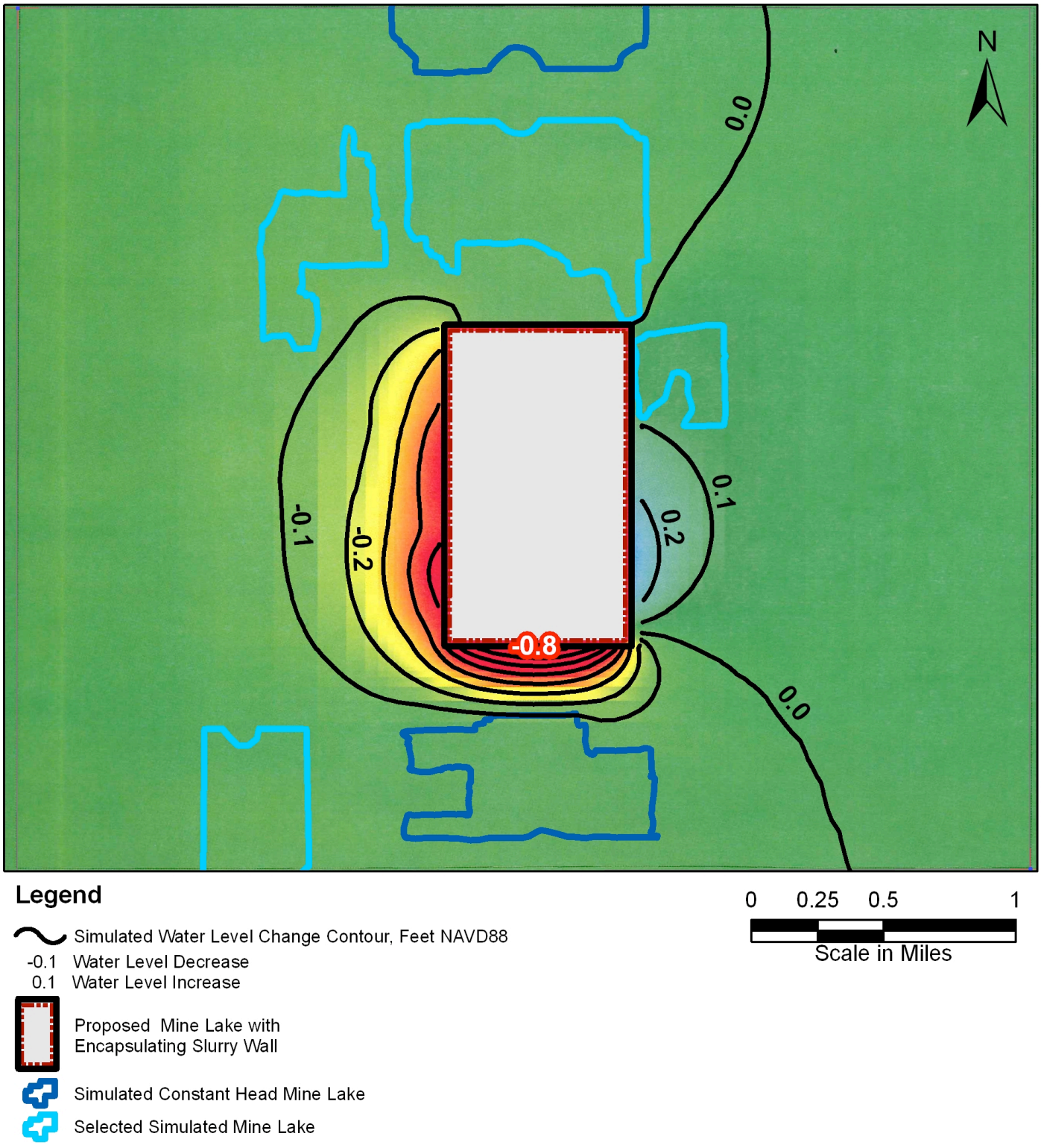


Figure 4.14: Simulated Contours of Water Level Changes for Scenario 5

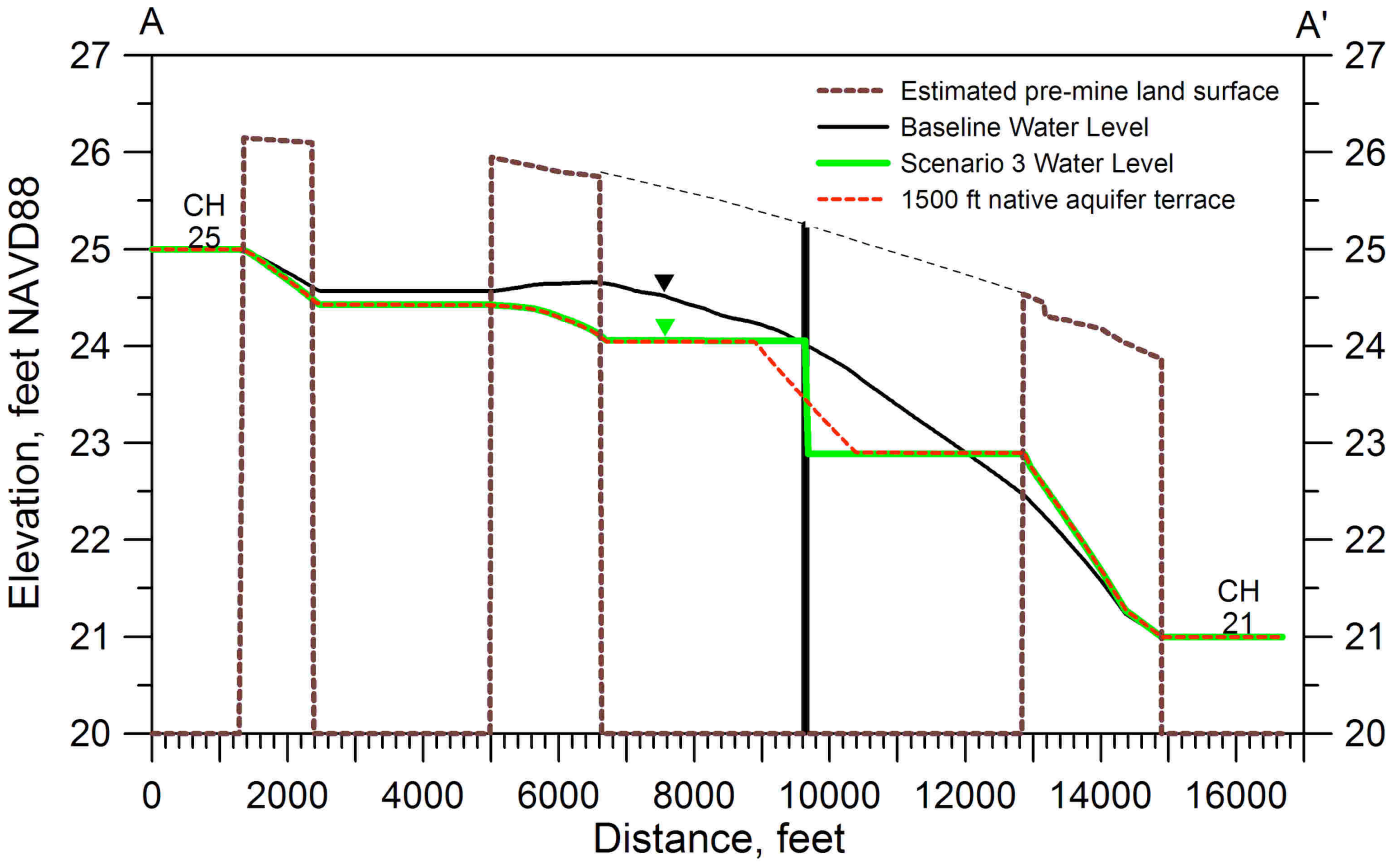


Figure 4.15: Profile of Groundwater Levels Comparing 1,500-foot-wide Native Aquifer Terrace versus Slurry Wall

Summary of Findings

SDI used a MODFLOW groundwater model to investigate and assess the relative hydrological value of innovative mining concepts that have been suggested to help minimize the effects of mining operations on groundwater levels in the DR/GR area of Lee County. Native aquifer terraces and engineered slurry walls were simulated in five scenarios to evaluate their effectiveness in mitigating groundwater level changes induced by mine lakes. The following summarizes the results of the groundwater modeling.

- Innovative mining concepts could be beneficial in mitigating groundwater level changes caused by mine lakes; however, the simulations conducted indicate a need to assess the concepts on a case-by-case basis. The extent and magnitude of groundwater level changes caused by proposed mine lakes are dependent upon (1) the existing pre-mine groundwater gradient, (2) the size and shape of the proposed mine lake, (3) the orientation of the proposed mine lake relative to the local groundwater gradient, and (4) the size and proximity of surrounding water bodies.

- An engineered hydraulic barrier of low permeability (i.e., a slurry wall) incorporated into or around proposed mine lakes will increase water levels on the up-gradient side and decrease water levels on the down-gradient side of the barrier. Fully encapsulating slurry walls cause groundwater level declines in the down-gradient direction.

- Hydraulic barriers may help mitigate some undesirable water level changes near a proposed mine lake, but their effectiveness is heavily dependent on location and engineered properties. Improperly located hydraulic barriers may aggravate undesirable water level changes caused by proposed mine lakes, particularly if significant groundwater pumping occurs nearby. Nearby groundwater pumping was not evaluated as part of this study, nor was any surface water pumping associated with mining activities from the mine lakes.

- Distances from a proposed mine lake that water level changes might occur are dependent upon aquifer properties and surrounding water bodies. Multiple mine lakes, either existing or proposed, can have cumulative water level changes. Evaluating such cumulative changes are beyond the scope of this study.

- Native aquifer materials in the DR/GR area are relatively permeable and, in narrow widths, are only moderately effective as a hydraulic barrier to the movement of groundwater between mine lakes. This study indicated, that for the conditions simulated, a native aquifer terrace width of 1,500 feet would be required to have a hydraulic effect similar to the engineered slurry wall simulated. What type of 'innovative' mining concept is best would need to be evaluated on a case-by-case basis.

Innovative mining concepts may be beneficial in reducing groundwater level changes caused by proposed mine lakes; however, their use may have unintended consequences unless these concepts are carefully designed for each individual proposed mine lake and its unique surroundings. Proper design may allow groundwater levels to be maintained or even increased in a particular area of interest, such as a nearby wetland. None of the innovative mining concepts evaluated preclude the occurrence of lower water levels in some portions of the surrounding environment. SDI believes that the use of a site-specific groundwater flow model would be required to properly evaluate the design and placement of any innovative mining concepts. However, a site-specific groundwater flow model would not likely be the preferable tool to address the issue of regional cumulative impacts nor any transient changes due to climatic or pumping variations.

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Ecological Review of Lee County's Land Development Code Chapter 12: Resource Extraction

5

Introduction

Kevin L Erwin Consulting Ecologist, Inc. (KLECE) was contracted by Dover, Kohl & Partners (DKP) to review Lee County's current mining regulations, which were extensively amended in 2008 and are now compiled in Chapter 12 (Resource Extraction) of the Land Development Code.

This review focuses on ecological issues, with special attention given to groundwater impacts. This review also evaluated mine pit reclamation requirements for consistency with *Prospects for Southeast Lee County* (Dover, Kohl & Partners, 2008).

This chapter recommends changes to Lee County's mining regulations, including the addition of tables and figures to clarify the reclamation requirements.

Interconnected Mining Pits

LDC § 12-107(5) anticipates mining lakes being interconnected in the future. This section is based on Lee Plan Policy 10.1.5, which was originally written in 1999 and then amended in 2002.

Recent research, such as the modeling described in Chapter 4 of this report, describes how large mining pits can affect the water table aquifer.

Although the lands in the DR/GR appear flat, there is a natural sloping of the land generally from the northeast to the southwest, with a typical elevation change of about 1 foot per mile. However, there are locations where there are steeper slopes, such as the 8-foot gradient between T20-S46-R27 and T36-S46-R26 over about a mile in horizontal distance.

The natural water table typically follows the slope of the land. When the soil and rock are excavated for a mine, the water table is not maintained relative to the previous slope of the land, but instead levels off to a completely flat surface. Additionally, the removal of the sandy "overburden" and the excavation of the limerock below the sandy layer will change the dynamics of groundwater flow, lowering the ground water table especially on the upstream side of the mine pit.

If large mining pits are interconnected, they create even larger pits, magnifying the impacts on water resources, contrary to the overall goals of the Lee Plan to protect and enhance the DR/GR's water resources.

Another report in this series recommends that Lee Plan Policy 10.1.5 be amended to indicate that connecting mining lakes together should no longer be county policy:

POLICY 10.1.5: Lee County will support efforts by government, community leaders, and the extractive industry owners and businesses to ~~seek incentives that will help to facilitate the connection of natural resource extraction borrow lake excavations~~ incorporate reclaimed mining pits into a comprehensive and coordinated effort of county and regional agencies to ~~system of interconnected lakes and flowways that will~~ enhance wildlife habitat values, minimize or repair the long-term impacts to adjoining natural systems, provide for human recreation, education~~al~~, and other appropriate uses, and/or strengthen community environmental benefits.

To carry out this policy revision, § 12-107(5) of the Land Development Code needs to be amended.

Sec. 12-107. Lee Plan Consistency

(5) Mining activities and reclamation efforts must ~~facilitate the connection of natural resource extraction lakes and borrow lake excavations~~ incorporate reclaimed mining pits into a comprehensive and coordinated effort of county and regional agencies to ~~system of interconnected lakes and flowways that will~~ enhance wildlife habitat values, minimize or repair the long-term impacts to adjoining natural systems, and strengthen community and environmental benefits.

Site Design Requirements

The Land Development Code's design standards currently require mining operations to be located, designed, and operated to maintain minimum surface and groundwater levels within the site boundaries as deemed appropriate by Natural Resources staff during the MEPD rezoning process.

This requirement should also include the Environmental Sciences staff because the Natural Resources staff focuses on groundwater quantity and quality whereas the Environmental Sciences staff focuses on the protection of native habitats including wetlands. It is important to consider these water levels in relation to sustaining and enhancing the wetland resources.

Sec. 12-113. Site Design Requirements

(b) Mining operations must be located, designed and operated to:

(11) Maintain minimum surface and ground water levels within the site boundaries as deemed appropriate by Natural Resources and Environmental Sciences staff during the MEPD approval process.

Water Quality and Quantity

LDC § 12-117 sets forth requirements for water quality and quantity baseline analysis and monitoring to insure the protection of water resources. Minor but important revisions are recommended below for this section of the code.

The code currently requires the submittal of topographic data but does not require the information to be submitted in a suitable electronic format. Receiving the topographic data in an electronic format will allow the data to be incorporated into regional and local surface and groundwater models.

In the recent past, electronic water level monitors in southeast Lee County have performed erratically. It is important that any faulty meter be replaced in a timely manner to insure the continuity in the water level data for analysis. It is also important to have manually read piezometer monitoring wells in close proximity to the continuous monitors in order to take readings documenting the water level once a month with the time noted as part of quality control and assurance. If the continuous monitor readings are off, then the manually read wells can be used to calibrate the data collected on electronic meters.

Sec. 12-117. Water Quality and Quantity Issues

(a) Application submittal information and standards.

(6) Topography contours. Detailed topography of the site showing one-foot contours based upon NAVD 1988 datum, with sufficient data points to support these contours in accordance with professional land surveying and mapping standards; cross-sections (on an x – y axis) of all state and federal jurisdictional wetlands at sufficient intervals to represent the hydrologic flows and storage within the wetlands, extending a minimum of 200 feet into the adjacent uplands; and cross-sections of all ditches within and immediately adjacent to the site. The topographic data must be submitted in both hard copy and an electronic format acceptable to the Division of Natural Resources, the managers of the county's regional integrated surface and groundwater model.

(d) Monitoring.

(3) Water level monitoring

a. Groundwater wells. A pair of wells consisting of one well constructed to the bottom of the unconsolidated formation or top of confining unit that supersedes the aquifer that is being mined. The applicant must construct a pair of wells for every 2500 feet of mine bank to be created. Each well must be fitted with an electronic data logger that is capable of taking and recording a measurement every six hours.

b. Surface water. Two staff gauges must be installed in each mine cell or area to monitor surface water levels at the lowest and the highest preconstruction grade elevations. Each gauge must be fitted with an electronic data logger capable of taking and recording measurements every six hours.

c. Water level data. The data must be gathered on a monthly basis with 25 percent of the wells being read manually for the purposes of redundancy and calibration. Any problems with the electronic meters must be reported to the county and the meters replaced to insure continuity and accuracy of the data. The surface and groundwater data must submitted in an electronic data base format acceptable to the Division of Natural Resources staff, which maintains water level data for the county.

Sec. 12-118. Monitoring Requirements. Inspections

(c) Monitoring reports. Monitoring reports must be submitted in accord with this section unless the MEPD resolution conditions provide otherwise.

(1) Water quality and quantity.

Reclamation Requirements

KLECE staff reviewed the mining reclamation standards in Chapter 12 of the Lee County Land Development Code. These standards were also reviewed for consistency with the recommendations in the *Prospects for Southeast Lee County* report. The following recommended amendments to Chapter 12 Section 12-119 include new tables and figures to clarify the created marsh littoral design requirements.

Sec. 12-119. Reclamation Requirements

(b) Reclamation Standards. Mining operations will be subject to the following reclamation standards to insure long term plans to sustain or improve the baseline water quality as well as sustain fish and wildlife. The Board of County Commissioners may modify these standards as a condition of approval when in the public interest, or where they determine a particular requirement unnecessary due to unusual circumstances. These conditions are not intended to conflict with the wetland permitting requirements of the U.S. Army Corps of Engineers, Florida Department of Environmental Protection or South Florida Water Management District.

(1) Littoral Area Design. In order to maximize the ecological benefits of reclaimed mine pit shorelines, the following features should be included in designs for littoral areas:

a. *Non-linear form*
b. *Varying water depths with foraging pockets created for low water levels*
c. *Some open sand substrate*
d. *Diversity of plant species, including wetland trees, shrubs, and herbaceous species*
e. *Re-use of native soil*
f. *Control of exotic and nuisance species (<1% cover maintained)*
g. *Erosion control measures along the interface with the mine pit lake*

(2) All Mining Operations Must Meet the Following Standards:

a. ~~(1)~~ All disturbed areas of the mine site including the top of lake banks must be stabilized with native plants, sod or grass seeding at the completion of mining or completion of a separate mining cell or area.

b. ~~(2)~~ Reclamation must be completed along the perimeter of the excavation and within the excavated lake including a littoral zone composed of created wetlands to improve water quality and create wildlife habitat. The minimum area and width of the littoral zone is stated in Table 1. The created wetlands may be evenly distributed around the lake or clustered, providing for flexibility in design (Figures 5.1A through 5.1C).

c. The minimum number of native wetland plants species is listed in Table 1.

d. Each native wetland plant species planted in a created wetland littoral zone must comprise no less than 5% or more than 25% of all plants.

e. ~~(3)~~ The entire created wetland littoral zone must be planted with native herbaceous wetland species (3' on center). In addition, 10 percent of the created wetland littoral zone must consist of native wetland shrubs (10' on center) and native wetland trees (25' on center).

f. ~~(4)~~ Created littoral zone native wetland plants must meet or exceed the following standards: Herbaceous plants bare root; shrubs 12" in height; and, trees 3' in height.

g. ~~(5)~~ The created wetland littoral zone must be designed with an appropriate slope to provide a littoral shelf that reaches a depth of not less than -3.0 feet from control elevation or seasonal high water level (Figures 5.2A through 5.2B).

h. ~~(6)~~ 80 percent survival of herbaceous wetland plants, trees and shrubs must be met within five years of planting and maintained in perpetuity. The created littoral shelf must be maintained free of exotic or nuisance plant species in perpetuity.

i. ~~(7)~~ The mine reclamation required should be designed to compliment post mine uses. The created wetlands may be used as wetland impact mitigation required by federal-, or state ~~or water management district~~ permits.

j. ~~(8)~~ The created wetland littoral zone areas must be protected from impacts during and after mining. If the agricultural use of livestock is ~~intended~~ an approved use during or post mining ~~post mine use~~, adequate fencing must be installed to protect the created littoral zone from livestock damage.

k. ~~(9)~~ If appropriate, organic soils (muck) must be excavated from impacted wetlands on the site and placed in the created littoral zone wetland areas. The existing 'A' and 'B' soil horizons must be utilized to ensure successful wetland creation. The 'A' horizon must be stored in a manner that prevents the soil from oxidizing. The 'B' horizon may be stockpiled. The 'B' horizon will be placed over a base of sand with the 'A' horizon placed over the 'B' horizon during the reclamation process.

l. ~~(10)~~ The reclamation design must include varying depths within the created wetland littoral zone to provide foraging "pockets" for woodstorks and other wading birds as water levels recede.

m. ~~(11)~~ All spoil piles and stockpiles must be removed from the site or incorporated into the reclamation plan when the excavation is completed.

n. ~~(12)~~ A recorded Conservation Easement dedicated to the County and any other appropriate government organization for all indigenous preserves, indigenous replanting areas, preserved or restored flowways, buffers, wildlife habitat areas, and the created marsh wetland littoral shelf zone may be required as part of the reclamation.

(3) Deviations from the Reclamation Standards. Deviations from the reclamation standards may be requested through the Mine Excavation Planned Development process when:

(a.) There is a potential public safety hazard due the proximity of an existing airport to the mine excavation. In these cases the reclamation standards may be met through the use of steep rip-rap shorelines and submergent vegetation, or other appropriate designs.

(b.) The enhancement or restoration of a flow-way is deemed necessary or important to the watershed by staff. In these cases, the emphasis should be on enhancing or restoring the hydroperiod and vegetation within the flow-way in lieu of either eliminating or reducing the required amount of created wetland littoral zone within the mine pit.

Figure 5.1A: Littoral Zone Design

This figure depicts a 230-acre mine excavation area within an overall project area used for demonstrating example littoral zone areas.

MPED within the future limerock mining area must have at least 10% of the excavation area as littoral zone.

(230-acre excavation area = 23-acre littoral zone + 207-acre deep excavation area.)

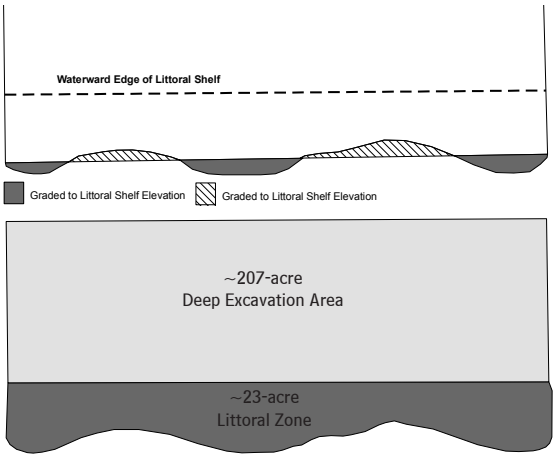

Figure 5.1B: Designing the Created Wetland Littoral Zone

This figure demonstrates how to design a meandering shoreline for the littoral zone as part of the mine excavation. The area left at grade within the 230-acre excavation area is offset by an equal amount of area graded to the littoral shelf elevation outside of the 230-acre excavation area. The waterward edge of the littoral zone is depicted as a straight line although it is understood that over time this edge will become variable or naturalized due to water movement and soil stabilization.

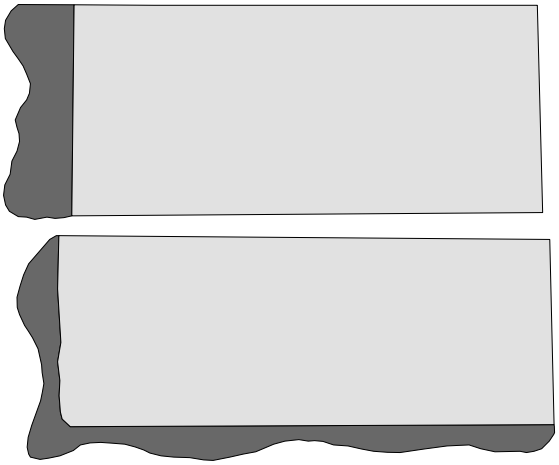

Figure 5.1C: Created Wetland Littoral Zone Design

A meandering created wetland littoral area with a minimum 100-foot width equivalent to 10% of the surface area of the mine pit is required. The design should be based upon the site-specific ecological conditions and the post mining use of the property. There are many options for designing the created wetland littoral area with two shown in this figure. The designs are based upon a 230-acre mine pit which would be required to provide 23 acres of created wetland.

Littoral Zone Deep Excavation Area

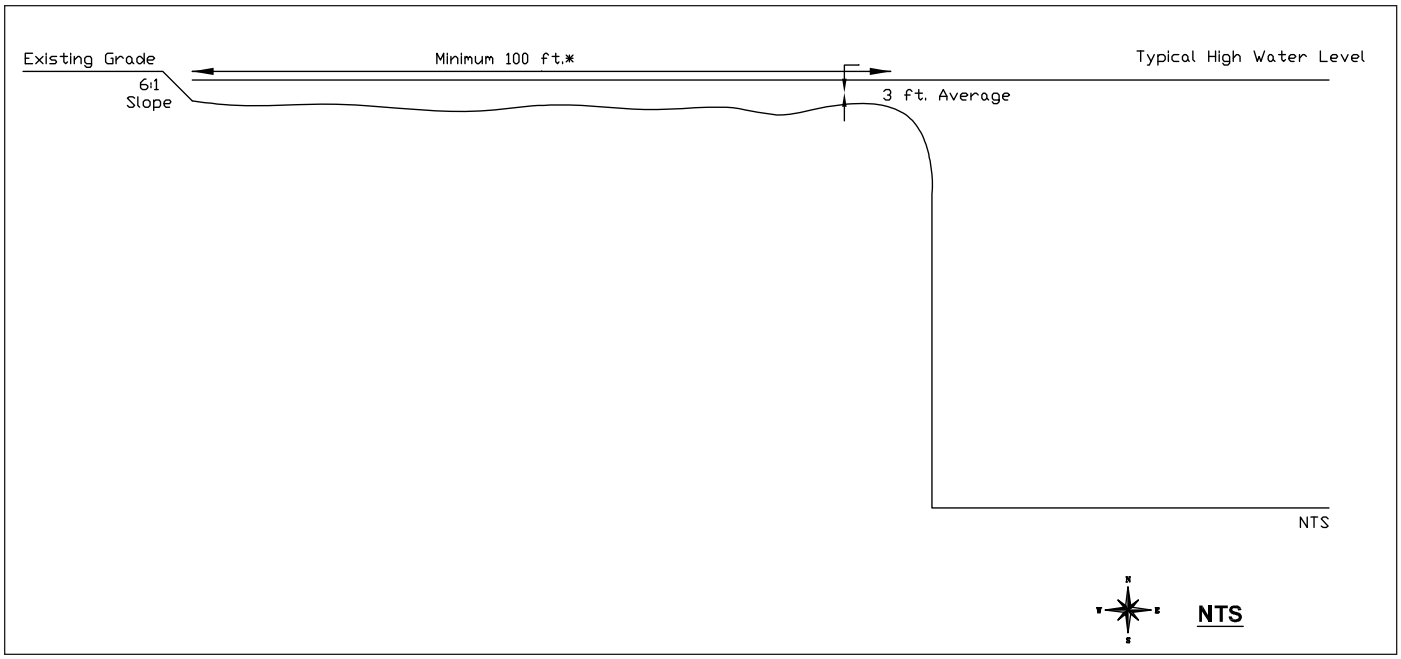

Figure 5.2A: Example littoral shelf design for created marsh area. This design incorporates a 6:1 slope to approximately 3 feet with varying water depths to create diversity and drawdown pools.

*Minimum 300 foot width on mine pits of 500-acres in size or larger.

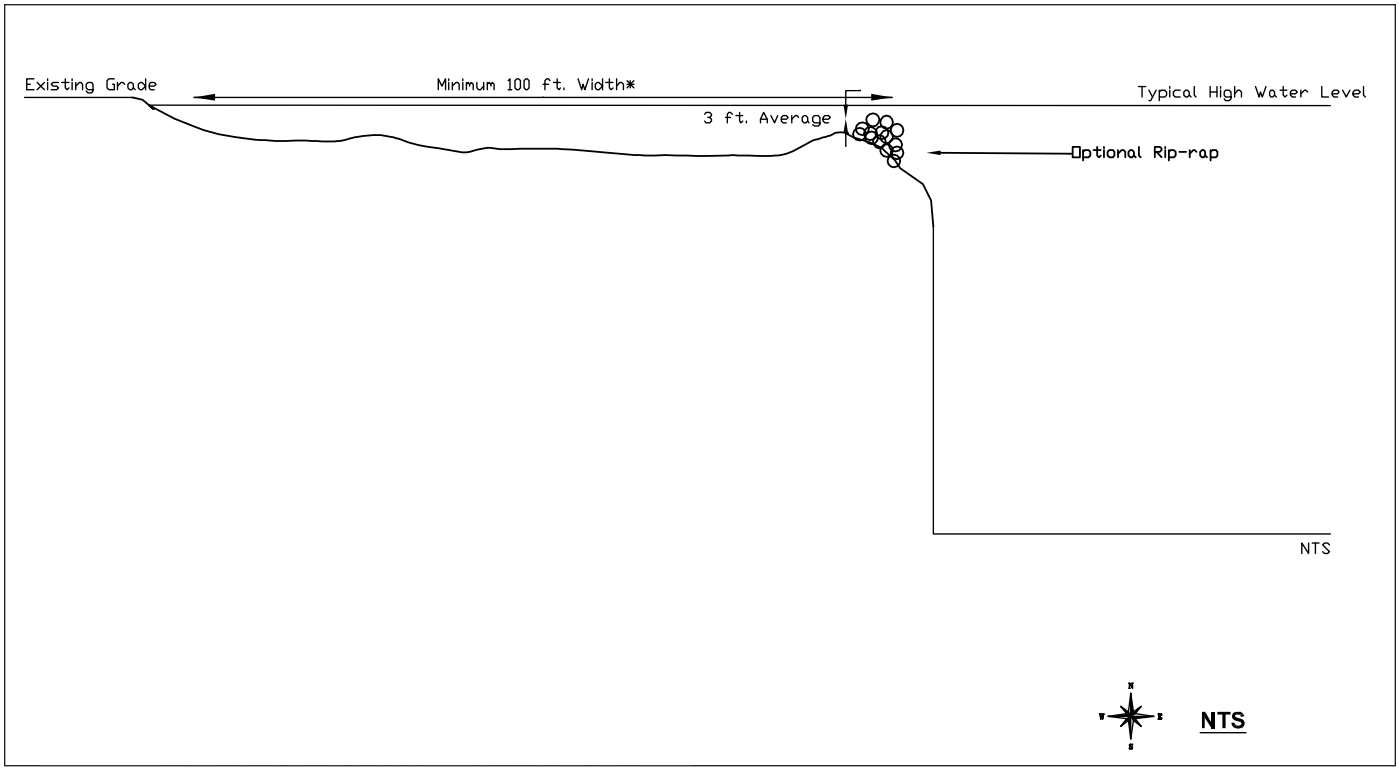

Figure 5.2B: Example littoral shelf design for created marsh area. This design incorporates 30 - 50% of the littoral shelf at a depth of 1.5 feet or less, and the remainder of the littoral shelf 2 - 3 feet, providing for a shallow marsh abutting the shoreline. The optional rip-rap increases substrate diversity, and may provide additional stabilization during low water levels.

*Minimum 300 foot width on mine pits of 500-acres in size or larger.

RECLAMATION STANDARDS TABLE	MEPD for Limerock Mines within Lee Plan's Future Limerock Mining Overlay	MEPD for Fill Dirt > 20-foot depth	MEPD for Fill Dirt 20-foot depth or less
Minimum Littoral Shelf Width	100 feet (mine footprint <500 acres) 300 feet (mine footprint >500 acres)	50 feet (mine footprint <50 acres) 100 feet (mine footprint >50 acres) 300 feet (mine footprint >500 acres)	25 feet (mine footprint <25 acres) 50 feet (mine footprint 25-50 acres) 100 feet (mine footprint >50 acres)
Minimum Percentage of Mine Surface Area (Footprint)	10%	25%	10% (mine footprint <25 acres) 25% (mine footprint >25 acres)
Minimum Number of Plant Species	6	15	6 (mine footprint <25 acres) 15 (mine footprint >25 acres)

Table 5.1: Reclamation Standards Table