

# **THE MANATEE AGRICULTURAL REUSE SYSTEM (MARS): EVALUATING A SUSTAINABLE COMMUNITY WATER SYSTEM IN MANATEE COUNTY, FLORIDA**

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## **ABSTRACT**

The State of Florida, like many states and nations around the world, will be facing critical choices regarding the future of its natural resources and economy in the next decade. Manatee County is one of eight (8) Florida counties included in the Southern Water Use Caution Area designated by the Southwest Florida Water Management District in 1992, indicating that the aquifer is under severe overuse. Manatee County is interconnecting three (3) regional wastewater treatment plants to provide a 32-mile distribution system for urban and agricultural irrigation needs called Manatee Agricultural Reuse System (MARS). The Florida West Coast Resource Conservation and Development (RC&D) Council has developed the MARS Farm Connection Grant Program to connect farmers to the main distribution line. One of the objectives of the MARS Farm Connection Grant Program is to evaluate the project both agronomically and economically. The methodology for the first phase of the project implementation was to inventory a variety of sustainability principles and properties of sustainable systems and qualitatively assess the program according to these criteria. The following sustainability principles and sustainable system properties were used in the evaluation: transfer of knowledge and education, public input and involvement, the precautionary principle, the proximity principle, equity, and other systems analysis properties. Overall, the development of an alternative water source for agricultural irrigation seems to have sustainable characteristics. Many people have been involved and have helped to create a joint vision of a successful reclaimed water delivery system, which has increased the potential for a sustainable solution.

## **KEYWORDS**

Reuse water, wastewater reuse, sustainability, reclaimed water, agriculture

## **INTRODUCTION**

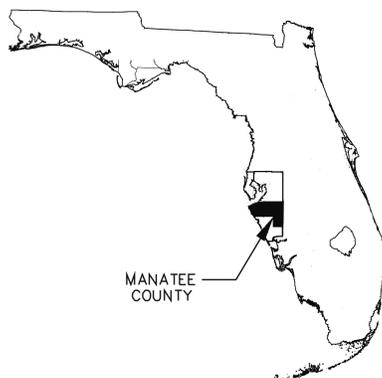
The State of Florida, like many states and nations around the world, will be facing critical choices regarding the future of its natural resources and economy in the next decade. Three interrelated factors are contributing to the urgency of this problem: water use patterns and aquifer depletion, an important agricultural economy, and immense population growth. Although Florida is not typically considered an arid state, there are many complex water resource issues, including areas in the state that have been identified as having water supplies that are at risk due to overuse. Florida ranks number 2 nationally in production of fresh vegetables with 2002 sales of \$1.4 billion and number 9 nationally in the value of farm products with \$6.85 billion in sales for 2002. Additionally, the U.S. Census Bureau reported in April of 2005 that current projections indicate Florida, California, and Texas will account for 46 percent of the total U.S. population

growth between 2000 and 2030, and that Florida will move from the fourth to the third most populous state, behind California and Texas. The Census Bureau also predicts that Florida will add more than 12 million people between 2000 and 2030.

The combination of water resources, food production, and population growth create an opportunity to document and evaluate a case study on sustainable water resources development in Manatee County, Florida. This case study is called the Manatee Agricultural Reuse System (MARS) Farm Connection Grant Program being implemented by the Florida West Coast Resource Conservation and Development (RC&D) Council.

The Florida West Coast RC&D Council is a local U.S. Department of Agriculture sponsored 501(c)(3) organization specializing in community leadership capacity building in the areas of sustainable economic and community development, natural resources use and conservation, and sustainable agriculture. The RC&D Area (Figure 1), authorized by the Secretary of Agriculture in 2001 includes Hillsborough, Manatee, Pinellas and Sarasota Counties, on the central southwest coast of Florida, serving a population of approximately 3 million people (Community Survey of the U.S. Census Bureau, 2003).

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Figure 1 – Location of Manatee County, Florida within the Florida West Coast Resource Conservation and Development (RC&D) Area

Sustainability has been at the core of the RC&D concept since the inception of the program by the Department of Agriculture in the 1960s when the USDA program was created to address rural poverty the United States. Assistance from USDA was provided to help local people build sustainable natural resource-based economies that would improve their quality of life. RC&D is very much like many community or economic development non-governmental organizations around the world, using natural resources, ingenuity, and partnerships to empower people to make their lives better.

involvement of the Florida West Coast RC&D Council in the MARS project has created an opportunity for partnerships, local economic development, and an evaluation of sustainability in an innovative program in Manatee County, Florida.

### **Sustainable Food and Water Balance**

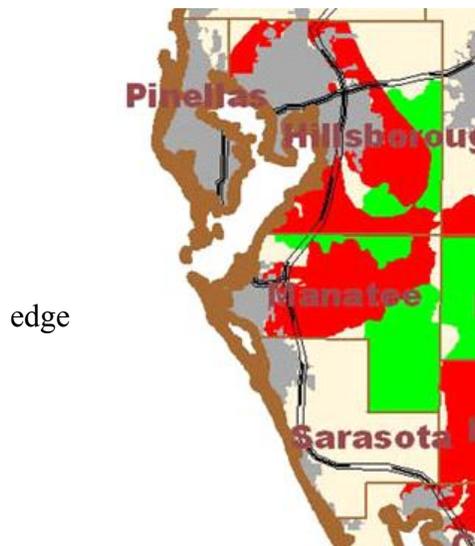
The Food and Agriculture Organization (FAO) of the United Nations has reported extensively on the relationship to food production and water resources (UNESCO, 2003). One trend that exists globally and at a local level in Manatee County, is that agriculture accounts for up to 70 percent of the world's water withdrawals from surface and groundwater. Up to 80 million gallons of water per day are pumped from the Floridan Aquifer for agricultural irrigation in Manatee County (approximately 85% of total usage) and an additional 12 million gallons are pumped per day for residential use. Irrigation efficiencies worldwide are approximately 40 percent, with 60 percent of the water drawn being lost to evaporation, deep infiltration, runoff, or weed growth.

Irrigation efficiencies in Manatee County vary widely depending on type of irrigation system, maintenance of the system, and the commitment to irrigation water management to maximize the system's efficiency.

Across a worldwide scale, food production equals consumption. For countries, states, and smaller units such as counties, townships or boroughs, production and consumption are typically not in balance due to market conditions, and the ability to cheaply transport food and agronomic supplies over large distances. For example, in Manatee County, nearly all of the food produced is exported from the county, implying that the vast majority of food consumed in Manatee County is imported from other areas. In developing countries, food imports are growing faster than their agricultural exports, due to issues such as limited water for irrigation, lack of access to credit and markets, and inadequate agricultural policy and management.

As reported by the FAO (UNESCO, 2003) the relationship between the food trade and water policy required the concept of "virtual water." Virtual water, a term coined in the 1990s means the following: in areas where water resources are limited, water is reserved for domestic and industrial uses and does not need to be used for food production because food can be imported

relatively cheaply. Importing food is therefore considered import of "virtual water." The virtual water number is one measure of the area's dependence on external markets for their food supply.



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Figure 2 - Red areas have high-quality farmland (USDA definition of "prime" or "unique") and high development pressure together. Data from the National Resources Inventory, USDA-Natural Resources Conservation Service

Manatee County, Florida is one place where the importance and future of agriculture is in question (Figure 2). Manatee County, like many urban-areas, is facing agricultural land conversions to residential and commercial uses. The county's status in the ranks of agricultural production implies that the natural resources situation in Manatee County is favorable for economically viable agriculture and that water resource planning should address the economic importance of agriculture as well as contributing to a local food system. However, state legislation requires regional water management districts around the to plan for allocation of scarce water resources to population needs for potable consumption, natural systems, agriculture and industrial users in that order. Florida counties, under the jurisdiction of regional water management districts, are required

to follow these regional plans in planning for their own water supplies.

## Non-sustainable Water Resource Consumption

Manatee County (Figure 1) is one of eight (8) Florida counties included in the Southern Water Use Caution Area (SWUCA, Figure 3) designated by the Southwest Florida Water Management District (SWFWMD) in 1992. A “water use caution area” is an area where water resources are or will become critical in the next 20 years. The implication of a water use caution area is that the use of water exceeds recharge, or in other words, the use is not sustainable.

The SWUCA is a 5,100-square-mile area in southwest Florida where water resources are already critical. Within the SWUCA, the Eastern Tampa Bay Most Impacted Area (ETB MIA) extends along the coast of southern Hillsborough, Manatee, and northwestern Sarasota counties, where there is the greatest concern for saltwater intrusion as a result of depressed aquifer levels. Depressed aquifer levels not only allow saltwater intrusion, but also contribute to reduced flows in the rivers and lowered lake levels in some areas.

To work towards stabilization of groundwater levels, permitted groundwater withdrawals from the Floridan aquifer in the ETB MIA have not increased since 1990. However, this effort alone is not enough to offset increases in groundwater withdrawals in the Floridan aquifer as a whole, due to increased demand from rapid population growth in the state.

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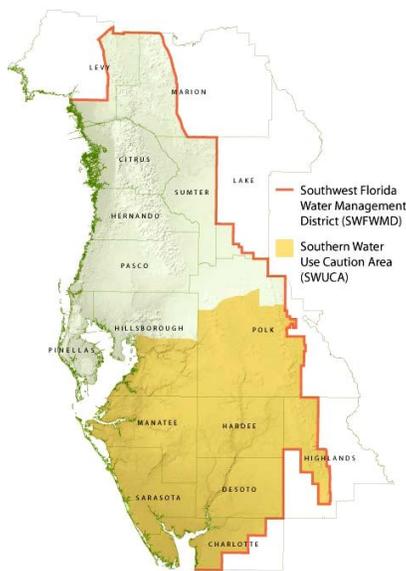


Figure 3 – The Southern Water Use Caution Area (SWUCA) of the Southwest Florida Water Management District (SWFWMD). Graph source: SWFWMD.

SWUCA Recovery Strategy, developed by the SWFWMD and currently in draft form, is designed primarily to manage groundwater withdrawals to achieve and sustain the Floridan aquifer saltwater intrusion minimum aquifer level. There are numerous strategies in the SWUCA, including the incorporation water reuse measures and providing financial incentives to develop alternative supplies such as reclaimed water projects. However, very few of the strategies come without actual costs, opportunity costs, or other material and non-material implications.

Continued development of reclaimed water projects been established as a priority for the state by the Florida Reuse Coordinating Committee and the Water Conservation Initiative Water Reuse Work Group in June 2003 report *Water Reuse for Florida*.

Manatee Agricultural Reuse System (MARS) project part of this larger regional strategy to reduce aquifer withdrawals through treated wastewater reclamation recycling, designed to pipe reuse water from urban areas to rural areas for use in agricultural irrigation as an alternative to groundwater use.

## The MARS Project

Manatee County is interconnecting three (3) regional wastewater treatment plants (Figure 4) to provide a 32-mile distribution system for urban and agricultural irrigation needs (Figure 5). Manatee County has been working on the main transmission pipeline for approximately five years with a budget of approximately \$55 million, with projected completion by 2006.

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Figure 4 – One of the three (3) wastewater treatment plants that serve Manatee County, Florida. Photo source: Manatee County Utilities Operations Department.

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required the County to demonstrate that it had 20-year contracts in place prior to construction, to provide a disposal option for the useful economic life of the treatment plants. Farmers were asked to cooperate with Manatee County to receive treated effluent for supplemental irrigation providing the County a permitted outlet for their reclaimed water, because Federal and State regulations did not allow surface water discharges to receiving water bodies in the County.

the planning, funding, and construction of the MARS main transmission line had been addressed, link from the main transmission line to the agricultural irrigation system remained as a physical and economic gap in the completion of the system. The first concern was that there was no incentive for farmers to abandon their wells in of reclaimed water. In 1986, Manatee County solicited and paid for a limited number of agricultural operations to receive reclaimed water at cost so that the County might receive construction funding from the U.S. Environmental Protection Agency (EPA) for the expansion of its regional wastewater treatment program. In this instance,

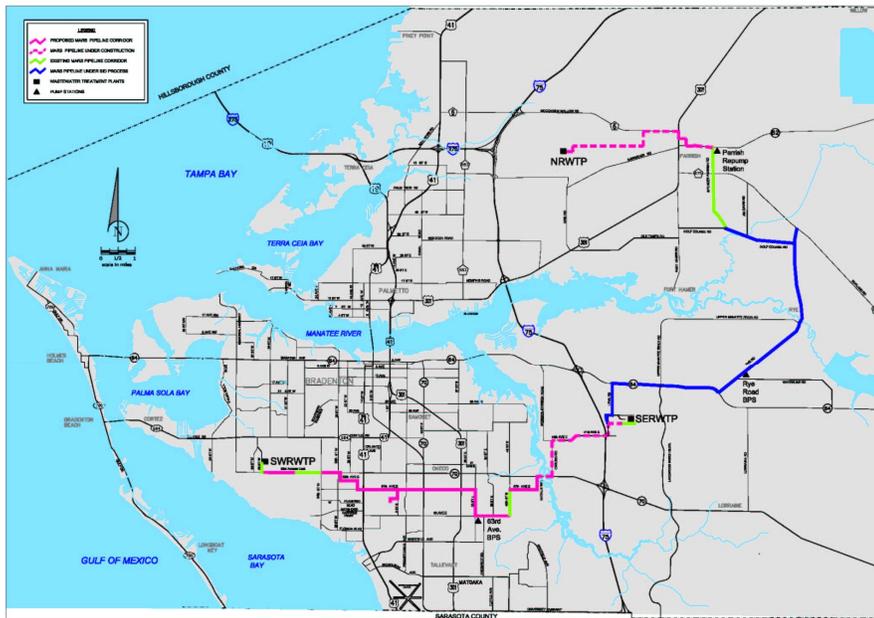


Figure 5. Above is a map of the MARS pipeline in blue, pink, and green segments. These segments will all be completed and operational in 2006. Graphic source: Manatee County Project Management Department

A study was done to determine the “tipping point” for farmers to connect to the reclaimed water pipeline. The study found that farmers were unwilling to pay more for reclaimed water than the cost of running their groundwater pumps to provide the same amount of supplemental irrigation. That cost is dictated in many cases by the cost of diesel fuel and pumping efficiencies on individual farms.

The connections to the system on private lands have been limited by two main factors: lack of incentives for agricultural operations to take on the costs of switching to reclaimed water and limits on the authority for Manatee County to construct and maintain public water distribution facilities on private land. These limitations will be addressed by the Florida West Coast Resource Conservation and Development (RC&D) Council grant program portion of the project (Figure 6). The RC&D provide funding and technical assistance to link Manatee County’s MARS main transmission line to farmer’s agricultural irrigation system using funds obtained through Congressional direct appropriations, which now total \$6.5 million.

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The Figure 6 – Symbol of the MARS Farm Connection Grant Program of the Florida West Coast RC&D Council

Florida West Coast RC&D’s role will also play a community role through the implementation of demonstration projects and incentives that address reclaimed water quality, seasonality of rainfall and reclaimed water availability, and water conservation.

Projects will include best management practices such as tailwater recovery, on-site filtration and storage, compost utilization, and other water quantity and quality practices.

The Florida West Coast RC&D Council has completed the MARS Farm Connection Grant Program and is preparing to advertise the program to the farmers.

## **METHODOLOGY**

Manatee County is one of countless communities around the world facing the balance between food production, competing water use, economic development, and the emergence of the people's desire for sustainable solutions. The implementation of the MARS Farm Connection Grant Program provides an opportunity to assist in natural resource recovery efforts while evaluating a community's ability to address competing interests regarding water resources.

One of the objectives of the MARS Farm Connection Grant Program is to evaluate the project both agronomically and economically. This report represents the first of several publications on the evaluation of the MARS project and the MARS Farm Connection Grant Program. As the project matures, additional data will be available both on water use changes, actual dollar costs, and the full integration of the MARS project into Manatee County's overall water supply plan.

The methodology for the first phase of the project implementation was to inventory a variety of sustainability principles and properties of sustainable systems. Then, the MARS Farm Connection Grant Program and, where feasible, the entire MARS project, was qualitatively assessed for social, economic, and environmental issues related to implementing a sustainable community water system.

### **Inventory of Sustainability Principles and Properties**

A variety of organizations dedicated to sustainable development, sustainable water resources, and community development were inventoried for their guiding criteria for sustainability. The foundation of principles and values associated with sustainability are important factors in the likelihood of producing a sustainable system, or at least positive indicators of sustainable conditions. The following resources were consulted:

- Information from the Sustainable Water Resources Roundtable
- United Nations. Various commissions and reports, including Our Common Future a.k.a. "The Brundtland Report", Agenda 21 of the Rio Earth Summit
- Moffat, I., N. Hanley, and M.D. Wilson, 2001. Measuring and Modeling Sustainable Development. Parthenon Publishing Group. New York, NY.

The following sustainability principles and sustainable system properties were used in the evaluation:

1. Transfer of Knowledge and Education
2. Public Input and Involvement
3. The Precautionary Principle
4. The Proximity Principle
5. Equity
6. Systems Analysis Properties
  - Time scale (duration)
  - Dramatic changes
  - Compromise of available options
  - Reversibility
  - Diversity

## **RESULTS**

The MARS Farm Connection Grant Program and where possible, the MARS project were reviewed for their general compliance with sustainability principles and properties of sustainable systems. The following is a qualitative discussion of these findings.

### **Transfer of Knowledge and Education**

Transfer of knowledge is one way that societies can increase their capacity to develop and adopt sustainable solutions. There are a variety of ways that this transfer can happen in communities, from informal social interactions to formal schools and colleges.

The MARS Farm Connection Grant Program addresses the transfer of knowledge and education in both informal and formal methods. The customers working with the Florida West Coast RC&D Council will have a chance to engage in one-on-one training on new methods of irrigation automation. The Manatee County Extension Service is a partner that will be involved in providing training on reclaimed water quality, irrigation efficiencies, and other agricultural water resource issues. The incentives that provide funding for such efforts will also include on-the-ground improvements on each farm that will provide continuing evidence for the farmers along with a comprehensive quantitative measurement and evaluation process.

The transfer of knowledge to improve agricultural water management and a greater understanding of regional water issues has been a goal of the partnership, especially due to the public investment that has been made in the project. The Florida West Coast RC&D Council has structured the program to allow for demonstrations of new technology, outreach to interested growers, and promotion at various venues locally and nationally.

### **Public Input and Involvement**

Greater numbers of stakeholders working together can create a solution that meets a variety of needs, represents a compromise, and has buy-in from the community. Also, a diverse group of people typically can bring more ideas together and brainstorm to create solutions that are much better than a single person could develop.

Openness and access to the decision-making in communities is also a fundamental step towards empowerment and ownership of outcomes, especially if the groups are trained in collaborative techniques, and have a facilitator that is trained in guiding the process of community input. Genuine public involvement also generates trust in the groups that are leading the implementation of the solution, and trusting long-lasting relationships are key to successful collaborative efforts. In Manatee County, it was clear early on that, at best, the vision was not shared by the entire community and, at worst, was in direct conflict with certain interests.

Extensive efforts were made to assess the agricultural perspective and motivations in water resources management, especially with respect to adopting reclaimed water under historical conditions and proposed conditions. As part of the master planning process for the MARS Farm Connection Grant Program, a half-day stakeholder workshop was held in October, 2003 facilitated by a professional facilitator. All potential agricultural users and a broad partnership were invited to develop user ranking criteria for prioritizing MARS users. Surveys and information about the MARS were also sent out in advance to collect additional information about potential customers interest and irrigation needs.

Participating agencies were the Florida West Coast RC&D Council, Manatee County Utilities, Manatee County Project Management, Manatee County Cooperative Extension, Florida Farm Bureau, Southwest Florida Water Management District, Natural Resources Conservation Service, and the Manatee River Soil and Water Conservation District.

The objectives of the MARS system were prioritized by all the workshop participants along with suggestions for ranking customers and itemizing potential concerns and issues in the project and grant program development. Pertinent issues and questions from the workshop reflect the diversity of concerns, participants, ranging from agricultural customers to public utilities managers, and are reproduced below:

1. Has reuse water been tested on crops to show no losses in crop size, compatibility, etc?
2. Do I keep my flexibility in changing my crops?
3. What do I have to give back to the supplier, in addition to dollars, if I change my mind later?
4. What are the limits on my maintenance responsibilities, and what are Manatee County's?
5. Can I sue the County when I don't get what I signed up for?
6. What red tape, inspections, records, etc. will be required of me?
7. Will there be a minimum of reuse water that I have to take?
8. What is the quality of the water?
9. What is the cost to hook up?
10. What is the cost of the reuse water?
11. Will I be able to retain my present irrigation water supply as a back up?
12. How reliable will the reuse supply be?
13. Will I have what I need for protection in times of drought, frost and freezing?
14. What are the USDA's requirements and do I want to comply?
15. What is my liability for crop loss due to water quality issues?
16. Will the reuse water be available in the quantities I need when I need it?

17. What other incentives are available (e.g. SWFWMD 20 Year Water Management Plan)?
18. What will the effect of additional salt content from reuse water be on my stormwater management?
19. What is the length of my agreement with the supplier?
20. Can I use MARS to expand my present use?
21. What other restrictions apply?
22. What will be the overall quality of runoff water and my management responsibilities?
23. Will I face consumer resistance to my crops if I use reuse water for irrigation?
24. Can I hook up, pay a fee, and forget about the RC&D MARS grant program?
25. Do I have to schedule my water use relative to others to avoid pressure loss?
26. Will the water quality be consistent over time?
27. Is there evidence that MARS works, via local test case or demonstration?
28. Can I use RC&D dollars for non-capital costs?
29. Do I have to repump or store reuse water?
30. Do I get the reuse water at suitable pressures at my connection point?
31. Should I/can I really depend on MARS?
32. If I sell my property, do I have to pay my “gain” back?

### **The Precautionary Principle**

In essence, the precautionary principle says that a lack of scientific certainty shall not be used as an excuse for allowing degradation to the environment or to human health.

Manatee County had several options with handling of their wastewater, and considering the dire condition of the aquifer, surface waters, and the potential for funding additional treatment, an alternative was chosen that seemed to provide the most benefits and the least costs. Reclaimed water was only used on crops that were allowed by the Florida Department of Environmental Protection. Human health issues relating to consumption of reclaimed water had been addressed in state legislation. However, since the County’s decision in the 1980’s, concerns have developed in some areas about endocrine disruptors and the persistence in the environment of what is being referred to as “emerging pollutants.”

When looking at the precautionary principle, it is difficult to assess compliance if knowledge on a particular topic has not even begun to develop. In many cases, communities are facing the least harmful alternative to dealing with environmental and health issues, and this is the case with Manatee County.

The Florida West Coast RC&D Council hopes to develop partnerships with researchers and create some on-site treatment systems using sustainable technologies that can further treat the wastewater if needed.

## **The Proximity Principle**

The proximity principle states that sustainable natural resources problems and solutions should be as close together as possible. The primary reason for this is that it takes additional energy consumption to move things around from place to place. One critical additional reason that the proximity principle is important is that it encourages people to be more accountable for problems that they create or economically benefit from. In sustainable systems, there is no such thing as “away” and keeping things local is one way to see the benefits of actions and changes in behavior.

The MARS project does attempt to develop a local, sustainable solution to a water supply shortage. It contains the solution, so far, to one geographical area. However, it does not address the overall lack of sustainability of most municipal water supply and wastewater systems. Since all the wastewater is collected and taken to three main processing plants, and then redistributed for beneficial uses, there is a significant energy requirement in the movement of water across these distances.

However, this solution is one step forward without requiring additional major changes in behavior of the citizens of Manatee County while they are simultaneously dealing with increases in potable water costs, taxes, and reductions in ability to irrigate their yards. Because of the political pressure, the proximity principle was addressed to a lesser extent than the need for a compromise solution.

## **Equity**

For a solution to be sustainable, it should include equitable access to problem-solving resources. Equity in this way means social equity and social sustainability, where the human factor is considered a critical part of ensuring long-term sustainability in the economy and the environment. The social equity component is the other item in the “triple bottom line” of sustainability: economy, environment, social equity.

In the development of the MARS Connection Grant Program, the RC&D has been careful to consider the importance of providing funding and technical assistance to as many farms as possible, including small and large farms, beginning farmers and farmers with limited financial resources.

To accomplish this, the RC&D has instituted a phased approach to offering grant funding. The first phase will offer funding for one connection per interested farmer, from Manatee County MARS transmission line to a farmer’s agricultural irrigation system, contingent upon available funding. This approach will stretch the funding dollars to provide access to the reused water resource for the largest number of farmers. Conversely, if the RC&D had not chosen to offer initial funding on a one connection-one farmer basis, one or two large farms with extensive irrigation systems and many fields could have depleted the available funding, making the reused water resource, the financial resource, and the technical resource unavailable to a larger number of farmers.

After the first phase has been completed and if funding is available, farmers can then apply for additional connections to the transmission line and for assistance with demonstration of

innovative technologies and irrigation efficiency enhancements. But the first priority for the program is equitable access and opportunity.

### **Systems Analysis Properties**

The Center for Sustainable Systems (CSS) at the University of Michigan defines a sustainable system in the following way:

“A set of integrated industrial and ecological processes that equitably meets the biophysical needs of society while maintaining the integrity of life-supporting ecosystems over a long-term time horizon. The word "industrial" is intended here to encompass all human-designed processes and activities in the production, use and retirement of goods and services.”

### Dramatic Changes and Compromise of Available Options

A solution that attempts to comply with sustainable systems properties should not require large dramatic changes over a short period of time. Although there are some naturally-occurring events in nature that reset ecosystems with dramatic changes (fire, floods, freezing, etc.), those ecosystems are typically adapted to changes and disturbances such as this or require large amounts of time and energy to recover. The human assessment of dramatic change typically involves a short time scale (months to decades), making observations of recovery difficult.

The solution of developing a large-scale, expensive publicly-funded infrastructure is a major undertaking. It also demonstrates the commitment of Manatee County leadership and the water resources community to the solution. However, Manatee County, the SWFWMD, and even the SWUCA Recovery Strategy and MARS are all subject to substantial political and economic pressure. The politics of compromise, involving multiple stakeholders and even large groups of powerful stakeholders has ensured that solutions proposed are not extreme, even in light of some fairly extreme conditions in the marketplace and environment.

Initially, the MARS project and even the MARS Farm Connection Grant Program seemed to require very dramatic changes to both the County's wastewater distribution system and to the individual farmers in accessing their water. The dramatic change required by Manatee County was assisted by the SWFWMD through significant funding of the \$55 million project. Managing just the installation of the main transmission line was a significant investment of Manatee County resources, that included system design, obtaining easements from landowners, construction, and operational protocols. The system is nearly complete at this point and initiating operation of the full system will begin in 2006 after the hiring of two additional staff members for operation and maintenance of the system.

In the social context, extreme solutions that serve only one interest in the long term are not sustainable and can actually generate mistrust and ill feelings in communities that need to share their resources and jointly solve their problems. It was found early on in the process that dramatic changes were not going to work when dealing with voluntary participation by farmers who were currently under very little pressure to make changes. The political and economic drivers of the MARS Farm Connection Grant Program dictated that small changes that are palatable to the farmers would be required.

Manatee County, in the development of the contracts with farmers for reclaimed water delivery, recognized the dramatic change that might be required and handled it in a couple of ways. First, the farmer will be allowed to keep their groundwater well as a backup system even if they transfer their water use permits to Manatee County. Secondly, the cost of the reclaimed water will not exceed the estimated pumping costs even if well use permits are not transferred.

The MARS Farm Connection Grant Program also acknowledged the dramatic change that might be required in the basic management of reuse water accessibility. Since the supply of reuse water does not meet the total demand, there were no indications in the Manatee Contract of a guaranteed quantity. Farmers need to have access to water when their plants need irrigation, and so additional attention will be given to addressing automation of the backup system relying on existing permitted irrigation wells. Advances in technology, as with many solutions, can make dramatic changes feel less dramatic to those implementing them.

### Time Scale

Since sustainability implies a “never-ending” permanent cycle of use and reuse, the duration or time scale of a solution should reflect that goal, or at the least incorporate flexibility in responding favorably to changing conditions. The duration of the MARS Farm Connection Grant Program and solution proposed to help reduce groundwater withdrawals is an interesting exercise in compromise as well. There had to be significant programmatic concessions to other economic forces, such as agricultural land conversion, property values, and the pace of development.

The MARS Farm Connection Grant Program has designed a solution that will last as long as agriculture remains on the landscape, but does not attempt to create artificial limits that would inhibit the implementation of the program. When agriculture is forced by market pressure to move further and further from the developing areas, the MARS Farm Connection Grant Program is designed to allow the extension of distribution lines to follow the agriculture retreat and still provide beneficial uses for reclaimed water.

### Reversibility

Solutions that are reversible with no negative impacts or side effects, and a high ratio of energy return could be very sustainable. Reversibility, on a time scale that is valuable to human societies, would be as close to replicating the natural environment’s mechanisms of recycling and reusing everything.

Although large metal and high-density polyethylene pipes are hardly reversible, the system set up for wastewater distribution allows important groundwork to build upon in future years. The MARS Farm Connection Grant Program is set up to be fairly “reversible.” The limits on the program allow the contract period to end upon delivery of reclaimed water. The flexibility allowed in a program ensures short term success but does not guarantee the long-term commitments to agricultural uses intended during program development. This trade-off is not always palatable and can create conditions that encourage misuse of the program, but the economic conditions and political environment in the suburban/agricultural interface dictate a high degree of flexibility in the agricultural user contracts.

## Diversity

Diverse systems are inherently more resilient. This can be demonstrated with a monoculture in agriculture that is very susceptible to a pest infestation. Diverse agricultural systems like any diverse system are more sustainable due to the resilience.

The MARS Farm Connection Grant Program has assisted Manatee County in developing a broad base of potential customers. Throughout the program development, Florida West Coast RC&D Council has encouraged the County to create demand for reclaimed water that includes a variety of customers and sizes of farms and crops. It is also planned to include some customers that would like to obtain on-site storage with corresponding additions in irrigation requirements for reclaimed water and stormwater capture that could further increase the diversity in the system.

## **DISCUSSION**

The MARS project and MARS Farm Connection Grant Program together create a partnership solution to a complex natural resource problem in an area with depleted water resources. The preceding evaluation of the project's compliance with sustainability principles and sustainable system properties is an interesting exercise in hindsight, as local community leaders faced the decision that needed to be made quickly.

Overall, the development of an alternative water source for agricultural irrigation seems to have sustainable characteristics. Many people have been involved and have helped to create a joint vision of a successful reclaimed water delivery system, which has increased the potential for a sustainable solution. However, most of what is happening in Manatee County is not being controlled by any of the stakeholders involved in the MARS project, so adapting to the conditions has been the primary focus of getting the project on the ground.

## **CONCLUSIONS**

The value of local projects and reviews such as these allows a formal discussion of the realities of decision-making in communities in the face of politics, low budgets, and competing powerful interests. To put these decisions into the context of sustainability can empower community leaders who have the vision to make their communities a better place to live. Standing under the umbrella of sustainability and using a systems analysis approach can provide a foundation for joint actions and decisions by all stakeholders. Most communities have not fully realized the power of this method. This paper is intended to generate further dialogue about sustainability measurement, indicators, the socio-political factors that control the future of a community and its use of natural resources.

As the MARS Farm Connection Grant Program moves into the next phase, additional quantitative analysis will be needed to further evaluate the system's sustainability. Data collection will be done remotely on well pumpage, reclaimed water use, and water quality analysis. The "virtual water" that is being moved in and out of Manatee County will also be assessed.

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