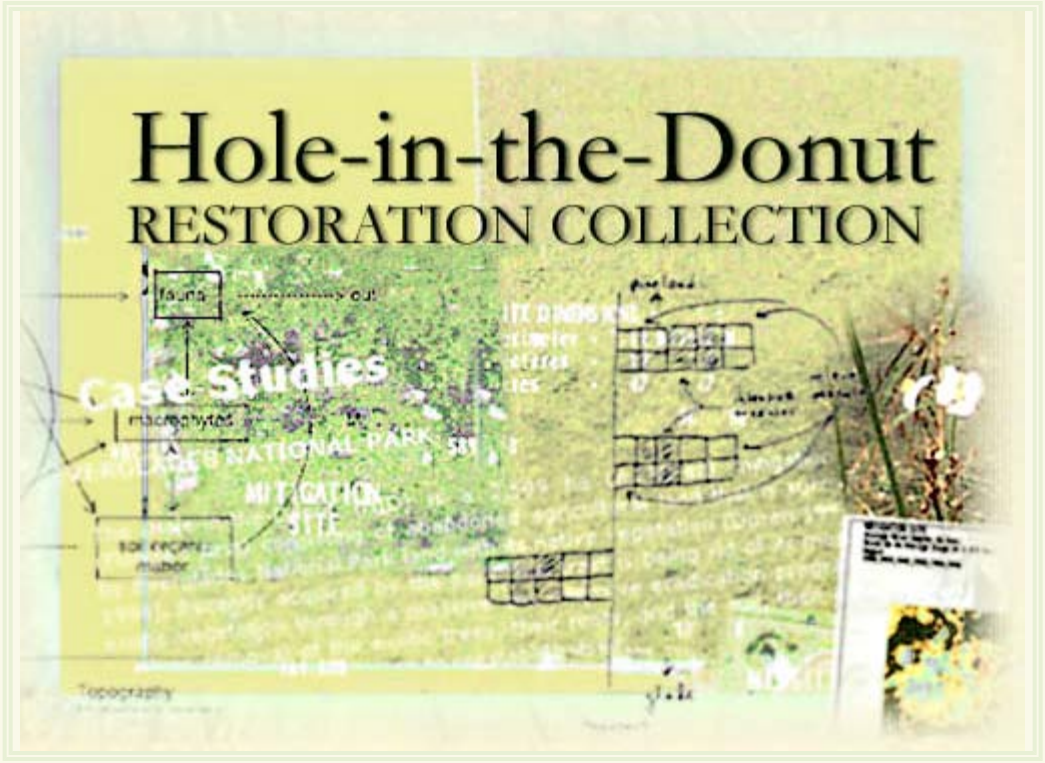
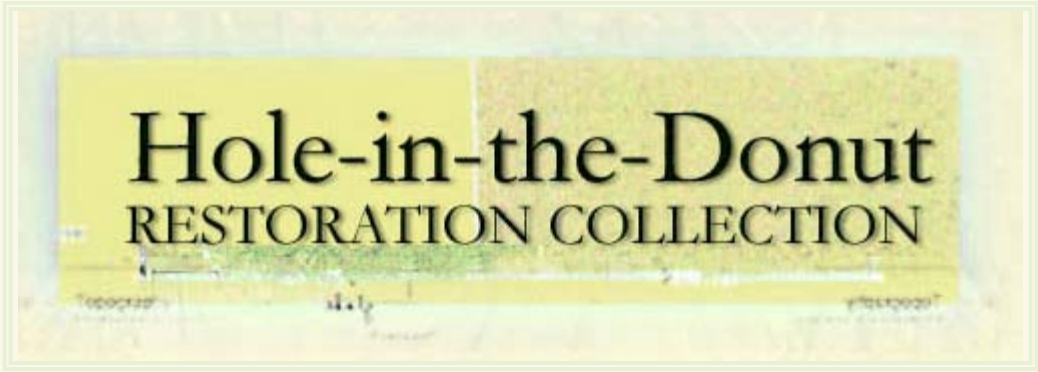


The *Hole-in-the-Donut (HID) Restoration Collection* is a central archive for information relating to this model landscape restoration project taking place in Everglades National Park. The materials included in this Collection were provided by HID project managers and scientists from the Park's South Florida Natural Resources Center (SFNRC), with additional material reproduced from holdings at the Florida International University Libraries. Materials include reports, contractual documents, scientific articles, maps, and photographs.

The Hole-in-the-Donut is a 9,900-acre tract located in the eastern half of Everglades National Park. Its long history of agricultural use from the early to mid-1900's justified its exclusion from the original boundaries of the Park. However, when the U.S. Government finally acquired the "Donut" for the national park in 1975, all farming operations were suspended and the tract was abandoned, leaving the area susceptible to intensive invasion by exotic pest plants. In particular, the noxious and highly invasive Brazilian pepper (*Schinus terebinthifolius)* quickly formed forests of non-native growth in the Hole-in-the-Donut, creating a canopy so thick that native vegetation could not grow in its understory.

Eradication of the exotic plants and restoration of the Hole-in-the-Donut began in the 1990's, using Miami-Dade County wetland mitigation bank funds. The goal of the proect is to restore the area to a marl prairie wetland vegetative community with its associated wildlife. Total estimated project costs are more than $100 million. To date, more than 4,000 acres have been treated; about 65% of the total of 6,250 acres. Environmental monitoring activities, also supported through cooperative funds, are documenting recovery stages and success rates, as well as wildlife re-uses of the area.



Index to Titles in the Collection

BACKGROUND DOCUMENTS

HID Restoration Themes Document (Doren, 1996)

Target Restoration Team Document (Doren,1982) [*Adobe PDF format*]

Memorandum of Agreement (1993) [*Adobe PDF format*]
on Establishment of "Freshwater Wetlands Mitigation Trust"

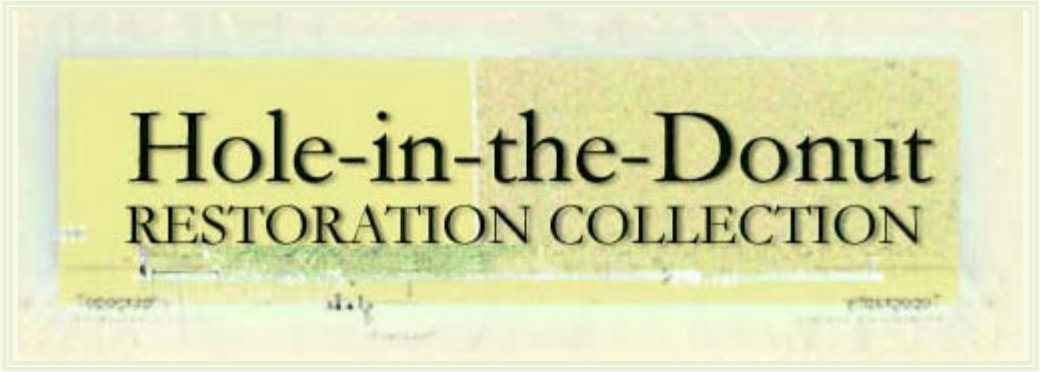
Memorandum of Understanding (1993) [*Adobe PDF format*]
between U.S. Department of Interior, National Park Service, Everglades National Park; and the National Park Foundation; and Metropolitan Dade County, Department of Environmental Resources Management Regarding Restoration of Wetlands in the Hole-in-the-Donut

Brazilian Pepper Management Plan for Florida (Amy Ferriter, Editor)
A publication of the Florida Exotic Pest Plant Council's Brazilian Pepper Task Force, chaired by Dan Clark. July 1997.

DATA

- Photographs
- Slides
- Maps & and Other Images

TECHNICAL REPORTS AND SCIENTIFIC PAPERS



RESTORATION RESEARCH THEMES AND HYPOTHESES

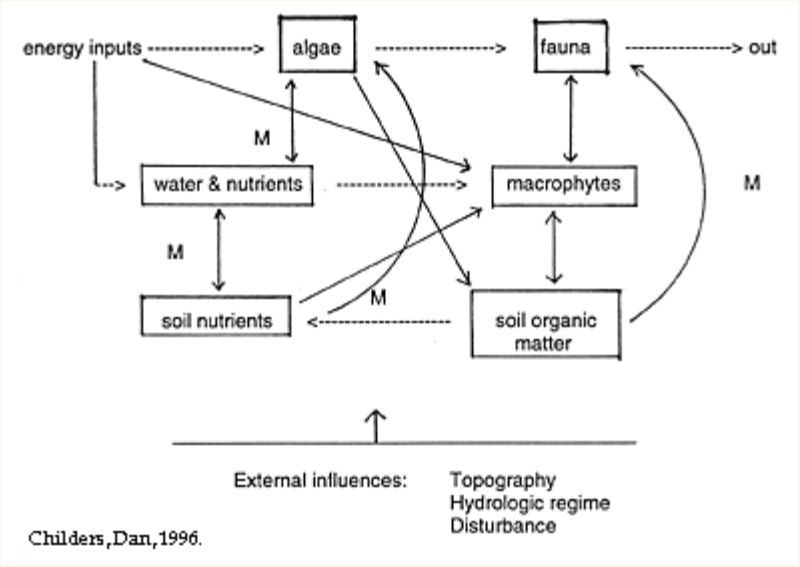
Prepared by Robert F. Doren, Assistant Research Director, South Florida Natural Resources Center, Everglades National Park, April 1, 1996.

The following concepts and questions about the research issues of HID restoration were developed by the HID Technical Proposal Evaluation Committee and are provided as a starting point for developing the framework research plan and program.

Do the newly created wetlands of the HID restoration project fall within the range of natural wetland variability (structure and function) found within the Park? The various method(s) available for making this kind of assessment have to be explored. An important consideration is whether the proposed methodology will allow us to answer the many research concerns and questions arising from the restoration work.

One important factor in establishing research criteria is the permit requirement that the Park must demonstrate successful mitigation, i.e., wetland restoration. The requirements are spelled out in the permit under special conditions.

The flow diagram below, presented by Dan Childers, Florida International University, establishes a foundation for understanding the interrelationships among biotic and abiotic components within the HID ecosystem, specifically, and the Everglades ecosystem, generally. Temporal and spatial relationships are not shown. The symbol "M" indicates microbial activity. This diagram was used solely to assist us in developing questions that did not inadvertently omit ecological elements.



HID RESTORATION CONCERNS AND RESEARCH QUESTIONS: A PRELIMINARY LIST

Structure and Function Interactions:

1. How are ecosystem structure and function related in newly created wetlands, and in oligotrophic Everglades wetlands in general?
2. How important is spatial variability/heterogeneity in understanding the interaction of structure and function in newly created wetlands?
3. How does whole-system productivity and energy flow change as these newly created wetlands develop?
4. Are plant community "differences", *i.e.,* species composition, cover, dominance, richness, etc., independent of function and state condition in newly created wetlands?
5. Are plant communities and associations structural representations of function and state variables in newly created wetlands?
6. What is the desired wetland (and upland) structure and function for the restoration site?
7. How do the interactions of the biotic and abiotic factors, including disturbance, determine the outcome of the restoration activity, and can the manipulation of the abiotic or biotic elements of the area redirect the outcome in a particular (favorable?) way for a particular outcome?

Exotic Plant Establishment:

1. Do nutrients control Brazilian pepper or is it a combination of water and nutrients?
2. What is the interaction between elevation, hydrology, and nutrients in influencing survival and persistence of Brazilian pepper?
3. In its native habitat, what controls Brazilian pepper spread and vigor (pests, diseases, browsers, etc.)?
4. Are native or newly created wetlands more or less invasible by exotic

pest plants, why, and what makes them so?

Restoration Alternatives:

1. Could the biological objectives of the restoration project be achieved without removing the substrate?
2. What role does the hydrologic regime play in achieving the biological objective of the restoration project? Can the hydrologic regime be controlled?
3. How does the chemistry of rock plowed substrate differ from "native" (unaltered) soil? Can the soil characteristics/chemistry be changed?

Vegetation Dynamics and Succession:

1. What are the characteristics of successional velocity and trajectory after soil removal and other major soil disturbances in newly created wetlands?
2. Where do seeds come from during recolonization of newly created wetlands?
3. What determines change from an herbaceous to a wooded structure in newly created wetlands?
4. How does the plant matrix affect the vegetation colonization pattern in newly created wetlands?
5. How does soil (soil nutrients, soil organic content, bulk density, soil elevation, etc.) develop in newly created wetlands, where there is no soil to begin with?
6. Is soil and/or water chemistry an adequate predictor of vegetation composition in newly created wetlands? Is topography?
7. Are there any direct interactions between algae and macrophytes in newly created wetlands?
8. How does a change in the soil nutrient regime influence community structure in newly created wetlands?
9. How dynamic is the mosaic of habitats found in the Everglades? Specifically, is there a predictable transition probability matrix among habitats (or, alternatively, are they usually relatively stable across long time intervals)?
10. If there is any dynamic transition between habitats in the Everglades, is it caused by fire, flood, drought, hurricanes, or other influences?
11. Does lack of soil in rockland systems determine macrophytic species composition?
12. Does lack of phosphorus in aquatic systems determine macrophytic and microbial species composition?

Wildlife:

1. Are there threatened or endangered species that need to be accommodated in the restoration site?
2. What animal populations may be displaced, reintroduced or enhanced by the removal of Brazilian pepper from the restoration site?

Hole-in-the-Donut Restoration Project
TARGET RESTORATION TEAM

Robert Doren
Assistant Research Director
South Florida Natural Resources Center, Everglades National Park

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The TARGET RESTORATION TEAM, in case you're wondering, is the band of individuals who are interested in research related to the "restoration" of the Hole-in-the-Donut (HID) in Everglades National Park and all the issues related to ecological resotration of wetland and associated wetland communites of the Everglades. I realize the word "team" has been overused and often has a trite bureaucratic connotation. But, according to Webster's, there are several viable, non-bureaucratic definitions that include: 1) draft animals with a harness pulling a vehicle; 2) a brood of pigs or ducks; 3) a number of persons associated together in work or activity; 4) collaborate. While I may agree with some of you who see merit in definitions one and two, the message I impart here arguably has more to do with the latter two definitions. I hope you'll agree.

The purpose of the TARGET RESTORATION TEAM is to bring scientists working on the HID restoration and other related Everglades restoration efforts together to ensure consistency and compatability throughout the research being conducted. The Target Team will serve as the nexus for ensuring congruity of research effort, eliminate duplication, and provide a forum for scientists woking on related areas to talk about their research, learn about and hopefully from others' research, and to collaborate and coordinate their individual and collective efforts. In order to accomplish this the Park is developing a research plan to guide the short and long-term research and monitoring studies. Developing this research program entails organizing numerous scientific specialties and research questions into an integrated whole. A whole that, through this team coordination and synergy, will, we hope, be greater than the sum of its parts. This team needs to be flexible; to increase or decrease participants as research focuses on new or different questions; to regularly adapt the findings of the integrated research program to resource management needs and changes in direction; and to incorporate new information and new ideas into the research program to provide new directions to the existing program; to interact with other professionals in appropriate and complementary fields of expertise; to conduct quality research; to collaborate; and to cooperate.

In order to accomplish the tasks ahead the Target Restoration Team will have to

be able to ask; what is the big picture in this restoration program, are we focused on expectation not methods, do we have the right resources identified, and are we focused on actions and products? Only through these coordinated interactions will individual scientists working on a large but integral project be able to take advantage of team synergy to be resourceful and proficient.

The scientific approach advocated embraces a closely linked and integrated program of monitoring, research, modeling, and adaptive management. Through monitoring, we can track critical ecosystem parameters and provide baseline data and model parameterization. Through research, we can develop an understanding of the physical and biological process regulating succession, and their underlying causal relationships. Through modeling, we can develop predictive tools to assess system response to change, to hindcast to historical conditions, and to develop, adapt and select management alternatives.

In order to provide extramural oversight to this loose and potentially large team of scientific investigators, an interdisciplinary panel of nationally recognized scientists will be invited to become members of a Department of the Interior chartered, Scientific Peer Review Panel, members of which will have no financial stake or research investment in the project. The review panel's role will be to provide periodic, broad, technical review of the overall research plan and program, individual research project elements of the program, program priorities and direction and research results. Members of the panel will have to forego subsequent research as investigators funded under this program.

No one organization has sufficient management control or scientific expertise to independently answer the broad research questions in wetland restoration. Only through an instrument of the Target Restoration Team and Scientific Peer Review Panel can we expect to find a way to make complementary contributions and encourage synergy in the scientific enterprise entailed in this precedent setting project. Everglades National Park has the principal responsibility for leading deliberations on the HID restoration planning, for setting research-restoration goals and for coordinating the science programs. The Park intends to carry out this responsibility by encouraging and developing a collegial and integrated program of research leading to the restoration of the Hole-in-the-Donut and a comprehensive understanding of the scientific questions underlying the concept(s) of restoration. It will be the Park's job to develop this restoration-research-management program, to implement it, to adapt it, to make it successful and, perhaps, a paradigm for other such programs.

MEMORANDUM OF AGREEMENT
MA 5280-3-9006

BETWEEN

THE UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
EVERGLADES NATIONAL PARK
40001 STATE ROAD 9336
HOMESTEAD, FLORIDA 33034-6733

AND

THE NATIONAL PARK FOUNDATION
1101 17TH STREET NW, SUITE 1102
WASHINGTON, D.C. 20036

This Memorandum of Agreement is between the National Park Service, Everglades National Park (hereinafter the PARK), an agency of the United States Department of the Interior, acting in this behalf through the Superintendent of Everglades National Park, or his designee, and the National Park Foundation (hereinafter the FOUNDATION), a non-profit corporation chartered by Act of Congress, acting through its President.

WITNESSETH

Whereas, it is the purpose of the National Park Service to preserve, interpret, and mange the National Park System for the benefit, education and enjoyment of the people of the United States, as provided for in the Act of August 25, 1916 (16 U.S.C. §1 et seq.); and

Whereas, the FOUNDATION is authorized by Act of Congress to receive and administer donations made for the benefit of units of the National Park System; and

Whereas, 48 STAT. 816 passed May 30, 1934, provided for the establishment of Everglades National Park in the State of Florida, and

Whereas, the National Park Service and Everglades National Park recognize their responsibilities to control exotic pest plant species to prevent or reverse disruption to native communities, and

Whereas, Everglades National Park shall establish a regional mitigation bank within the area known as the Hole-in-the-Donut, through a Clean Water Act, section 404 permit through the U.S. Army Corps of Engineers and the Florida Department of Environmental Protection, for receipt of funds from various development actions in the southern Florida area for restoration of the Hole-in-

the-Donut, and

Whereas, the purpose of this Memorandum of Agreement is to establish terms for the FOUNDATION's administration of such funds.

Now, Therefore, pursuant to the authorities set forth above, the PARK and the FOUNDATION do hereby agree as follows:

1. TRUST FUND.

The FOUNDATION shall establish the "Everglades National Park Freshwater Wetlands Mitigation Trust Fund" (hereinafter the FUND) through which it will manage funds transferred from requests by mitigation applicants to utilize for mitigation purposes the Everglades National Park Mitigation Bank in the Hole-in-the-Donut. Monies from the FUND shall be used soley for restoration, research, monitoring and long term management of former wetlands within the "Hole-in-the-Donut" area of Everglades National Park, and as determined soley by the PARK for other purposes relating to this mitigation and restoration work. Elements of the project are detailed in a report entitled *Restoration of Former Wetlands within the Hole-in-the-Donut in Everglades National Park*, attached hereto as exhibit A.

2. INVESTMENT OF THE FUND.

Unless otherwise agreed by the PARK and the FOUNDATION, the FOUNDATION shall invest monies contained in the FUND in U.S. Government and Agency issues, with a ten year maximum maturity, and cash equivalents. All interest earned shall be credited to the FUND. The FOUNDATION shall be entitled to a fee for the management investment and audit services contemplated hereunder in the amount of 1% of the monies transferred to the FUND from applicants to the Everglades National Park Mitigation Bank.

3. REIMBURSEMENT PROCEDURES.

The PARK shall establish a reimbursable account into which the FOUNDATION shall transfer monies from the FUND upon request of the PARK. Monies so transferred shall be used for or to reimburse expenditures for the purposes set forth above and in accordance with the Everglades National Park Mitigation Bank Permit requirements. The PARK shall send a written request to the FOUNDATION requesting funding transfers approximately four times per year.

4. AUDIT.

The FUND will be audited annually by the FOUNDATION's auditors in connection with the June 30th fiscal year audit of the FOUNDATION's financial statements.

5. GENERAL.

(a) Term of Agreement. This Memorandum of Agreement shall be for twenty (20) years, beginning on the latest day and year noted on the WITNESS blocks, and may be terminated upon sixty days notice by either party, provided that such termination must be in accordance with applicable provisions of Everglades National Park Mitigation Bank Permit requirements and any other agreements the PARK may have regarding completion of mitigation work for monies already distributed for that purpose related to mitigation within the Hole-in-the-Donut. Any monies contained in the FUND upon such termination will be disposed of as directed by the PARK. This agreement may be renewed and extended by mutual written agreement of both parties.

(b) Required Clause. No member of, or delegate to, Congress, or Resident Commissioner, shall be admitted to any share or part of this Agreement or to any benefit that may arise therefrom, but this restriction shall not be construed to extend to this Agreement if made with a corporation or company for its general benefits.

(c) Required Clause. The FOUNDATION agrees that all its activities shall be conducted in accordance with all applicable laws and regulations, both State and Federal. Specifically, the Association shall comply with the requirements of (a) Executive Order No. 11246 of September 24, 1967, (b) Title V., Section 503 of Government Contractors and Sub-contractors to take affirmative action to employ and to advance in employment qualified handicapped individuals, and (c) with regulations heretofore or hereafter promulgated, relating to non-discrimination in employment and in providing facilities and service to the public.

d) Key Officials for the PARK. Richard Ring, Superintendent, will provide review and approval of terms of all agreements and will exercise the authority to approve conduct of agreements regarding Everglades National Park. Robert F. Doren, Assistant Research Director, will act as the Superintendent's authorized and designated representative with regard to implementation and coordination of this agreement. Written notice shall be provided to the FOUNDATION of any changes in key officials within thirty (30) days of such change.

e) Key Officials for the FOUNDATION. The President of the FOUNDATION will provide review and approval of terms of all agreements and will exercise the authority to approve conduct of cooperative projects regarding The National Park FOUNDATION. The Controller with the National Park FOUNDATION, will provide contracting authority and fiscal control for the FOUNDATION. The FOUNDATION shall provide written notice to the PARK of any change in authorized technical representative within thirty (30) days of such change.

f) Maintenance of Records. The FOUNDATION shall keep accounting records which conform with generally accepted accounting principles which shall include, but not be limited to, a cash receipt journal, general ledger, and all such subsidiary ledgers as reasonably necessary. All such records will be

retained by the FOUNDATION for not less than five (5) years beyond the term of this AGREEMENT.

g) Access to Records. The FOUNDATION shall provide access to all their records of or relating to this project and agreement, and agrees to provide such assistance as may be necessary to facilitate their review by the PARK when deemed necessary by the either to insure compliance with accounting and financial standards. The PARK shall have the right to access all records for not less than five (5) years beyond the terms of this AGREEMENT. The FOUNDATION shall make all records or documents which relate to this AGREEMENT available to the PARK at the FOUNDATION's offices during regular business hours.

h) Preparation and Submission of Reports. An annual report shall be generated by the FOUNDATION and provided to the PARK for distribution to any parties of their choosing. The FOUNDATION's reports shall include a statement showing the amount of funds received to date for the Everglades National Park Mitigation Bank and a summary of account activities (deposits and expenditures) relating to the Mitigation Bank, Hole-in-the-Donut restoration project.

IN WITNESS WHEREOF, the PARK and the FOUNDATION have caused this Memorandum of Agreement to be executed this _____ day of _____, 1993.

National Park Foundation

BY:_____
Alan A. Rubin, President

National Park Service

BY:_____
Richard Ring, Superintendent

BY:_____
Sherry Dague, Contracting Officer

MEMORANDUM OF UNDERSTANDING

BETWEEN

THE UNITED STATES DEPARTMENT OF INTERIOR
NATIONAL PARK SERVICE
EVERGLADES NATIONAL PARK

AND

THE NATIONAL PARK FOUNDATION

AND

METROPOLITAN DADE COUNTY
DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT

REGARDING

RESTORATION OF WETLANDS

IN THE HOLE-IN-THE-DONUT

TABLE OF CONTENTS

MEMORANDUM OF UNDERSTANDING

BETWEEN
UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
EVERGLADES NATIONAL PARK
40001 STATE ROAD 9336
HOMESTEAD, FLORIDA 33034-6733

AND

NATIONAL PARK FOUNDATION
1101 17TH STREET, SUITE 1102
WASHINGTON, D.C. 20036

AND

METROPOLITAN DADE COUNTY
DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT
PROFESSIONAL SAVINGS BANK BUILDING
33 SW 2ND AVENUE
MIAMI, FLORIDA 33130

THIS AGREEMENT (hereinafter the "AGREEMENT")is made and entered into this _____day of _____ 1993, by and between the United States Department of the Interior, National Park Service, Everglades National Park (hereinafter the "PARK"), the National Park Foundation (hereinafter the "FOUNDATION") and Metropolitan Dade County, a political subdivision of the State of Florida (hereinafter the "COUNTY").

ARTICLE I. BACKGROUND AND OBJECTIVES

WHEREAS, 48 STAT. 816 passed May 30, 1934, provided for the establishment of Everglades National Park in the State of Florida; and

WHEREAS, Public law 90-583 (1968) provides for the control of noxious plants on federal lands, and Executive Order 11987, issued May 29, 1977, calls for restrictions on the introduction of exotic species into natural ecosystems on Federal lands; and

WHEREAS, Everglades National Park in its "General Management Plan" (1979) recognized the Park's responsibilities to "control exotic plant and animal species when necessary to prevent disruption to native communities"; and

WHEREAS, The Everglades National Park Master Plan and the Resource Management Plan address the issue of mitigating the effects of exotics, particularly the successional trends in the area known as the Hole-in-the-Donut in Everglades National Park (Exhibit A); and

WHEREAS, 39 STAT. 535, passed August 25, 1916, enables Everglades National Park to enter into Agreement with other agencies and persons; and

WHEREAS, Public Law 90-209 of the 90th U. S. Congress, December 18, 1967 established the National Park Foundation; and

WHEREAS, the FOUNDATION is empowered by Congress to act on behalf of the PARK with regard to the acceptance and management of funds or income; and

WHEREAS, the COUNTY and the PARK have agreed to establish a cooperative program to implement control of exotic plants in the Hole-in-the-Donut; and

WHEREAS, on July 21, 1992, the Dade County Board of County Commissioners created Section 24-58.21 of the Code of Metropolitan Dade County, which established the Freshwater Wetland Mitigation Trust Fund (FWMT Fund) for receiving mitigation contributions from developers in the Bird Drive Everglades Wetland Basin and the North Trail Wetland Basin; and the COUNTY represents that (1) this AGREEMENT has been duly authorized, executed and delivered by the Board of County Commissioners as the governing body of the COUNTY, and (2) it has the required

power and authority to perform this AGREEMENT.

WHEREAS, the FWMT Fund was created for use in acquiring (including by eminent domain), restoring, enhancing, managing or monitoring freshwater wetlands within Dade County.

NOW, THEREFORE, in consideration of these premises and mutual covenants contained herein, the parties agree as follows:

ARTICLE II. STATEMENT OF WORK

A. PARK'S RESPONSIBILITIES

1) Implementation of Restoration. The PARK agrees to, and shall be solely responsible for implementing, the program in accordance with the general procedures and methods contained in the document entitled, Restoration of Former Wetlands within the Hole-in-the-Donut in Everglades National Park; Project Plan and Specifications, attached hereto as Exhibit B. The PARK shall be solely responsible for obtaining all of the required federal, state and local permits for the performance of the work, writing and awarding of contracts or cooperative AGREEMENTs regarding implementation of work, scheduling, hiring and payment of personnel, purchase or rental of supplies, materials and equipment or other project support as necessary. The PARK may, at its sole discretion, add to or modify the methods or procedures contained in Exhibit B as deemed necessary or appropriate based on information from the results of previous or ongoing project work, monitoring data or study results in order to improve or enhance any of the elements or purposes of this project as described in this AGREEMENT, provided, however, that such modification shall not alter the PARK'S obligation to mitigate the number of acres for which payments have been committed prior to such modification pursuant to this AGREEMENT. This AGREEMENT, including all appendices, attachments and codicils shall not under any of its terms, limitations or conditions be considered by any of the parties to this AGREEMENT to encumber or otherwise in any way limit

the use or direction of funds received from sources other than those described within this AGREEMENT by the FOUNDATION on behalf of the PARK.

2) Preparation and Submission of Reports. The PARK shall provide to the COUNTY documentation and reports, as specified in Article VI of this AGREEMENT, sufficient to verify satisfactory completion of work in accordance with Exhibit "B". Annual reports shall be generated by the PARK and provided to the COUNTY and the FOUNDATION for distribution to any parties of their choosing. The PARK's reports shall include a general description of the work performed to date, discussion of monitoring results (as these become available) or general observations, as well as a summary of expenditures to date.

3) Receipt of Funds by the FOUNDATION on behalf of the PARK. The PARK agrees and represents that receipt by the FOUNDATION of fund(s) from the COUNTY in accordance with the provisions of this AGREEMENT shall constitute receipt by the PARK of the funds for use in implementing the Hole-in-the-Donut project in accordance with Exhibit "B".

4) Maintenance of Records. The PARK shall keep accounting records which conform with generally accepted accounting principles which shall include, but not be limited to, a cash receipt journal, general ledger, and all such subsidiary ledgers as reasonably necessary. All such records will be retained by the PARK for not less than five (5) years beyond the term of this AGREEMENT.

5) Access to Records. The PARK shall provide access to all their records of or relating to this project and AGREEMENT, and agrees to provide such assistance as may be necessary to facilitate their review by the COUNTY or the FOUNDATION when deemed necessary by either to insure compliance with accounting and financial standards. The COUNTY or the FOUNDATION shall have the right to access all records for not less than five (5) years beyond the term of this

AGREEMENT. The PARK shall make all records or documents which relate to this AGREEMENT available to the COUNTY or the FOUNDATION at the PARK's offices during regular business hours.

6) Nothing in this AGREEMENT shall be construed to require the PARK to expend funds that have not been lawfully appropriated and administratively allocated for such purposes.

B. FOUNDATION'S RESPONSIBILITIES

1) Receipt of Funds by the FOUNDATION on behalf of the PARK. The FOUNDATION agrees to accept, on behalf of the PARK, and solely for the purposes as outlined in this AGREEMENT, the principal amounts received from the COUNTY's above-described revenue index code of the FWMT Fund.

2) FOUNDATION to Manage Funds Received. The FOUNDATION shall manage the funds received from the above-described index code of the FWMT Fund solely for the benefit of the PARK in order to provide solely for the implementation of the work and projects outlined in this AGREEMENT and any attachments, exhibits, appendices or codicils.

3) Maintenance of Records. The FOUNDATION shall keep accounting records which conform with generally accepted accounting principles which shall include, but not be limited to, a cash receipt journal, general ledger, and all such subsidiary ledgers as reasonably necessary. All such records will be retained by the FOUNDATION for not less than five (5) years beyond the term of this AGREEMENT.

4) Access to Records. The FOUNDATION shall provide access to all their records of or relating

to this project and AGREEMENT, and agrees to provide such assistance as may be necessary to facilitate their review by the COUNTY or the PARK when deemed necessary by the either to insure compliance with accounting and financial standards. The COUNTY or the PARK shall have the right to access all records for not less than five (5) years beyond the terms of this AGREEMENT. The FOUNDATION shall make all records or documents which relate to this AGREEMENT available to the COUNTY at the PARK's offices during regular business hours.

4) Preparation and Submission of Reports. An annual report shall be generated by the FOUNDATION and provided to the COUNTY and the PARK for distribution to any parties of their choosing. The FOUNDATION's reports shall include a statement showing the amount of funds received to date from the FWMT Fund and a summary of account activities (deposits and expenditures) relating to the project described in this AGREEMENT.

C. COUNTY'S RESPONSIBILITIES

1) Review and Implementation of Program. The COUNTY shall participate in the review of the implementation of this exotic plant control/freshwater wetland restoration program. The COUNTY's Department of Environmental Resources Management ("DERM") shall be responsible for review of the project to ensure compliance with project goals, procedures and methods contained in Exhibit "B".

2) Identification of Hole-in-the-Donut Contribution Amounts. The COUNTY shall, upon receipt of a mitigation contribution, identify an amount equal to that percentage of the total amount collected which has been designated, by mutual consent and agreement of the member agencies of the Special Area Management Plan Committee (SAMP Committee), for use in restoring that area of the PARK known as the "Hole-in-the-Donut." This percentage is set forth in Exhibit "A", which exhibit may be amended to reflect any changes (as determined in writing by the U.S. Army Corps of

Engineers, the Florida Department of Environmental Regulation, and the COUNTY) by mutual written agreement of the COUNTY and the PARK. The Assistant County Manager and the Everglades National Park Superintendent are authorized to provide the written AGREEMENT required to amend Exhibit "A".

3) Crediting to Index Code of Hole-in-the-Donut Contribution Amounts. The COUNTY shall credit to a revenue index code within the FWMT Fund the percentage of the mitigation amount received in accordance with paragraph 3 above. Interest accrued on this principal amount prior to disbursement to the FOUNDATION shall be retained by the COUNTY for use for administrative costs.

4) Transfer to the FOUNDATION of Hole-in-the-Donut Contribution Amounts. The COUNTY shall, within 30 days of the end of each month, transfer to the FOUNDATION those principal amounts accrued in the above-described revenue index code of the FWMT Fund.

5) Maintenance of Records. The COUNTY shall keep accounting records which conform with generally accepted accounting principles which shall include, but not be limited to, a cash receipt journal, general ledger, and all such subsidiary ledgers as reasonably necessary. All such records will be retained by the COUNTY for not less than five (5) years beyond the term of this AGREEMENT.

6) Access to Records. The COUNTY shall provide access to all its records of or relating to this project and AGREEMENT, and agrees to provide such assistance as may be necessary to facilitate their review by the PARK or the FOUNDATION when deemed necessary by the either to insure compliance with accounting and financial standards. The PARK or the FOUNDATION shall have the right to access all records for not less than five (5) years beyond the terms of this AGREEMENT.

The COUNTY shall make all records or documents which relate to this AGREEMENT available to the PARK or the FOUNDATION at the COUNTY'S offices during regular business hours.

7) Preparation and Submission of Reports. Annual reports shall be generated by the COUNTY and provided to the PARK and FOUNDATION for distribution to any parties of their choosing. The COUNTY's reports shall include a summary of all activities (e.g., deposits, transfers, expenditures, land purchases, etcetera) of the above-described revenue index code of the FWMT Fund.

ARTICLE III. TERM(S) OF AGREEMENT

(1) Initial Term. This AGREEMENT shall have an initial term of TWENTY (20) years, beginning on the latest day and year noted on the WITNESS page of this AGREEMENT.

(2) Renewal Term(s). This AGREEMENT may be renewed upon the same terms and conditions for up to TWO (2) additional FIVE (5) year terms by mutual written agreement of all parties.

(3) Continuation of this AGREEMENT (in whole or in part) beyond the term specified in ARTICLE III, item 1 above is contingent upon the availability of funds.

ARTICLE IV. KEY OFFICIALS

PARK: The Superintendent of Everglades National Park will provide review and approval of terms of all agreements and will exercise the authority to approve conduct of cooperative projects regarding Everglades National Park. Robert F. Doren, Assistant Research Director, will act as the contracting officers' authorized technical representative with regard to the technical scope of this AGREEMENT. The Contracting Officer with the National Park Service (NPS), Everglades National

Park, will provide contracting authority and fiscal control for the PARK. The PARK shall provide written notice to DERM and FOUNDATION of any change in key officials within thirty (30) days of such change.

COUNTY: The Director of DERM will provide review and approval of terms of all agreements and will exercise the authority to approve conduct of cooperative projects regarding Dade County. Frank Bernardino, Environmental Resource Project Supervisor, shall act as the authorized technical representative for DERM with regard to the technical scope of this AGREEMENT. The COUNTY shall provide written notice to the PARK and FOUNDATION of any change in authorized technical representative within thirty (30) days of such change.

FOUNDATION: The Director of the FOUNDATION will provide review and approval of terms of all agreements and will exercise the authority to approve conduct of cooperative projects regarding The National Park FOUNDATION. The Controller with the National Park FOUNDATION, will provide contracting authority and fiscal control for the FOUNDATION. The FOUNDATION shall provide written notice to the PARK and COUNTY of any change in authorized technical representative within thirty (30) days of such change

ARTICLE V. PROPERTY UTILIZATION N/A

ARTICLE VI. PRIOR APPROVAL N/A

ARTICLE VII. REPORTS

Reports shall be prepared and submitted as previously described for each party in ARTICLE II above. Reports shall be due by each agency ninety (90) days after the end of the respective

agencies fiscal year.

ARTICLE VIII. AMENDMENT

This AGREEMENT may be modified by amendment upon mutual written agreement of all parties.

ARTICLE IX. TERMINATION

(1) This AGREEMENT shall terminate automatically unless the same is extended by mutual written agreement prior to twenty (20) years from the latest date of authorized signature upon the WITNESS page, provided, however, that this AGREEMENT shall NOT terminate until the PARK has completed the amount of mitigation required under the terms of the AGREEMENT for the funds already transferred to the FOUNDATION on behalf of the PARK for this project, from the above-described revenue index code of the FWMT Fund. During the term of this AGREEMENT, should further funds become unavailable, this AGREEMENT shall NOT terminate until the PARK has completed the amount of mitigation required under the terms of the permit for this AGREEMENT for the funds already transferred to the FOUNDATION on behalf of the PARK for this project, from the above-described revenue index code of the FWMT Fund.

(2) Either the PARK or the COUNTY may terminate this AGREEMENT at any time by providing ninety (90) days written notice to the other party. The PARK shall complete all mitigation work for which principal monies have been remitted by the COUNTY. Receipt of written notice from the PARK, issued upon completion of the mitigation work for monies remitted up to the point of written notice of termination, shall constitute the date of termination of this AGREEMENT.

ARTICLE X. REQUIRED CLAUSES

"During the performance of this AGREEMENT, the participants agree to abide by the terms of Executive Order 11246 on nondiscrimination and will not discriminate against any person because of race, color, religion, sex or national origin. The participants will take affirmative action to ensure that applicants are employed without regard to their race, color, religion, sex or national origin."

"No member or delegate to Congress, or resident Commissioner, shall be admitted to any share or part of this AGREEMENT, or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this AGREEMENT if made with a corporation for its general benefit."

ARTICLE XI. NOTICES

All notices required or permitted to be given under the terms and provisions of this AGREEMENT by either party to the other shall be in writing and shall be sent by registered or certified mail, return receipt requested, to the parties as follows:

As to the COUNTY:

John W. Renfrow, Director
Dade County Department of Environmental Resources Management
Professional Savings Bank Building
33 S.W. 2nd Avenue
Miami, Florida 33130

As to the PARK:

Richard Ring, Superintendent
Attn.: Robert F. Doren
Everglades National Park
40001 State Road 9336
Homestead, Florida 33034-6733

or to such other address as may hereafter be provided by the parties in writing. Notices by registered or certified mail shall be deemed received on the delivery date indicated by the U.S. Postal Service on the return receipt.

ARTICLE XII. VENUE

Any litigation hereunder shall be brought in the applicable state or federal court in Dade County, Florida. The liability of the United States for the acts and omissions of its employees arising out of this AGREEMENT shall be governed by the Federal Tort Claims Act.

IN WITNESS WHEREOF, the parties hereto have caused this AGREEMENT to be executed by their duly authorized representative(s) on the latest day and year noted below.

NATIONAL PARK SERVICE	By: Superintendent	Richard Ring Date Everglades National Park
	By: Contracting Officer	Sherry Dague Date Everglades National Park
NATIONAL PARK FOUNDATION	By: President	Alan Rubin Date National Park Foundation
	By: Controller	Chris Jerussi Date National Park Foundation
DADE COUNTY	By: County Manager P.E., P.L.S.	Joaquin G. Avino Date Dade County
	Attest:	
_____		By: Deputy Clerk

Approved by County Attorney
as to form and legal sufficiency_____

EXHIBIT A

Pursuant to facts and figures presented by representatives of Everglades National Park (the PARK) before the Special Areas Management Plan Committee (SAMP), the member agencies of the SAMP have agreed to transfer two thirds (2/3) of each per-acre mitigation contribution made to the Dade County Freshwater Wetlands Mitigation Trust Fund (FWMT Fund) for work in the Bird Drive Everglades Wetland Basin and the North Trail Wetland Basin, to the PARK, for the purposes of restoring, monitoring, studying and managing that area of the PARK known as the "Hole-in-the-Donut." The per-acre amount of revenue transferred to the PARK from the FWMT Fund, for work performed in the subject wetlands basins, shall not be less than that required to restore, monitor, study or manage an equal number of acres within "Hole-in-the-Donut." For the 1992-93 fiscal year, the cost of restoring, monitoring, studying and managing an acre of land in the "Hole-in-the-Donut" is $16,500.

EXHIBIT B

RESTORATION OF FORMER WETLANDS

WITHIN THE

HOLE-IN-THE-DONUT IN EVERGLADES

NATIONAL PARK

*****

PROJECT PLAN AND SPECIFICATIONS

RESTORATION OF FORMER WETLANDS WITHIN THE HOLE-IN-THE-DONUT IN EVERGLADES NATIONAL PARK[1]

by

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ABSTRACT

A major site of exotic plant invasion within Everglades National Park is an area of former mesic prairie wetlands now called the "Hole-in-the-Donut." This area (4000 hectares) was intensively farmed for several decades using only crude mechanical soil preparation methods. In the early 1950's the process of rock-plowing was developed which crushes the natural limestone rock, producing a substrate much better suited for crops than the existing substrate. This pedogenesis changed the area from primarily low nutrient, low oxygen (perhaps anaerobic in some circumstances) conditions to higher nutrient, higher oxygen conditions which have been tied to increased susceptibility to exotic invasion. Approximately half of the "Donut" was rock-plowed and, since acquisition by Everglades National Park, has become dominated by *Schinus terebinthifolius*. Various techniques (planting, mowing, burning, bulldozing, substrate removal, etc.) have been tried in an attempt to restore this area to wetlands. Of these methods, only substrate removal has been effective. The results of substrate removal are an increase in hydroperiod and mitigation of the conditions created by the disturbed substrate. These changes alter the secondary successional patterns in favor of natural revegetation. In order to evaluate this technique for possible use on all former wetlands in the Donut, a large scale test has been implemented utilizing an off-site mitigation program involving Everglades National Park, Dade County Department of Environmental Resources Management, and the U. S. Army Corps of Engineers. Substrate has been removed from 24.3 hectares within the Donut. Secondary succession, hydrological, microbiological and nutrient relationships are being monitored over the next several years. Preliminary results suggest that hydrological and pedological conditions are favoring succession toward native wetland vegetation.

INTRODUCTION

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[1] This publication should be cited as: Doren, R.F., L.D. Whiteaker, G. Molnar and D. Sylvia. Restoration of Former Wetlands within the Hole-in-the-Donut in Everglades National Park, *in* Webb, F.J., Jr., Ed. 1990. Proceedings of the Seventh Annual Conference on Wetlands Restoration and Creation. Hillsborough Community College, Tampa, Florida.

Exotic plants pose one of the greatest threats to the integrity of Everglades ecosystems. Over 220 species of introduced plants occur in Everglades National Park (Whiteaker and Doren 1989). One of the major areas of exotic plant invasion within the park is called the "Hole-in-the-Donut". This area includes approximately 4000 hectares of previously farmed land. Farming began in 1916 primarily using crude mechanical soil preparation and clearing. In 1934 Congress authorized the establishment of Everglades National Park but excluded this large area of privately owned agricultural land. In the early 1950's rock-plowing was developed. By crushing the natural limestone rock, rock-plowing produces a substrate much better suited for crops than the existing substrate (Ewel et al. 1982). This pedogenesis changed the area from primarily low nutrient, anaerobic conditions to higher nutrient, aerobic conditions which has been tied to increased susceptibility to exotics (Gerrish and Mueller-Dombois 1980, Bridgewater and Backshall 1981, Huenneke, et. al. 1990). Rock-plowing continued in the Donut through 1975 by which time approximately 2000 hectares of land had been rock-plowed. The remaining 2000 hectares of non rock-plowed land were variously abandoned from around 1930 through the early 1960's. The majority of non rock-plowed land has returned primarily to native vegetation, with only a small portion dominated by *Schinus* (Ewel et al. 1982). The oldest areas dominated by *Schinus* are about 35 years past abandonment (Figure 1). The 2000 hectares of rock-plowed land formerly consisted of approximately 1600 hectares of wetland prairies, 140 hectares of sawgrass glade, 40 hectares of ponds, 180 hectares of pineland, with the remainder in bayhead or hammocks (Krauss 1987). In 1975 the park acquired the remainder of the Hole-in-the-Donut, and farming ceased with this acquisition.

Once farming was discontinued, the Park Service perceived a dual problem of re-establishing native vegetation and preventing invasion of exotic species, particularly *Schinus*. Virtually no information was available regarding the successional trends of abandoned rock-plowed farm land in southern Florida (Alexander 1973). Several attempts to quantitatively and qualitatively define and describe old field succession were made. Regional studies on the processes and stages of old-field succession have been detailed by Oosting (1942), Keever (1950), McCormick and Buell (1957), Odum (1960), and Egler (1952). Robertson (1953, 1955), Hilsenbeck (1976), and Alexander (1972) attempted to quantify succession and early seral stages. Loope and Dunevitz (1981), Ewel et al. (1982), Krauss (1987), and Doren and Whiteaker (1990a) quantitatively examined the patterns of old field succession occurring in the park. Loope and Dunevitz (1981) determined that the *Schinus* was increasing by as much as twenty times its population density per year. Doren and Whiteaker (1990a) found that *Schinus* invasion proceeds from low densities in a mosaic of herbaceous vegetation (five to ten years since abandonment) through extremely high densities (ten to twenty years since abandonment) to a self-sustaining stand with somewhat reduced density but with many very large trees (>20 years since abandonment). Krauss (1987) and Ewel et al. (1982) were unable to relate successional patterns or apparent final stages to farming history, hydrological differences, or substrate variations, but concluded that the successional forests dominated by *Schinus* are maintaining themselves. They also concluded that proximity to seed source, seed rain intensity, and local distribution were primary causes for the expansion of *Schinus* in and around the Donut. Doren and Whiteaker (1990b) determined that fire does not exclude the establishment of *Schinus* and other hardwoods, nor does it promote the establishment or expansion of paragrass (Brachiaria mutica), or other grasses, in the Hole-in-the-Donut. Previous work by Allen (1936), Egler (1942), Myers (1983), Ewel (1986), Smith (1985), Harper (1965), Crawley (1987), Sukop and Trepl (1987) and Vitousek and Walker (1989), has shown that perturbation favors the colonization of weedy, principally exotic species, and the elimination or mitigation of the disturbance does not. Further, review of unpublished records pertaining to attempts to restore the Donut included various projects such as: 1) planting pine seedlings and saplings; 2) seeding with pine and several species of

hardwoods and grasses; 3) transplanting native grasses and sedges; 3) mowing; 4) discing; 4) burning; 5) bulldozing and other forms of mechanical removal of *Schinus*; 6) removal of substrate in a former slough to reestablish hydrological flow; 7) planting hardwood saplings; and 8) chemical control of *Schinus*. Only two of the projects, the substrate removal in the former slough and a portion of the bulldozed site, resulted in the recolonization of previously rock-plowed sites by native vegetation to the exclusion of *Schinus*. While constant mowing or discing prevent *Schinus* invasion, the cost of such a program is prohibitive, and once stopped succession again proceeds to *Schinus*. The net result of the two substrate removal project was the elimination of the effects of the disturbed substrate and subsequent increase in hydroperiod. Both disturbance and shortened hydroperiod have been directly related to changes in secondary successional patterns and exotic invasion by Bridgewater and Backshall (1981), Allen (1936), Egler (1942), Myers (1983), Ewel (1986), Smith (1985), Harper (1965), Crawley (1987), Sukop and Trepl (1987), and others. Additional examples of the effectiveness of substrate removal are demonstrated in several sites in the East Everglades Management Area, where Dade County Department of Environmental Resources Management has required the removal of substrate disturbed by illegal rock-plowing or filling as mitigation for permit violations (Dalrymple 1989).

The project presented here was proposed to systematically examine the results of the removal of rock-plowed substrate as a rehabilitation tool for abandoned farmlands dominated by *Schinus* forest in the Hole-in-the-Donut. The project has the following objectives:

1. Determine the effects of partial and total removal of disturbed substrate in former wetlands on vegetation composition, especially recolonization by *Schinus* and other exotics.

2. Determine the effects of increased hydroperiod due to the lowering of surface elevation on vegetation composition, especially recolonization by *Schinus* and other exotics.

3. Evaluate the synergistic effects of partial and total removal of disturbed substrate and increased hydroperiod on vegetation composition, especially recolonization by *Schinus* and other exotics.

4. Determine the changes in vesicular-arbuscular mycorrhizae fungi associations and their possible effect on plant succession as a result of the removal of disturbed substrate and an increase in hydroperiod.

5. Determine the changes in soil nutrient levels as a result of removal of disturbed substrate, standing vegetation, and increased hydroperiod.

STUDY AREA

The study area is located in the extreme southern everglades in Everglades National Park, Ranges 36 and 37 East, Township 58 South, in Dade County, Florida (Fig. 2). The natural features and vegetation of the area have been described by Davis (1943), Egler (1952), Robertson (1955), Craighead (1971), Alexander and Crook (1973), Hilsenbeck (1976), Wade et al. (1980), and Krauss (1987). Soils were mapped and described by the USDA (1958). The study site is within the Hole-in-the-Donut (Fig. 3, item # 1). Post farming successional vegetation associations have been described by Ewel et al. (1982), Krauss (1987), and Doren and Whiteaker (1990a). The site is located 335.4m $\pm$ north of the southeast corner of Section 36, Township 58S, Range 36E (Fig. 3). The site extends approximately 570m along the road, and approximately 426.8m perpendicular to

the road, and is a total of 24.3 ha. It is subdivided into two sections so as to allow partial removal of the disturbed substrate on the southern most 6.1 ha. Disturbed substrate was removed to the level of undisturbed substrate on the remaining 18.2 ha.

MATERIALS AND METHODS

This study involved the removal of exotic dominated vegetation cover (*Schinusterebinthifolius*) and the disturbed, previously farmed, substrate on 24.3 ha of the Donut. Removal was down to limestone bedrock on 18.2 ha (completely mitigated site), and on 6.1 ha (partially mitigated site) approximately one half of the disturbed substrate was removed. We proposed the study in order to evaluate the use of substrate removal as a means of restoring former wetlands. The two different removal strategies were developed in order to further evaluate the relative effects of soil removal and increased hydroperiod on effectiveness of restoration, and the prevention of *Schinus* reinvasion.

Substrate Removal and Surveying

Prior to vegetation or substrate removal, survey lines were cleared by bulldozer (model D8). Elevation sightings were taken at the edge of the cleared survey lines (outside of the disturbance created by the bulldozer) in order to provide a topographic map prior to soil removal. A 15.24cm (6") contour map was produced from the initial survey. Elevations were determined to $\pm$ 0.3cm (0.01 ft) National Geodetic Vertical Datum, 1929 (NGVD29). After this elevation survey, the vegetation was cleared and piled, allowed to dry, and burned. Soil depths were systematically taken on the 6.1 ha portion of the site. Three depth measurements were taken at each location using a standard soil probe.

Substrate removal began after the vegetation was burned. Substrate removal consisted of bulldozing the substrate into windrows, loading the substrate into dump trucks and hauling the substrate to a previously approved site outside the park for disposal.

After substrate removal, another topographic survey was completed and a six inch contour map was created.

Topography and control sheets were produced from a black and white aerial image taken of the site after substrate removal. The control sheets identify the location of all vegetation plots, seed traps, hydrological wells, site corners with UTM locations, location of bench mark, and topographic survey.

Data Sampling

Vegetation Sampling

Sixty-three vegetation sample plots were systematically placed in a grid pattern throughout the site, 49 plots on the completely mitigated 18.2 ha site and 14 on the partially mitigated 6.1 ha site.

Each plot is 100 m^2 (10 m X 10 m) in size. Each vegetation plot was placed at an intersection of a 60.75 m^2 (200 ft^2) grid previously surveyed on the site. All vegetation plots are permanently tagged and numbered, and marked at the four corners with 1.27 cm (0.5") rebar. Vegetation is sampled in six layers (1 = submersed, 2 = liana, 3 = 0 - 1m, 4 = >1m - <2m, 5 = >2m - <5m, 6 = >5m), and by life-form (herb, shrub, tree, liana). Occurrence of each species within each plot is evaluated by layer using the Braun-Blanquet cover-abundance scale (1 = numerous but with < 5% cover; 2 = any number with 5 - 25% cover; 3 = any number with 25 - 50% cover; 4 = any number with 50 - 75% cover; 5 = any number with > 75% cover; 8 = few with < 5% cover; 9 = solitary with < 5% cover) (Mueller-Dombois and Ellenberg 1974). Federal wetland category is determined for each species. A complete species list is determined for the site at each sampling interval (including species not found within the designated sampling plots. Vegetation data are collected every six months.

One square meter ($1m^2$) subplots are located in the southeastern corner of each plot. *Schinus* seedlings are counted in each subplot.

In order to estimate the amount and pattern of incoming *Schinus* seeds onto the site, 0.5 m^2 seed traps were placed adjacent to each vegetation plot. Nine additional seed traps were placed at systematic intervals near the edges of the mitigation site, and nine were similarly place within the surrounding *Schinus* forest. Seed traps are sampled monthly. Seeds collected in the seed traps are tested for viability by germination under mist, in a greenhouse. Germination is defined as the emergence of the cotyledons.

Total potential for *Schinus* seed germination from the existing substrate seed bank were estimated using substrate samples and allowing for germination. Samples were randomly located and will consist of 10 $1m^2$ samples of soil removed to bedrock.

Hydrological Sampling

Hydrological wells were drilled adjacent to each vegetation plot. Each well has an "effective" minimum of 1m deep. Each well was drilled using a standard well drilling rig with a 6 inch (15.24 cm) bit, and cleaned of rubble using the blow-out method - where compressed air is forced down the bottom of each well as drilling proceeds. Each well is then lined with 2 inch (5cm) PVC pipe which is surrounded by pea gravel and capped at ground level with concrete. The top of each well pipe is surveyed to $\pm$ 0.3 cm NGVD29. Water levels are measured manually every two weeks using an engineers tape measure.

A continuous water level recorder was placed in an additional well located near the center of the site. This well was drilled using the same drilling rig and clean-out method but used an 18 inch (45.7 cm) drilling bit. The finished well is 12 inch (30.5 cm) wide, has an "effective" minimum depth of 6m, and is lined and finished in the same manner as the other wells. Mean water level is automatically recorded to NGVD29 every hour using a potentiometric data logger.

Substrate Nutrient Sampling

Twenty substrate samples (approximately one per 1.25 hectares) were systematically taken, using a grid pattern covering the entire site, before substrate removal. Twenty additional samples were taken 2 years after the initial mitigation.

The analysis parameters include: pH, conductivity, ammoniacal nitrogen (ug/g - NH_4), nitrate nitrogen (ug/g - NO_3), total nitrogen (mg/g - Kjeldahl N), total phosphorus (ug/g - Total PO_4), chlorides (ug/g - Cl), total organic matter (%TOM), Aluminum (%Al), Iron (%Fe), Potassium (%K), Magnesium (%Mg), Copper (ppm Cu), Manganese (ppm Mn), and Zinc (ppm Zn).

Vesicular-Arbuscular Mycorrhizae (VAM) Fungi Sampling

A. Initial Documentation of Host Plant Colonization and Predominate VAM Fungi:

1. Adjacent *Schinus* forest:

The distribution of VAM Fungi and the intensity of VAM fungus colonization of roots in an adjacent site, comparable to the mitigation site, were determined. Twenty-five cores (ca. 15 cm diameter and 20 cm deep) were taken randomly at the site. Roots were washed free of soil. Fine roots (<2mm) were cleared in 10% KOH, stained with 0.05% trypan blue, and percentage of fine root length colonized by VAM fungi were estimated by a gridline-intersect technique. Spores were separated from the soil by wet-sieving and decanting, followed by centrifugation in water and 40% sucrose. Spores were quantified and identified to genus and, where possible from field-collected material, to species. A subsample from each core were mixed into a composite sample from the site for determination of the inoculum potential of VAM fungi, using the Most Probable Number (MPN) method.

2. Partial and full mitigation sites:

Following mitigation and permanent location of vegetation study plots, an assessment were made of the VAM status of the partial and full mitigation areas. Cores were collected adjacent to every other vegetation plot, giving a total of 32 samples. Distribution of spores were determined as noted in A.1. above. For determination of inoculum density, subsamples from cores were mixed to provide material for three and six MPN assays for the partial and full mitigation sites, respectively.

B. Determination of the VAM Status of Recolonizing Plant Species:

1. Root colonization of recolonizing plants:

Approximately 12 and 18 months after mitigation, representative fine root samples were collected from plants growing adjacent to the 63 vegetation monitoring plots. Root samples were processed as noted in A.1. above.

2. Monitoring inoculum potential and predominant VAM species:

Approximately 12 and 18 months after mitigation, cores were collected adjacent to every other vegetation monitoring plot. Spore populations and inoculum potential were determined as noted in A.1. above.

C. Determination of the VAM Status of Abundant Native Wetland Prairie Vegetation in Undisturbed Natural Communities.

1. Root colonization of native wetland species:

Representative fine root sample of *Cladiumjamaicensis*, *Muhlenbergiacapillaris*, *Eleochariscellulosa*, *Rhyncospora tracyi*, and *Pluchea rosea* were collected randomly from an area of undisturbed prairie.

2. Monitoring inoculum potential and predominant VAM species:

Cores were collected randomly from an area of undisturbed prairie. Spore populations and inoculum potential was determined as noted in A.1. above.

Data Analysis

Vegetation Data

The synthesis table technique (Mueller-Dombois and Ellenberg 1974, Gauch 1982) were used to arrange the sample plots in a sequence that brings together plots similar in species composition and to arrange species in a sequence relating to their distributions among samples. Sample plot vegetation data were input into a species/sample plot matrix for use with the COENOS (IBM PC compatible) microcomputer program (Ceska and Roemer 1971).

The data will also be analyzed using the dendrogram technique (Mueller-Dombois 1974). A dendrogram was produced to display the mutual relationships among sample plots. Data were input into a matrix for use with the MVSP (IBM PC compatible) microcomputer program (Kovach 1986).

Comparisons of the number of species were made by their Federal wetland categories to evaluate the numbers of species recolonizing the site and their relative habitat designation.

Seed trap data was used to calculate mean seed rain and standard deviation per m^2 per month. These calculated values will also be used to describe the variability of seed rain relative to time of year and distance from nearest seed source. Correlations between distance from seed source (and if possible, method of dispersal by bird, mammal, or wind/water) and occurrence of *Schinus* within the vegetation plots was determined.

Percent seed viability of the *Schinus* seed collected was determined using the germination results.

Hydrological Data

Water levels were determined to NGVD29. They were compared to the site topography to determine depth, total area inundated, and period of inundation by month. Water levels from the manual wells were correlated to the continuous reading well in order to determine hydrological conditions over the entire site using only the continuous well. These data were compared with the topographic map and were correlated with vegetation colonization. Data were entered into a GIS using the GRASS III program for geographic analysis.

VAM Fungi Data

The VAM study is being conducted to determine if there is a relationship between successional trends on the various sites and VAM fungi species that colonize these sites in unmitigated areas of the Hole-in-the-Donut, mitigated sites and natural prairie areas. The data collected here were used to establish any VAM fungi - macrophyte species affinities and habitat preferences. Correlations of

the occurrence of different VAM fungi species by site (disturbed substrate/*Schinus* dominated forest; mitigated sites; undisturbed native prairie) were determined. These results were instrumental in developing a method, through inoculation of sites, for encouraging more favorable and rapid recolonization by desirable wetland species on mitigated sites.

RESULTS

Substrate Removal and Surveying

Substrate scraping and removal was completed between January 23 and June 13, 1989. A total of 3,437 dump truck loads, or approximately 68,740 cubic meters of rock-plowed substrate, was removed from the site. The number of truck loads removed per work day ranged from 7 to 166 loads per day. The number of trucks working on days that substrate was hauled ranged between 1 and 14 trucks.

Exotic vegetation and rock-plowed substrate was removed from a 24.3 ha area that is 569 meters by 427 meters. Disturbed substrate was removed down to undisturbed substrate (limestone base) on 18.2 ha of the site that is 427 m^2. Substrate was partially removed from a 6.1 ha site that is 427 meters by 142 meters. Vegetation and substrate were also removed from a 30.5 meters wide "buffer zone" along three sides of the site.

Aerial photography of the site was taken in September, 1989 and adjusted to a scale of 1 inch = 50 feet (2.54cm = 15.2 m) based on targets placed at known points. A topographic map with 6 inch contours was produced at this same scale to overlay the aerial photography. Elevations on the site ranged from -0.9 meters (-3') NGVD29 to +1.1 meters (3.6') NGVD29.

Data Sampling

Vegetation Sampling

The vegetation of the site has been sampled twice from each of the 63 permanently marked vegetation plots. The initial sample was taken in August, 1989 and the second sample was taken in February, 1990. The data from the initial sampling has not yet been analyzed with community analysis methods. However, these data resulted in a list of 101 species that were classified into Federal wetland habitat categories. Eleven percent are obligate wetland species, 39% are facultative wetland species, 2% are submerged species, 29% are facultative upland species, and 20% are upland species. Thus, a total of 54% of the plants listed from the site are wetland species.

Six of the 63 one meter square seedling subplots contained *Schinus* seedlings in August, 1989. Only two of these subplots were in the area where the rock-plowed substrate was completely removed, and four of the subplots were in the partially removed area. In the partially removed section the calculated *Schinus* seedling density is 0.93/m^2, while in the complete substrate removal area the calculated *Schinus* seedling density is 0.08/m^2.

No seed traps contained seeds in September, 1989, two traps contained two seeds each in October, 1989, ten traps contained from three to 37 seeds in November, 1989, and twelve traps contained from two to 149 seeds in December, 1989. Of the seed traps that contained seeds, both were under the *Schinus* canopy in October, eight of the 10 traps were under the canopy in November, and nine of the 12 were under the canopy in December. Therefore, only five seeds traps outside the *Schinus* canopy contained seeds for the period for which the data has been tabulated. These five traps

contained from two to 21 seeds each. The traps under the *Schinus* canopy contained from two to 149 seeds each during this same period, and ranged from 17 to 149 seeds per trap in December.

DISCUSSION

This project was implemented as off-site mitigation for a private wetland development in Dade County. Total project costs of $640,000.00 were borne entirely by the private developer. Everglades National Park, the U.S. Army Corps of Engineers and the Dade County Department of Environmental Resources Management (DERM) worked cooperatively to develop this project. This cooperative effort was needed to ensure that it would meet the compensatory mitigation needs mandated under Federal, State and local regulations, as well as the National Park's needs to design a management tool for rehabilitating the Hole-in-the-Donut area.

Dade County DERM has had a long standing interest in promoting the development of a practical methods for wetland mitigation that could be applied to certain wetland dredge and fill projects requiring regulatory permits. The project represents a pilot attempt to accomplish such off-site mitigation. If project goals are met, Everglades National Park will consider whether to establish a large-scale funding source for off-site mitigation in the Hole-in-the-Donut. Under this concept, a General Permit mechanism would be approved to allow individual developers within a defined, highly-stressed wetland area of Dade County, to meet mitigation obligations under Federal, State and local regulations, by paying into a fund at a unit cost per acre of wetland impacted. Costs per acre would be based on mitigation ratios established under the General Permit by the regulatory agencies and the Park. It is anticipated that a mitigation rate of $15,000.00 per acre will be the minimum required. This process will hopefully provide sufficient resources to enable Everglades National Park to eventually rehabilitate the entire Hole-in-the-Donut.

Initial data suggest that the mitigation site is favorable for colonization by native wetland species, since 54 per cent of the species encountered in the initial monitoring have been classified as wetland species. These results also support the sequence of old field succession found by previous studies in the Hole-in-the-Donut (Loope and Dunevitz 1981, Ewel et al. 1982, Krauss 1987) where initial stages of this succession are dominated by weedy herbaceous wetland species (Figure 1). However, *Schinus* seedling colonization on the partially mitigated area is similar in density (0.93 seedlings/m^2) to that found on abandoned rock-plowed sites that have succeeded to woody communities dominated by a *Schinus* canopy (0.9 seedlings/m^2; Doren and Whiteaker 1990). In contrast, the fully scraped area has a substantially lower density of *Schinus* seedlings (0.08 seedlings/m^2). This suggests that the partially scraped area is more likely to follow the successional sequence towards a *Schinus* dominated successional forest, and the fully scraped area is likely to follow the successional sequence towards a community dominated by native plants.

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Table 1. Partial listing of species colonizing the mitigation site in the Hole-in-the-Donut.

Aeschynomene spp.
Ammania coccinea
Ammania latifolia
Andropogon glomeratus
Aster subulatus
Boehmeria cylindrica
Caperonia palustris
Conoclinium coelestinum
Cyperus brevifolius
Cyperus distinctus
Cyperus odoratus
Cyperus polystachyos
Cyperus surinamensis
Dichromena colorata
Diodia virginica
Erigeron quercifolius
Eupatorium leptophyllum
Chloris glauca
Ludwigia microcarpa
Ludwigia octovalvis
Lythrum alatum
Mikania scandens
Cynoctonum petiolata
Myrica cerifera
Phyla nodiflora
Pluchea odorata
Salix caroliniana
Senecio glabellus
Solidago stricta
Typha spp.
Sagittaria spp.
Carex spp.
Rhynchospora spp.
Najas spp.
Pontederia cordata
Cladium jamaicensis
Schoenus nigricans
Eleocharis spp.
Aletris farinosa
Muhlenbergia capillaris
Schizachyrium spp.
Flaveria spp.

Periphyton

Figure 1. Flow chart showing general pattern of succession on farmland abandoned without the effects of rock-plowing and with the effects of rock-plowing.

Figure 2. Map of southern Florida and Everglades National Park, indicating the area of the Hole-in-the-Donut.

Figure 3. Map of the Hole-in-the-Donut showing the location of the mitigation site.

ENGINEERING SPECIFICATIONS

A. Topography and Control Sheets

Soil depths are to be taken on a 100 X 100 foot grid on each site. Three depth measurements shall be taken at each sample site **before vegetation and soil removal**, using a standard soil depth probe.

A Topography and Control Sheet shall be done after substrate removal and final grading are completed in order to provide before and after substrate contours and profile. The control sheet will have three inch (3") contour lines plotted on black and white aerial photography using a scale of one inch equals one hundred feet (1 inch = 100 feet). The contour map shall be produced using a minimum 10 foot control grid. Additional elevation 'shots' are to be taken within each 10 X 10 foot grid to capture all elevation changes $\geq$ 3 inches for individual topographic features greater than 3 ft^2 in extent. All topographic features smaller than 3 ft^2 in extent do not have to be included in the elevation survey. The Topography and Control Sheet will be a reproducible negative, and five blackline copies of the sheet will be provided in 'D' size format. An additional 'E' size format will be provided for all sites where 'D' size format will not encompass the entire site at the indicated scale.

A separate registered overlay of the survey grid with all elevations at all surveyed points is to be provided at the same scale as the topography and control sheet. All surveys are to be performed and certified in writing by a surveyor licensed and insured in the State of Florida. All survey points are to be accurate $\pm$ 0.1 feet ($\pm$ 0.3 cm) NGVD29. Proof of State licensing and insurance shall be provided with bid package.

The following control items are to be represented on all Topography and Control Sheets:

- North Arrow
- Scale Bar (Scale ratios are **NOT** acceptable)
- UTM location for all photographic targets
- Survey grid; surveyed locations of all study plots, wells, equipment; survey corners of entire site, or other important features as determined by EVER
- Bench mark and UTM location and elevation for bench mark

In addition to hard-copy maps all geographic data are to be provided in digital format compatible with park GIS hardware and software configurations. Specifications for GIS compatibility are available from the Computer Sciences section at the Center for Everglades Restoration, Everglades National Park.

B. Aerial Photography for Production of the Topography and Control Sheets

All aerial photographs are to be black and white. All aerial photographs are to be taken **AFTER** substrate removal. Flight height above the ground will be such that the negatives will have an average scale of one (1) inch equals one-hundred (100) feet. Negatives having a departure from the specified scale by more that 5% because of tilt or abrupt changes in flying altitude must be corrected. Ground control targets are to be set out within each site. A minimum of 5 targets are to be placed within each site, or if a site requires more than one photographic image to capture the entire area, then 5 targets are to be placed within each photographic frame. The targets are to be placed such that there is one at approximately each corner of the site (or frame) and one in the approximate middle of the site (or frame). The targets will be a minimum of one meter square (1

m^2) with distinct alternate black and white checkerboard pattern. Each black area will be 0.5 m^2 alternating with each white area of the same size. The coordinates of each target center will be determined to within $\pm$ 0.25 meter accuracy using a Geographic Positioning System. The final coordinates will be noted on the Topography and Control Sheets in Universal Transverse Meridian (UTM). Should the 'site' require more than one photographic image, then end lap will be sufficient to provide full stereoscopic coverage of the area. End lap shall average 63%, plus or minus 5%. End lap of less than 58% or more than 68% in one or more negatives will be cause for rejection of such negatives. Negatives shall be made with the optical axis of the aerial camera in the vertical position. Tilt of any negative by more than three degrees, an average tilt of more than one degree for the entire project, or tilt between any two successive negatives exceeding four degrees may be cause for rejection. Crab in excess of three degrees may be cause for rejection. The photographs and resulting Topography and Control Sheets, will be clear and sharp in detail and of average uniform density. They shall be free from all clouds, cloud shadows, light streaks, static marks or other blemishes. All photography shall be taken at such time as to ensure a minimum solar angle of 30 degrees. The photographs shall be exposed using a distortion free 6 inch focal-length precision aerial mapping camera. A precision camera calibration report from the National Bureau of Standards shall be included in the bid proposal, for the camera to be used. If more than one image is required for the 'site' a photo index will be prepared by directly photographing on safety base film, at a convenient scale, the assembly of contact from all indexed and evaluated prints used. Each photo index shall carry a suitable title, scale bar and north arrow.

C. Bench Mark

A permanent bench mark, to U.S. Geological Survey or Army Corps of Engineers standards is to be established in the vicinity of the mitigation site (it shall be included within the aerial photographic coverage of the site, and shall be clearly marked on the photographs). The bench mark is to be constructed of concrete poured into a 12 inch diameter section of PVC pipe. It shall be extend into the ground at least 24 inches. It shall have a brass control plate firmly imbedded in the concrete. The top of the monument shall extend no more than three inches (3") above ground, but shall not be below the surface level of the ground. The elevation (accurate to within $\pm$ 0.01 feet; $\pm$ 0.03 cm), and the coordinates (accurate to within $\pm$ 0.25 meters using a GPS) shall be stamped into the brass control plate. All topographic surveys on the site shall be made using the benchmark established for that site. The locations for existing triangulation stations within Everglades National Park will be provided as reference for initial survey points.

D. Vegetation Clearing

Vegetation clearing is to be done using chopping or slash producing equipment that reduces the vegetation to manageable slash. This may require several passes by such equipment. After sufficient time to dry, the slashed vegetation may be burned on site if the existing slash is determined to be too bulky to include with substrate removal. Mulching and removal of mulch may be considered as an option.

E. Substrate Removal

Once substrate removal begins a crew superintendent will be on site at all times work is in progress. All interactions with EVER personnel regarding substrate removal specifications and directions on the site will be with the crew superintendent and/or site engineer, or other appropriate representative of the contractor, only.

Substrate is to be cleared and grubbed using appropriate equipment, such as bulldozers (ex. D8, D9), front-end loaders and dump trucks for hauling. All substrate, rubble, rock, vegetation, etc. removed from the site is to be completely removed from the site and deposited at a location previously identified and designated as part of this project. A map indicating the dumping location will be provided to the Contractor. The areas shall be bladed to remove all windrows, rubble piles, hillocks, or other raised sites or coarse disturbance which may serve as locations for re-invasion of *Schinus*. In order to reduce final disturbance and ensure minimum remaining rubble, the final two passes with bulldozer used to remove the soil must be done using equipment fitted with double Grouser treads. The entire removal process, in order to achieve the objective of total substrate removal and surface rock clearing, may take as may as six to eight passes with bulldozers. The total number of passes needed will be determined based on review of results by EVER personnel. Substrate that may be compacted by dump trucks during the removal of substrate windrows must be rescraped and removed as well. Resultant rock and rubble from fine grading is to be disposed of as all other substrate, rock, vegetation, rubble, etc.. All soil pockets, depressions, holes, or other topographic features of the site that can be cleared using heavy equipment are to be cleaned of disturbed substrate to ensure that variations in natural rock surfaces and micro-topographic features are restored and not filled and leveled with the disturbed substrate.

After final substrate removal the entire area is to be compacted with a multiple rubber-tired traffic roller. The compacting shall consist of two passes of the roller in one direction and then two more passes perpendicular to the first. Compacting does not have to include holes or depressions difficult for the compactor to negotiate, but shall include all negotiable portions of the site and shallow hard-bottom depressions.

No portion of the final scraped site shall have an elevation greater than +3.0 feet NGVD29. No minimum elevation applies.

F. Continuous-Monitoring Hydrological Well

An hydrological well is to be placed near the center of the site, but not in an extreme topographic position. Placement of these hydrological wells shall be as indicated on a GIS well grid-map as provided by Everglades National Park. The top of the well shall have a mounting platform that is a minimum of 36 inches (88 cm) and maximum of 40 inches (98 cm) above ground level.

The wells shall be installed according to the standards set by the Everglades National Park Hydrology Department to operate within a range of 12 feet (3.5 meters) below and 29 inches (0.75 meters) above ground level. In order to accomplish this quality of finished well, the unfinished well must be a minimum of 18 inches (44 cm) in diameter and be fully slotted starting at a depth of 1 foot (30 cm) below the top of the bedrock. The well must be blown-out during the drilling process using airlifting or comparable technology. The well must be lined with a minimum of 12" inside diameter PVC pipe. The pipe must have slots every 6 inches around the pipe to within 1 foot (30 cm) of the surface of the bedrock to ensure good water equilibrium within the well. The annular space shall be back-filled with coarse gravel to the top of the slotted screen, then completed with a concrete collar to the ground surface and a 4" X 3' X 3' poured concrete pad to anchor the well casing. The finished well shall be fully developed until all remaining sediment has been removed.

A PVC collar no less than 2 inches wide, shall be attached to the top end of the PVC well pipe to serve as a mounting platform for EVER environmental monitoring equipment. All well mounting platforms are to be placed level using a bubble level and the elevation of the top surface of the platforms are to be surveyed to within ± 0.1 feet (± 0.3 cm) NGVD.

G. Staging Area

If requested, a staging area will be made available for the refueling and staging of equipment and will be designated by EVER. All equipment maintenance (other than necessary on-site repairs) office or equipment trailers, vehicles or any other equipment or supplies that must be stored or warehoused are to be kept at this location. Storage of fuel, if not delivered by fuel truck(s) but stored in stationary tanks, must meet OSHA and NPS standards for fuel storage facilities. The staging area must be maintained and/or returned to original condition or better after completion of the project.

H. Time Frames

All earth-work is to begin when the substrate is reasonably dry and workable. This will usually be during the dry season from approximately December through May. No work is to begin until final approval to begin is provided in writing by the Park. Approximate timing for commencement of earth-work will be December through May, each year. Contractors work for each site **shall** be completed within the dry season the work starts, barring any "Acts of God" that would create environmental conditions precluding this type of earth-work. No contract will be awarded that would require more than one dry season for completion. No earth-work should be planned outside of the December to May period or planned to extend into the following December to May season.

I. Final Considerations - Engineering Specifications

Prior to commencement of work, the contractor is to develop a tentative schedule for all engineering work, including time frames, type and number of pieces of equipment and approximate number of vehicles passing through park entrance station daily with approximate numbers of dump truck trips expected per day through the entrance station or along park roads. After completion of substrate removal and final grading of the mitigation site, any and all damage or disturbance to the road shoulder is to be repaired and the shoulder graded to approximately a 7:1 slope into the mitigation site in order to prevent drop-offs into the restored area. The road shoulder is to be reseeded with Bahia grass.

All motor vehicles, trucks, trailers or other equipment must meet Florida highway road weight specifications. If dump trucks are equipped with a third axle, it must be placed down (except on turns) in order to properly distribute the vehicle weight. Trucks must not be overfilled, are to be covered while traveling on roads, and are to be reasonably free of loose rubble before leaving the work site in order to prevent rubble on road, and to eliminate hazards to other vehicles from falling debris.

The contractor must inform the designated EVER contact person(s) prior to bringing heavy equipment into the park. As each new piece(s) of equipment is needed the contractor must call the designated EVER contact.

All access roads created within the Hole-in-the-Donut for access to and from work sites must be created only from existing disturbed substrate within the Hole-in-the-Donut, and all traces of access road(s) must be removed from the restoration site(s).

Portions of these engineering specifications were developed using standard methodologies and procedures where available, and some were developed on site through trial and error for all cases where no standard methods were available. As such work is unique and in most cases unprecedented in scale and venture, these specifications may be modified as the project proceeds in order to enhance the quality or efficacy of this work.

MONITORING AND STUDY SPECIFICATIONS

Overview

The study of plant community ecology has many methods available and almost as many proponents of one method or another. Approaches have varied from the subjective description (no longer considered scientifically valid) of vegetation with or without reference to associated environmental factors to complex quantitative analyses of the characteristics of the vegetation under consideration (Mueller-Dombois and Ellenberg 1974, Greig-Smith 1983, Green 1979, Myers and Shelton 1980, Sokal and Rolf 1969, Gauch 1982, USDA 1962, Marriot 1974). Since the purpose of this study is to monitor the response of the vegetation to a management action and the associated changes, community sampling and multivariate analysis methods have been chosen as the principal methods since they have the advantages of objectivity, speed and low cost, effective correlation with other factors, relevance to other study interests, and compatibility and comparability with similar studies in the literature (Gauch 1982). Total floristic composition is an important aspect of this study to evaluate effectiveness of exclusion of exotic species and for comparison to similar projects on other sites, and to undisturbed native prairies (Gauch 1982, Mueller-Dombois and Ellenberg 1974).

As is understandably the case with such studies, many questions arise as data from existing studies are analyzed. When such questions inevitably occur additional studies may be developed and implemented. Restoration has become an important element in many natural areas today, and these additional studies will assist everyone involved in the restoration of natural areas in understanding the dynamics of the restoration process, the processes relating to succession in highly disturbed sites, comparisons with natural relatively undisturbed sites, the function of wetlands and the links between these processes and environmental factors effecting or affecting them, and the management implications of land restoration. As results from previous and ongoing studies and other work are analyzed, procedures, specifications or methods for carrying out this project work, studying or monitoring these sites will be modified to incorporate new information for the purposes of enhancing or improving the quality or efficacy of this project.

A. Vegetation Sample Plots

Vegetation sample plots will be placed throughout the site in order to best cover the expected range of variation of the environmental factors found throughout the site, and vegetation that will colonize

the site (Mueller-Dombois and Ellenberg 1974, Krauss 1987). Each plot will be at least 100 m^2 in size in order to sample the upper limit of the empirical area given by Mueller-Dombois and Ellenberg (1974) to sample the total species composition of grassland and agricultural weed communities. The plot size chosen is also significantly larger than required for sampling everglades prairie communities (Porter 1967). The corners of all plots and subplots will be permanently marked with 1/2 inch rebar stakes driven into the substrate, and each plot will be permanently tagged and numbered for future reference. All plot corners will have GPS locations that will be labeled as part of the aerial photography and site survey work. Smaller subplots may be located in each plot in order to evaluate and monitor smaller scale phenomena. Separate plots may be established for other individual monitoring or biological or environmental evaluations that may be deemed important to further the understanding of wetland restoration.

Each plot will be sampled at the time of completion and at specified intervals (to be determined by sampling design and protocol for each element of the monitoring program) for the term on the project. All plots, subplots, sampling locations and wells are to field numbered using tags of a permanent type material such as aluminum, and identification information (including GPS UTM location) is to be located on one blackline copy of the Topography and control sheet. Periphyton shall be considered as a species for sampling protocols involving macrophytes where appropriate.

B. Photopoints

Photopoints will be taken of each area before vegetation clearing, after vegetation clearing but before substrate removal, and after substrate removal. Additional photographs will be taken from the same locations once each year for the duration of funding for this study. Additional photographs of individual mitigation site will be established after substrate removal.

C. Hydrological Sampling

Continuous water level recorders shall be placed in within each project area. This finished wells are to be 18 inches (30.5 cm) wide, have an "effective" minimum depth of 6m. Mean water level shall be automatically recorded to NGVD29 every minute and averaged on the hour using a potentiometric data logger.

D. Additional Environmental Monitoring

Evapotranspiration and rainfall sampling will be added to the sensor arrays placed within the study area. These additional parameters will be used to assist in understanding the relationship to restoration dynamics of the site and environmental parameters.

E. Substrate Nutrient Analysis

A standard substrate analysis will be performed on the site before substrate removal. A minimum of one sample per 3 acres shall be taken. Samples are to be collected in a systematic grid pattern that covers the entire site. Analysis will include: a physical description of the soil, analysis for: N (ammoniacal nitrogen NH_4, nitrate nitrogen, and total nitrogen, P (phosphorous), K (potassium), Mg (Magnesium), Mn (Manganese), Fe (Iron), Cu (Copper), Zn (Zinc), organic content, chlorides, conductivity and pH. A second set of twenty samples are to be taken at the 12, 24, and 36 month monitoring intervals.

F. Additional Responsibilities of Contractor(s)

The contractor shall develop a schedule for monitoring all variables described in A, C, D and E above, which will be subject to the approval of EVER personnel. Standardized data collection formats and computer data entry methods will be used for data collection and data entry. Quality of data and entry will be subject to the review and approval of EVER personnel. All raw data and data formatted for analysis as specified below, maps, drawings, photographs, tables, etc. shall be available to EVER personnel within 30 days after each monitoring cycle and become the sole property of Everglades National Park at the end of the period for which the contractor is responsible for the monitoring program.

DATA ANALYSIS

A. Vegetation

The synthesis table technique as described by Mueller-Dombois and Ellenberg (1974) and Gauch (1982) will be used to arrange the sample plots in a sequence that brings together plots similar in species composition and, similarly, to arrange the species in a sequence that brings together species similar in their distributions in the samples. Thus, groups of sample plots can be identified that are similar in their vegetation structure and floristic composition. Sample plot vegetation data will be input into a species/sample plot matrix with the appropriate format for use in the COENOS program, which is an adaptation for use on a IBM PC or 100% compatible computer of an earlier main frame program for synthesis table analysis (Ceska and Roemer 1971).

To supplement the synthesis table analysis, the data will also be analyzed with the dendrograph technique as described by Mueller-Dombois and Ellenberg (1974). A dendrograph will be produced which displays the mutual relationships among the sample plots whose pairwise similarities are given. The dendrograph will be entirely based on a similarity matrix that will be calculated using several calculation methods. Data will be input into a matrix in ASCI format appropriate for input into MVSP, a program to analyze sample plot data on an IBM PC or 100% compatible computer using the dendrogram technique (Kovach 1986).

Previously identified and permanently marked plots where the vegetation communities recolonizing the Donut area at various time intervals since abandonment have been described, will serve as controls.

B. Hydrology Data

Water table levels will be determined relative to mean sea level and substrate surface. Hydroperiod at each well site will then be determined and analyzed for correlations with vegetation colonization.

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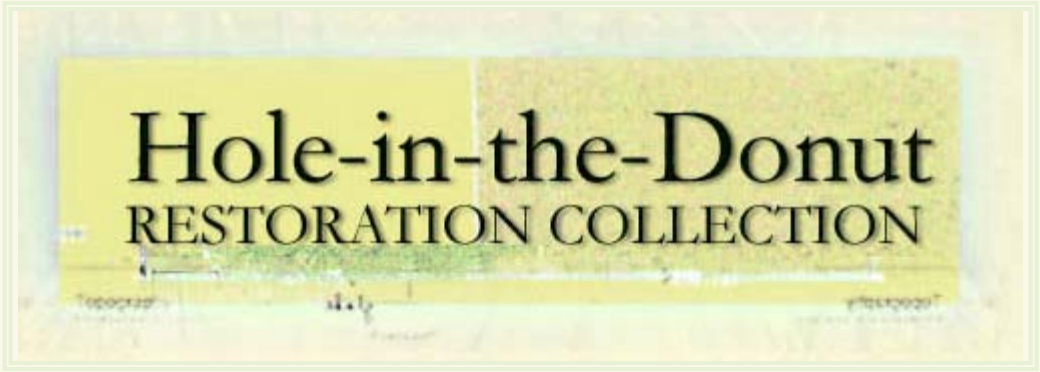
TABLE 2. Per Acre Budget

Per acre costs based on previous project costs and cost estimates and attached specifications.

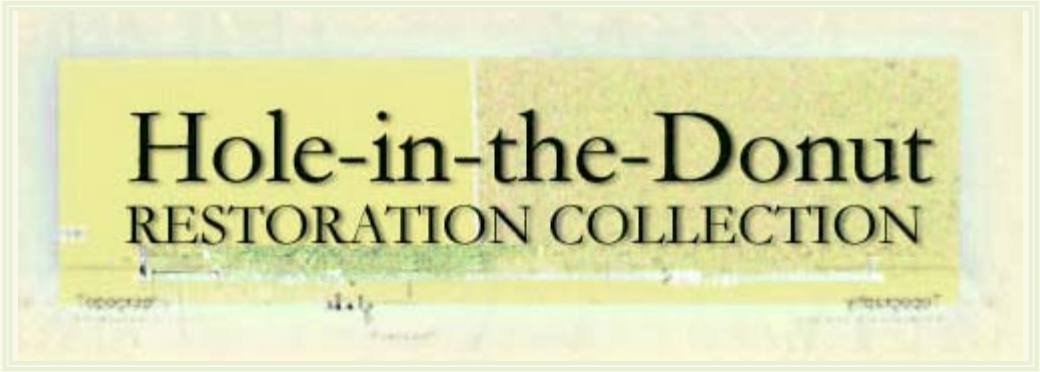
Land clearing, vegetation and substrate removal	7,800.00
Aerial Photography	70.00
Topographic surveys	350.00
Hydrological well construction, placement and survey	10.00
USACOE cost for contracting of earth-works (7% of contract costs)	??
Monitoring and Study of Physical and Biological Parameters	5,600.00
15% Adminstratvie and Project Support Costs - EVER	??
TOTAL COST PER ACRE	??



Photographs

Sample plot from the HID restoration site

View of the Hole-in-the-Donut...

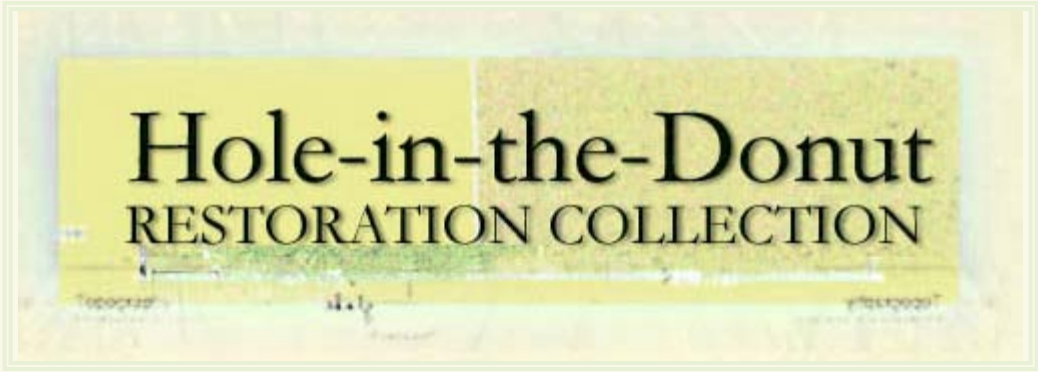


Slides from the Hole-in-the-Donut Restoration Site

Each slide album represents a set of related slides (equivalent to one roll of film). Slide numbers correspond to access numbers from the Museum & Archives Department at Everglades National Park

SLIDE ALBUM ONE

Equipment used for *Schinus* and substrate removal in the Hole-in-the-Donut.
21 images (JPEG format); includes Slide #36332_01 to #36332_24.



SLIDE ALBUM ONE

Equipment used for *Schinus* and substrate removal in the Hole-in-the-Donut

- Slides 36332_01 to 36332_07
- Slides 36332_08 to 36332_13
- Slides 36332_15 to 36332_21
- Slides 36332_22 to 36332_24

Slides 36332_02, 36332_14 and 36332_16 are not available in digital format.

Hole-in-the-Donut
RESTORATION COLLECTION

Slide Album One: Slides 36332_01 to 36332_07

Equipment used for *Schinus* and substrate removal in the Hole-in-the-Donut. Click on a thumbnail image to select a full-sized slide. All full-sized slides are in JPEG format; file sizes are as indicated in brackets.

< | >


Slide #36332_01


Slide #36332_03


Slide #36332_04


Slide #36332_05


Slide #36332_06


Slide #36332_07

Slide # 36332_01
Hole-in-the-Donut Restoration Project
Everglades National Park


Slide # 36332_03
Hole-in-the-Donut Restoration Project
Everglades National Park

Slide # 36332_04
Hole-in-the-Donut Restoration Project
Everglades National Park


Slide # 36332_05
Hole-in-the-Donut Restoration Project
Everglades National Park


Slide # 36332_06
Hole-in-the-Donut Restoration Project
Everglades National Park


Slide # 36332_07
Hole-in-the-Donut Restoration Project
Everglades National Park

Title List

Related Sites

Home

Hole-in-the-Donut
RESTORATION COLLECTION

Slide Album One:Slides 36332_08 to 36332_013

Equipment used for *Schinus* and substrate removal in the Hole-in-the-Donut. Click on a thumbnail image to select a full-sized slide. All full-sized slides are in JPEG format; file sizes are as indicated in brackets.

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Slide #36332_08


Slide #36332_09


Slide #36332_10


Slide #36332_11

Slide #36332_12

Slide #36332_13

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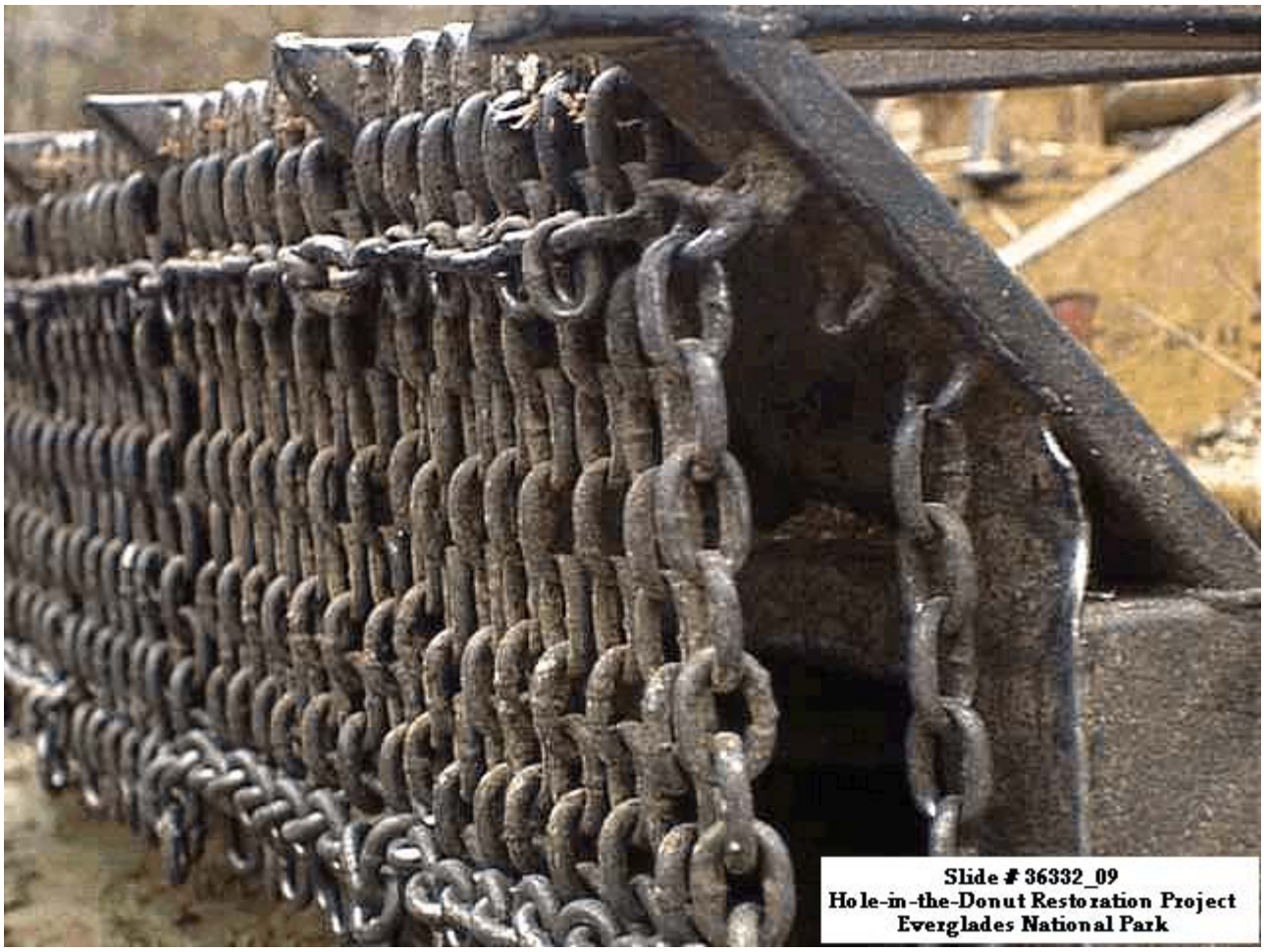
Slide # 36332_08
Hole-in-the-Donut Restoration Project
Everglades National Park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Everglades National Park


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Everglades National Park


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Hole-in-the-Donut Restoration Project
Everglades National Park


Slide # 36332_12
Hole-in-the-Donut Restoration Project
Everglades National Park


Slide # 36332_13
Hole-in-the-Donut Restoration Project
Everglades National Park

Hole-in-the-Donut
RESTORATION COLLECTION

Slide Album One:Slides 36332_15 to 36332_21

Equipment used for *Schinus* and substrate removal in the Hole-in-the-Donut. Click on a thumbnail image to select a full-sized slide. All full-sized slides are in JPEG format; file sizes are as indicated in brackets.

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Slide #36332_15


Slide #36332_17


Slide #36332_18


Slide #36332_19

Slide #36332_20

Slide #36332_21


Slide # 36332_17
Hole-in-the-Donut Restoration Project
Everglades National Park


Slide # 36332_18
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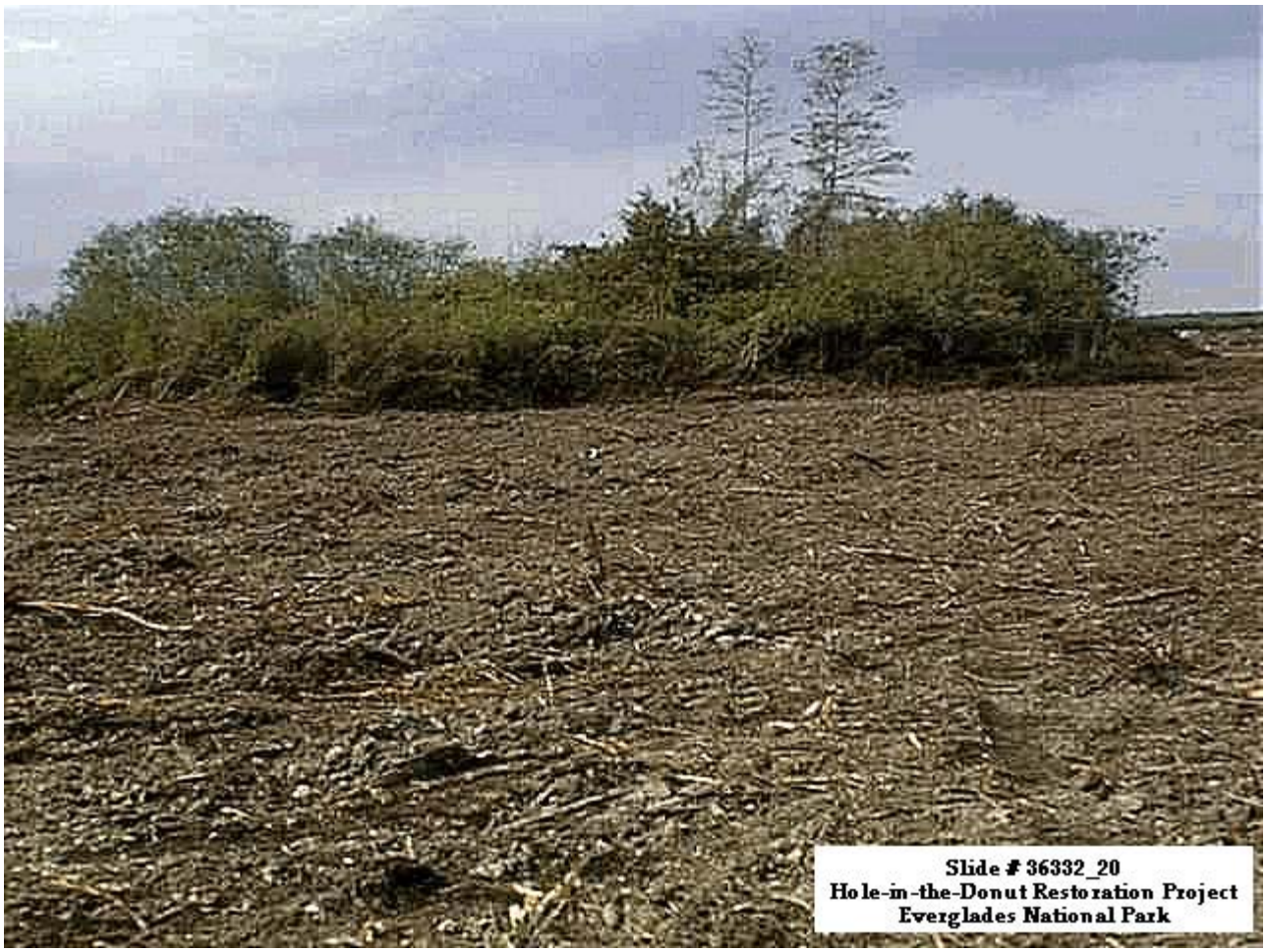
Everglades National Park


Slide # 36332_19
Hole-in-the-Donut Restoration Project
Everglades National Park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Hole-in-the-Donut Restoration Project
Everglades National Park


Slide # 36332_21
Hole-in-the-Donut Restoration Project
Everglades National Park

Hole-in-the-Donut RESTORATION COLLECTION

Slide Album One:Slides 36332_22 to 36332_24

Equipment used for *Schinus* and substrate removal in the Hole-in-the-Donut. Click on a thumbnail image to select a full-sized slide. All full-sized slides are in JPEG format; file sizes are as indicated in brackets.

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Slide #36332_22

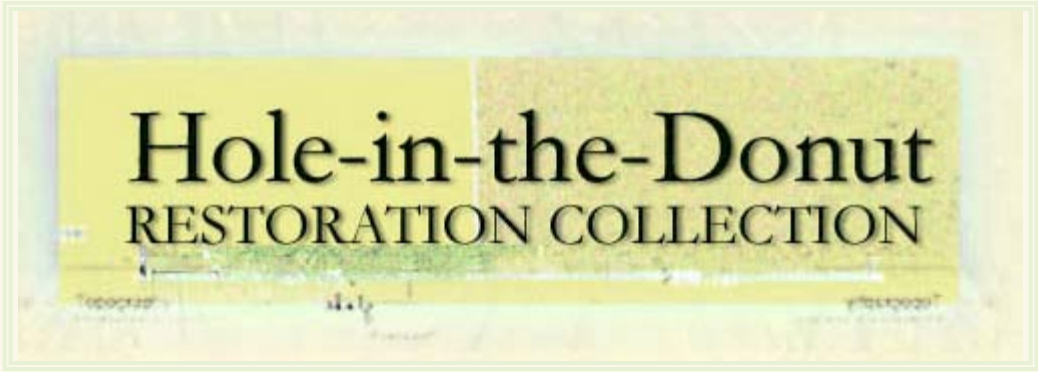

Slide #36332_23


Slide #36332_24


Slide # 36332_22
Hole-in-the-Donut Restoration Project
Everglades National Park


Slide # 36332_23
Hole-in-the-Donut Restoration Project
Everglades National Park


Slide # 36332_24
Hole-in-the-Donut Restoration Project
Everglades National Park



Maps and Other Images

All maps are in GIF or JPEG format; file sizes are as indicated in brackets.

Vegetation Maps

- 1952 Vegetation Map *[810k]*

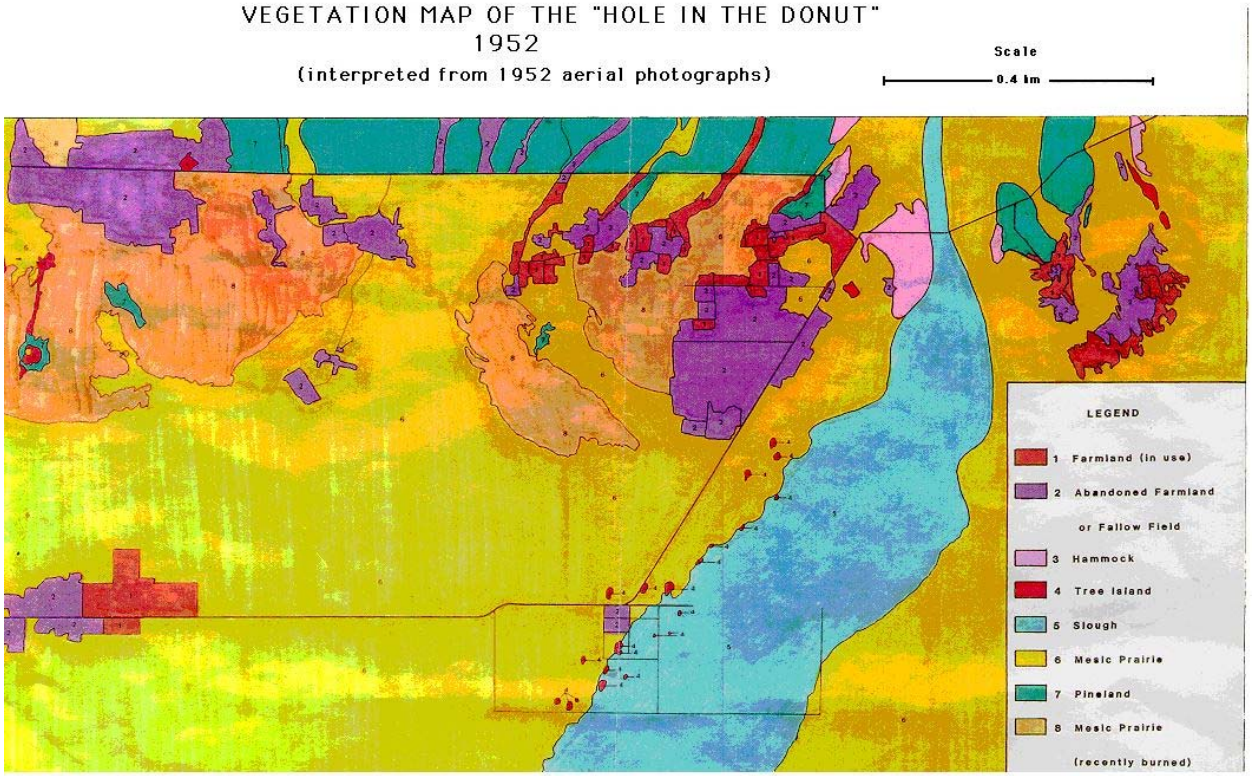
Elevation Maps

- Average Elevations of Mitigation Site *[192k]*
- Flat Elevation map*[31k]*
- Three-dimensional Elevation map*[96k]*

HID Remediation Sites

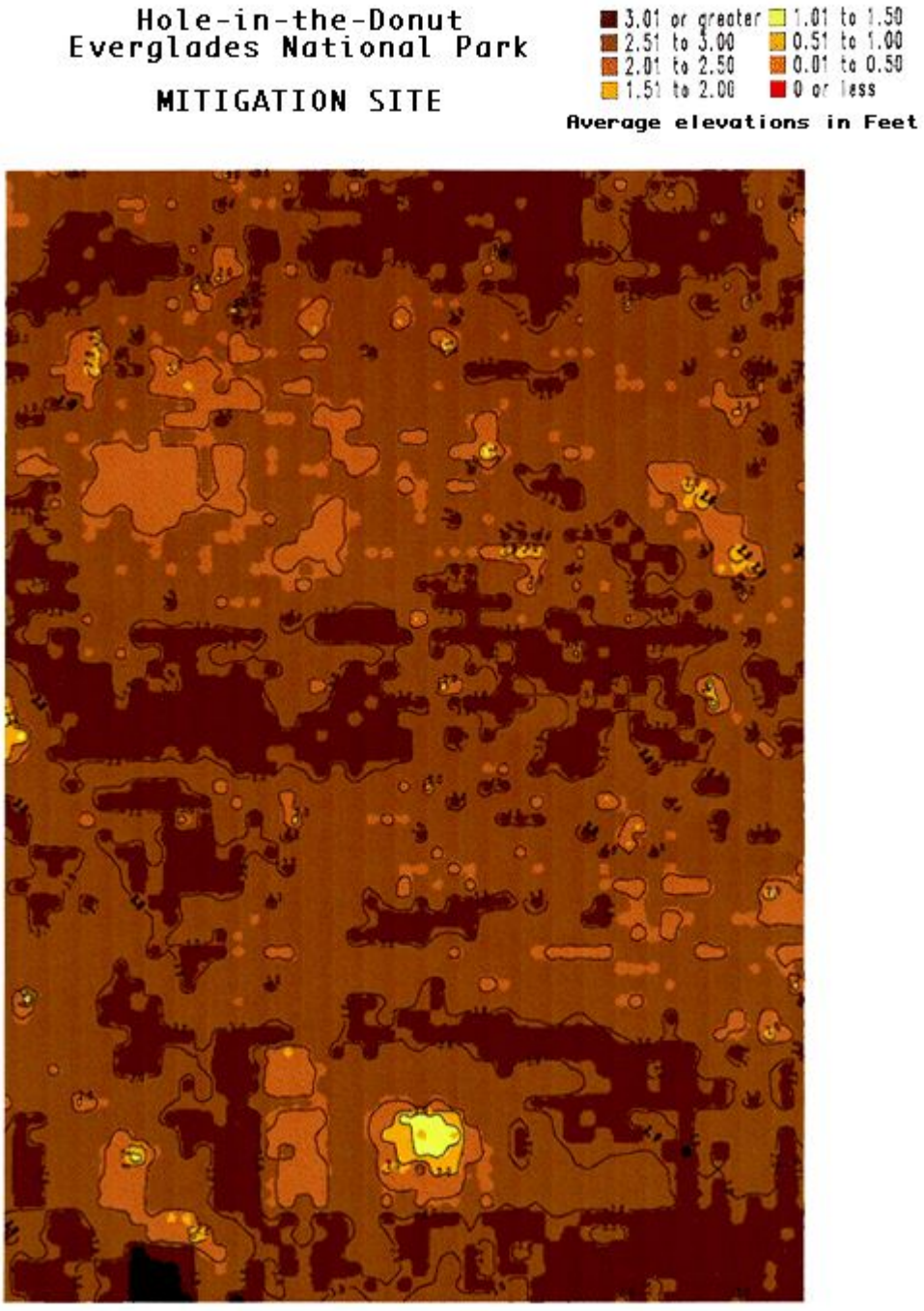
- Mitigation Site Average Water Depths, 1990-1996
- Restoration Site - Year 1*[32k]*
- Vegetation Sites to Protect Site *[288k]*
- Satellite image of HID site within larger context of south Florida ecosystem*[96k]*

1952 Vegetation Map

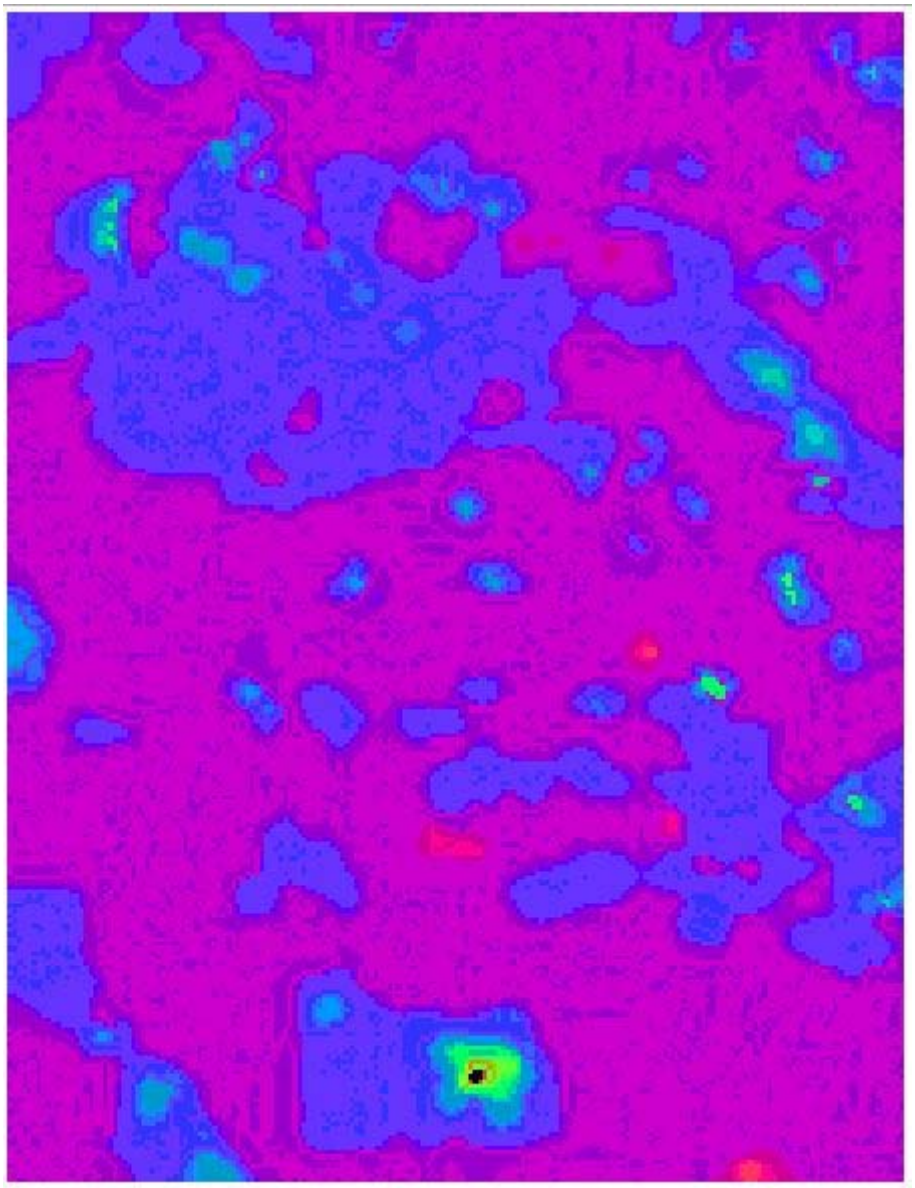


Hole-in-the-Donut

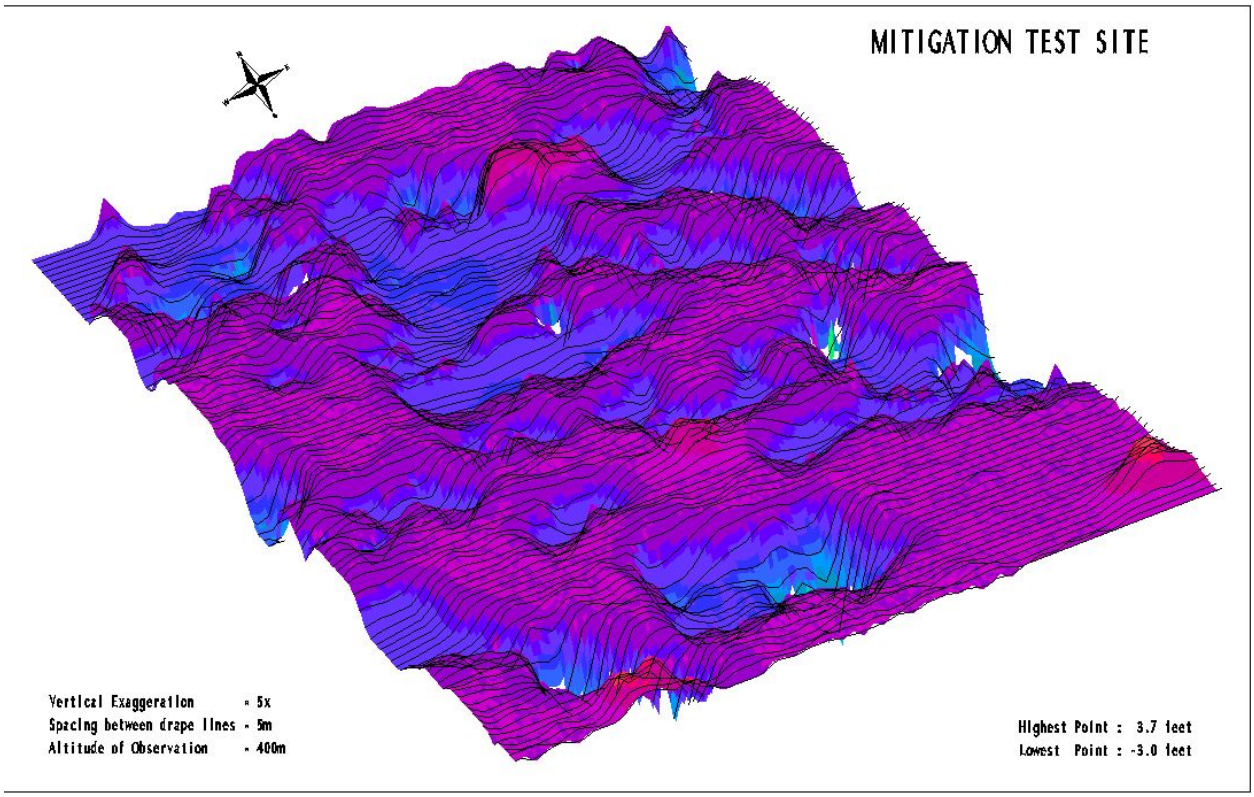
Elevation Maps

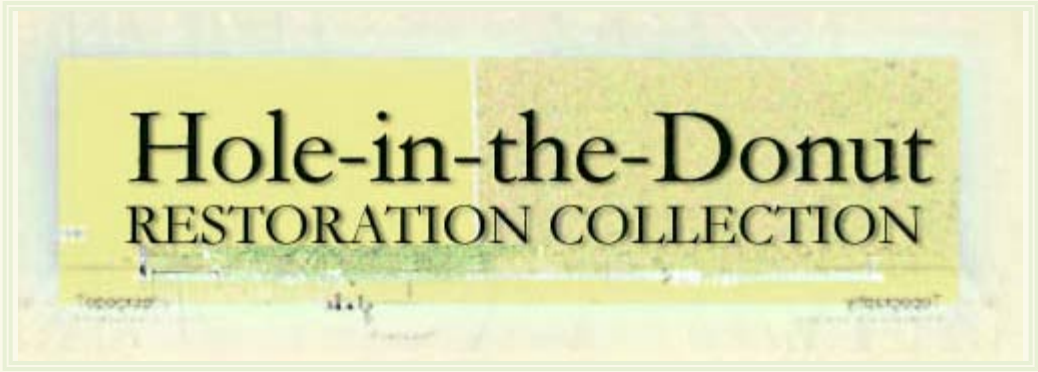


Hole-in-the-Donut Flat Elevation Map



Hole-in-the-Donut 3D Elevation map



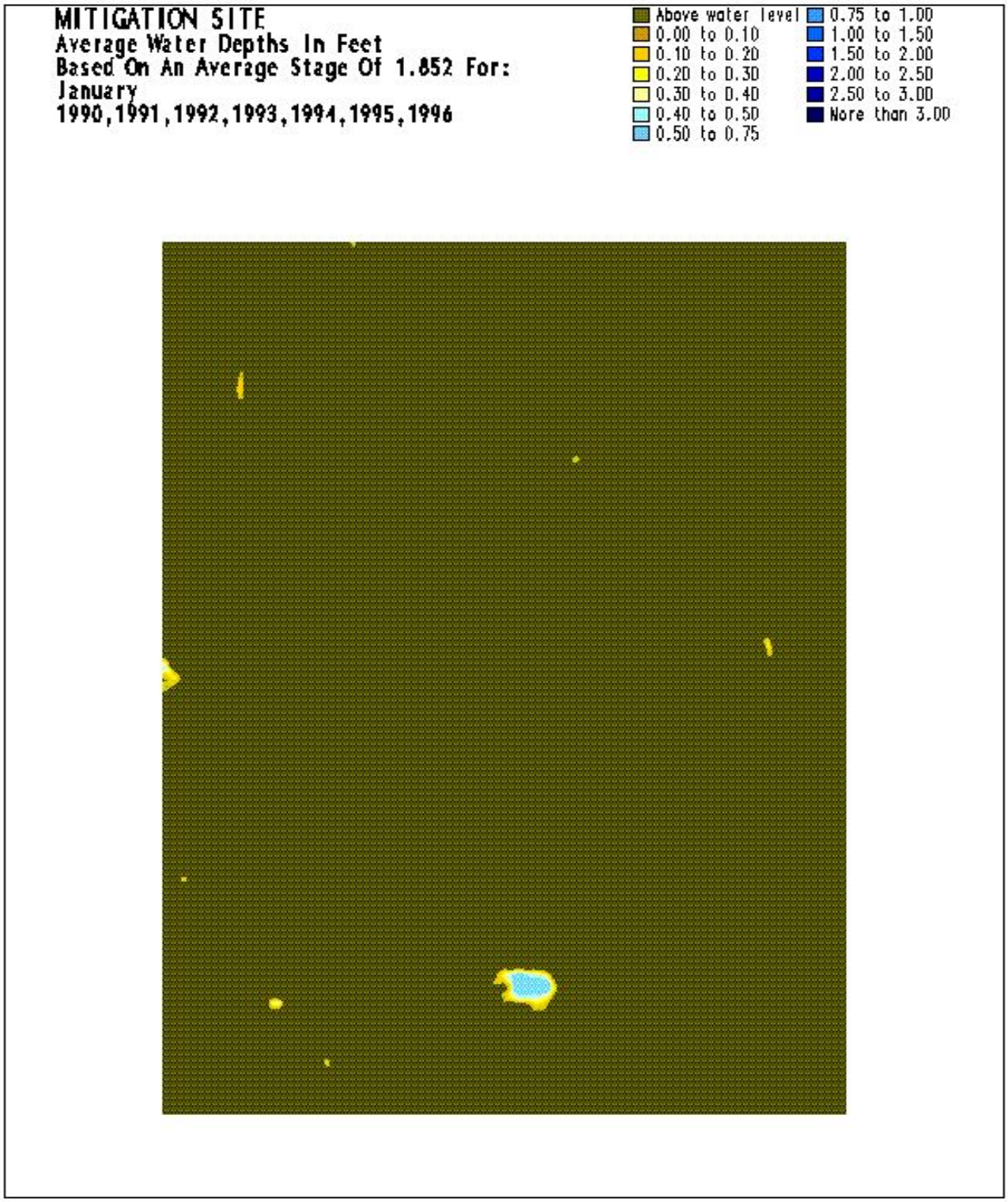


Mitigation Site Average Water Depths, 1990-1996 (in feet)

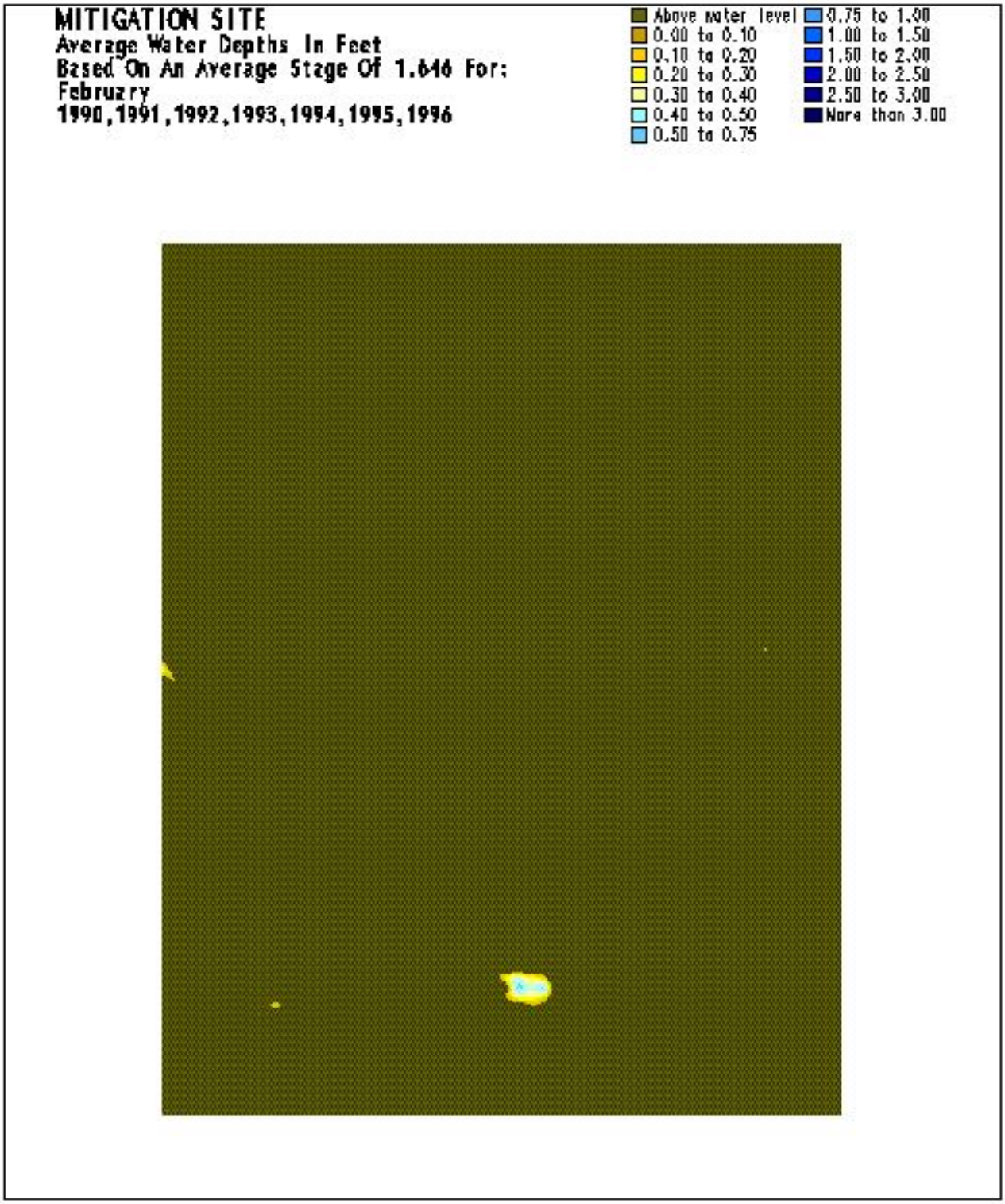
- January *[12k]*
- February *[8k]*
- March *[9k]*
- April *[10k]*
- May *[10k]*
- June *[20k]*
- July *[26k]*
- August *[25k]*
- November *[13k]*
- December *[9k]*

Mitigation Site Average Water Depths, 1990-1996 (in feet)

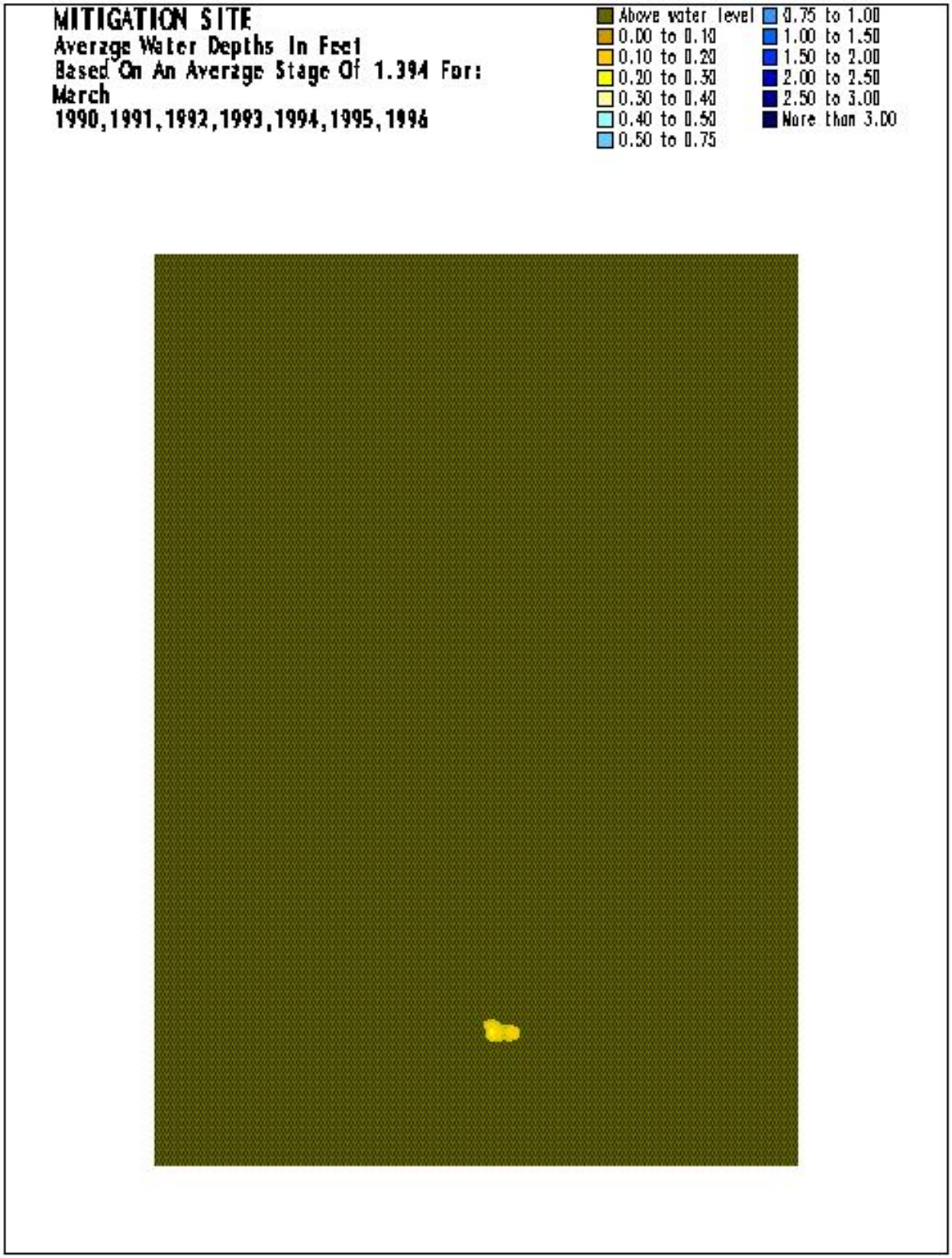
January



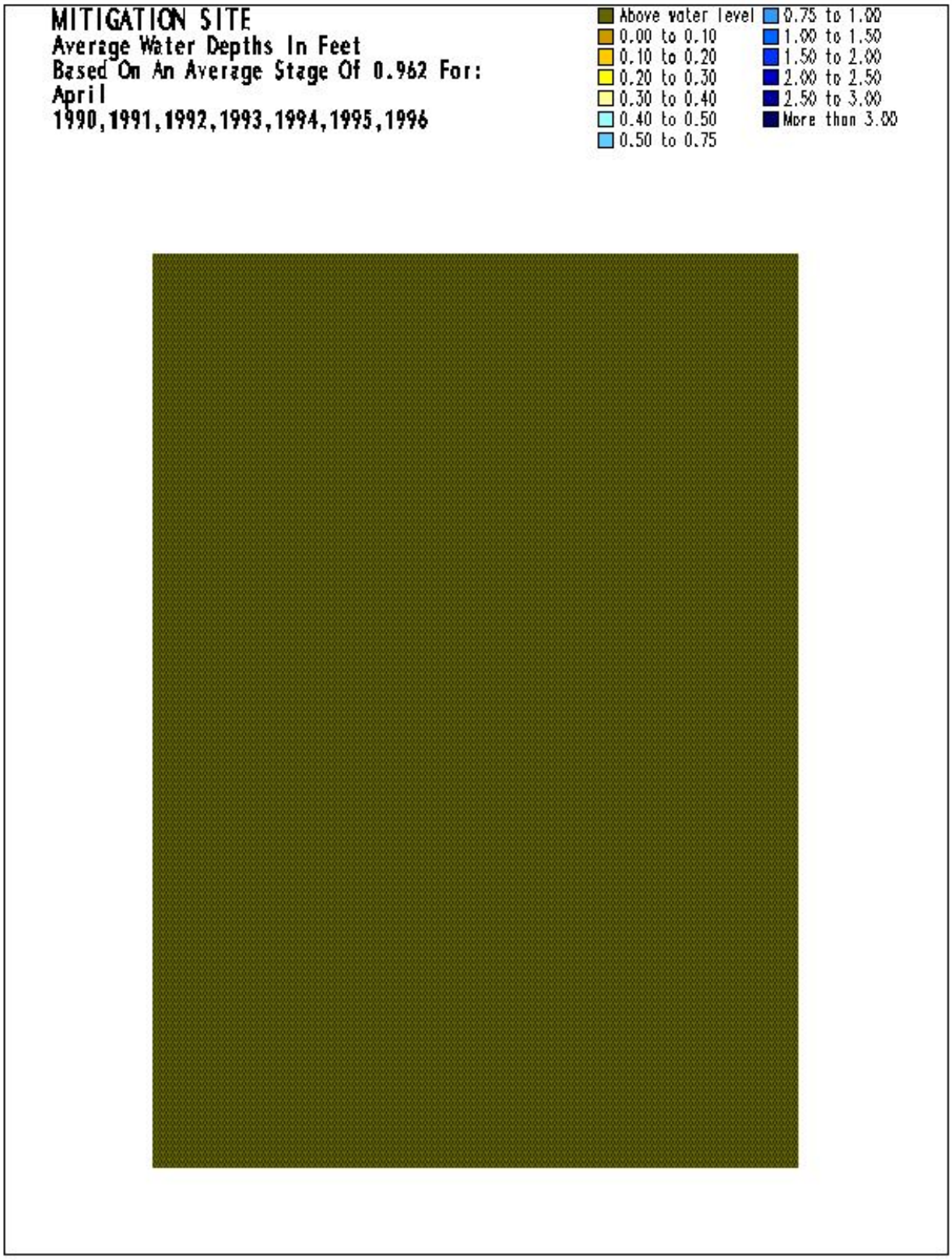
February


MITIGATION SITE
Average Water Depths In Feet
Based On An Average Stage Of 1.646 For:
February
1990,1991,1992,1993,1994,1995,1996
Above water level
0.00 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
1.50 to 2.00
2.00 to 2.50
2.50 to 3.00
More than 3.00

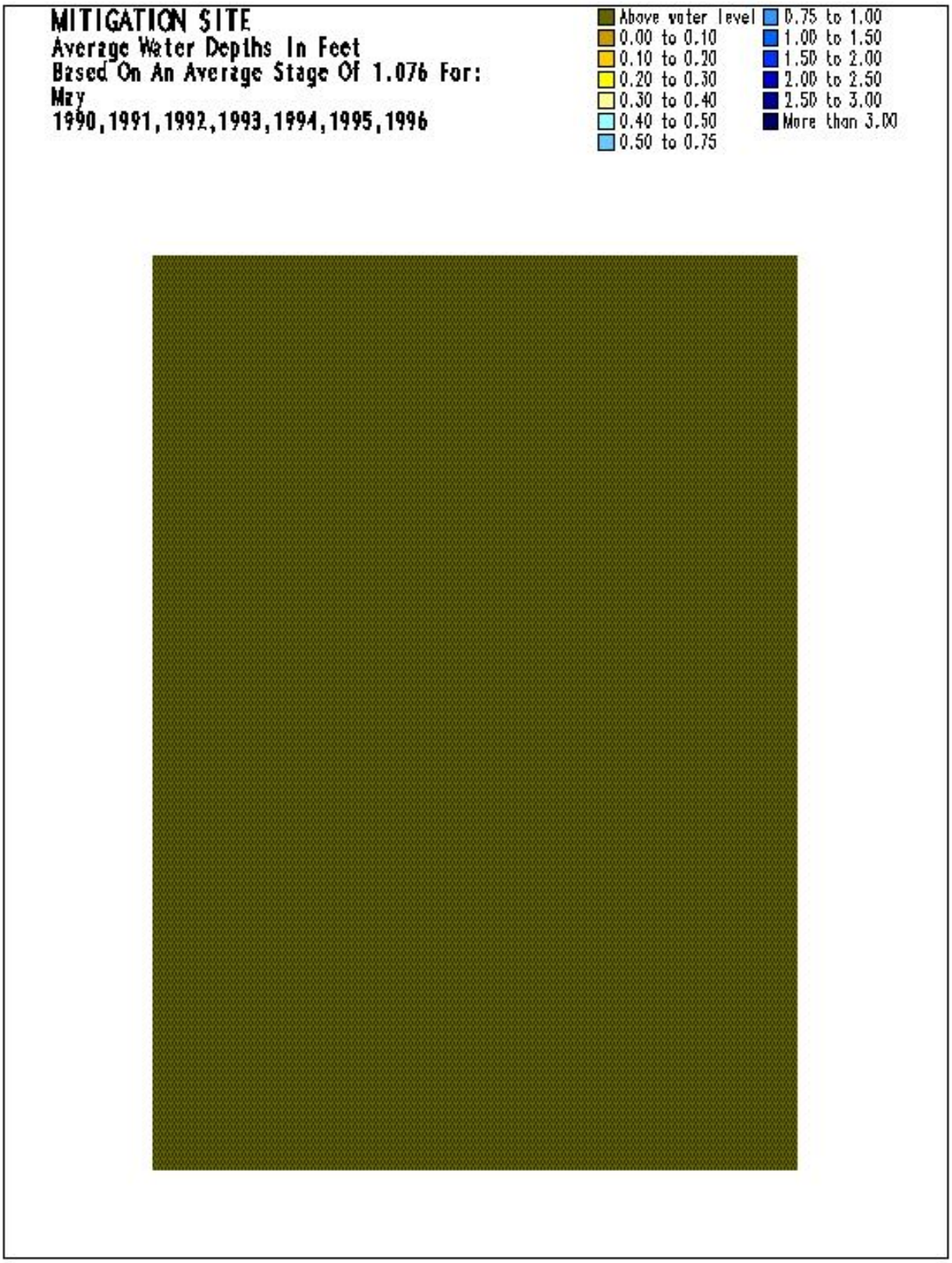
March


MITIGATION SITE
Average Water Depths In Feet
Based On An Average Stage Of 1.394 For:
March
1990,1991,1992,1993,1994,1995,1996
Above water level
0.00 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
1.50 to 2.00
2.00 to 2.50
2.50 to 3.00
More than 3.00

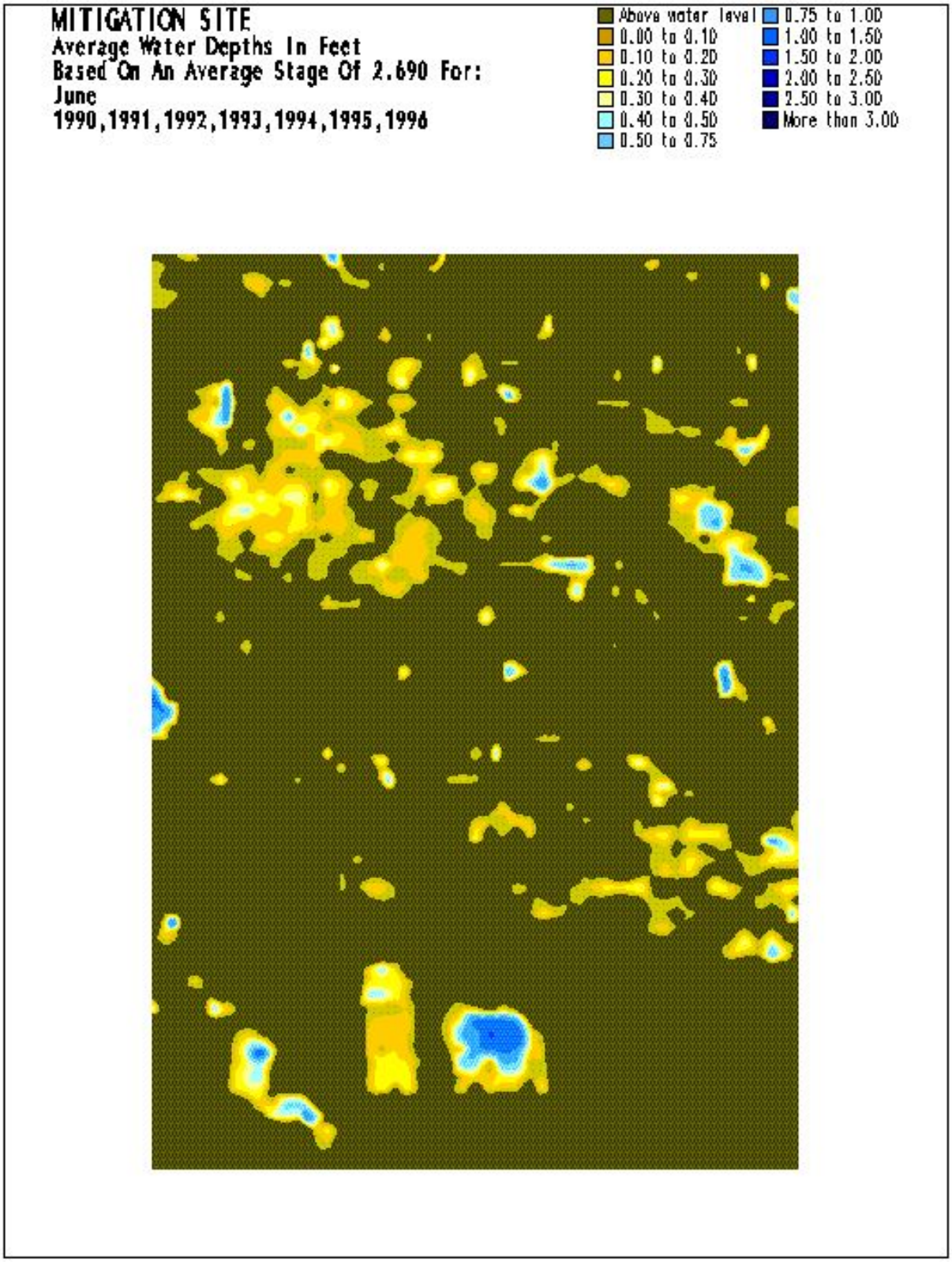
April


MITIGATION SITE
Average Water Depths In Feet
Based On An Average Stage Of 0.962 For:
April
1990,1991,1992,1993,1994,1995,1996
Above water level
0.00 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
1.50 to 2.00
2.00 to 2.50
2.50 to 3.00
More than 3.00

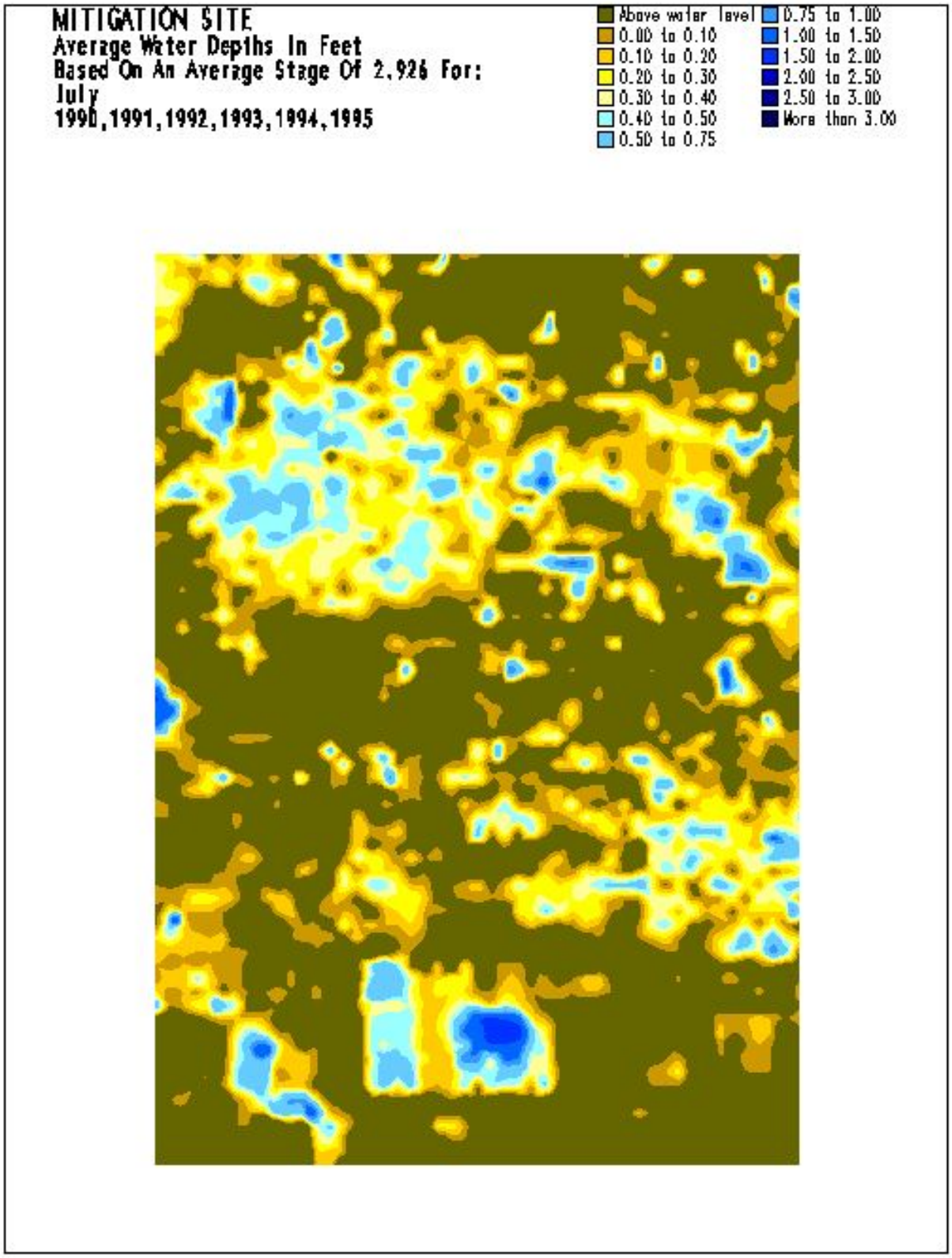
May


MITIGATION SITE
Average Water Depths In Feet
Based On An Average Stage Of 1.076 For:
May
1990,1991,1992,1993,1994,1995,1996
Above water level
0.00 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
1.50 to 2.00
2.00 to 2.50
2.50 to 3.00
More than 3.00

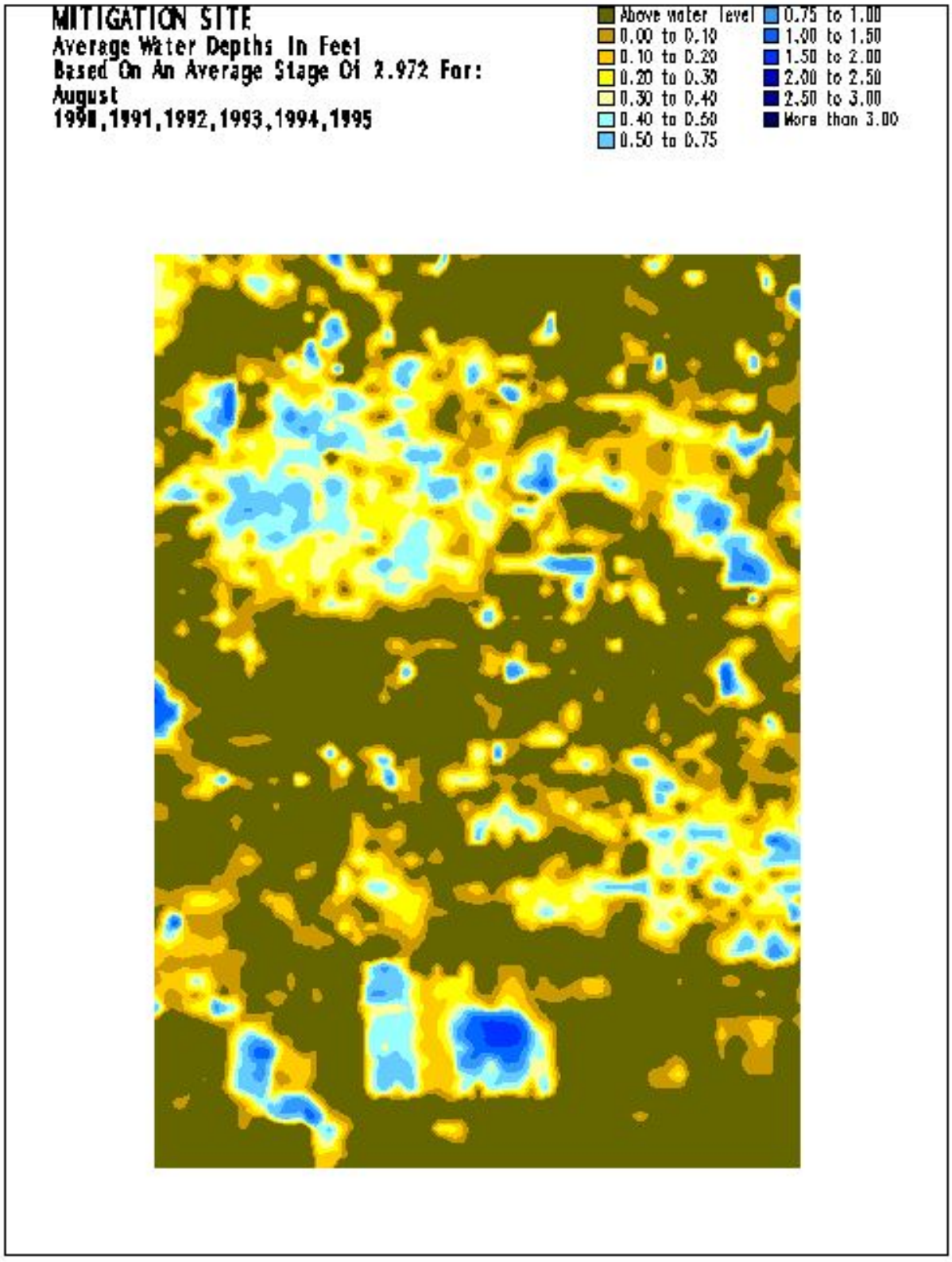
June


MITIGATION SITE
Average Water Depths In Feet
Based On An Average Stage Of 2.690 For:
June
1990,1991,1992,1993,1994,1995,1996
Above water level
0.00 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
1.50 to 2.00
2.00 to 2.50
2.50 to 3.00
More than 3.00

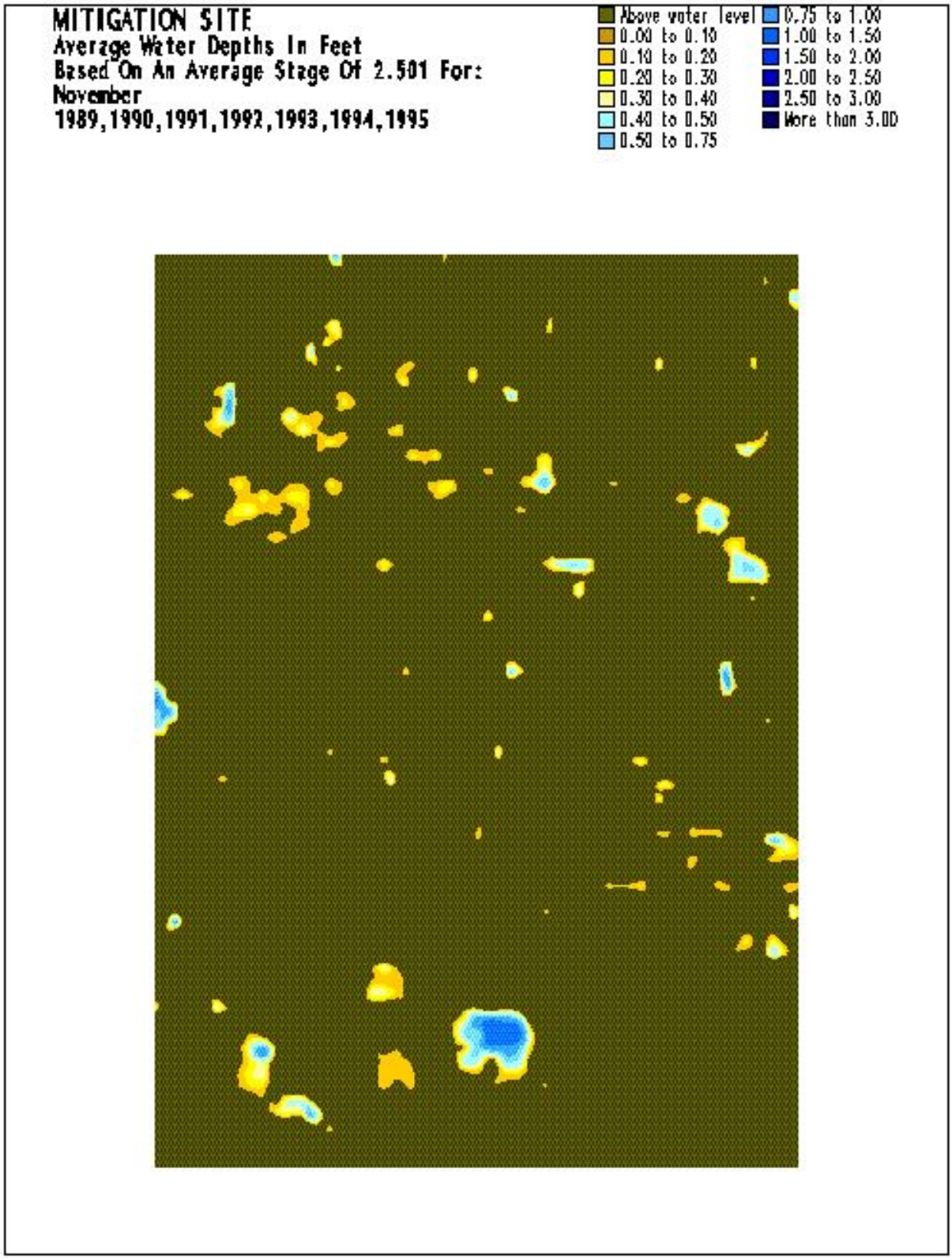
July


MITIGATION SITE
Average Water Depths In Feet
Based On An Average Stage Of 2.926 For:
July
1990,1991,1992,1993,1994,1995
Above water level
0.00 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
1.50 to 2.00
2.00 to 2.50
2.50 to 3.00
More than 3.00

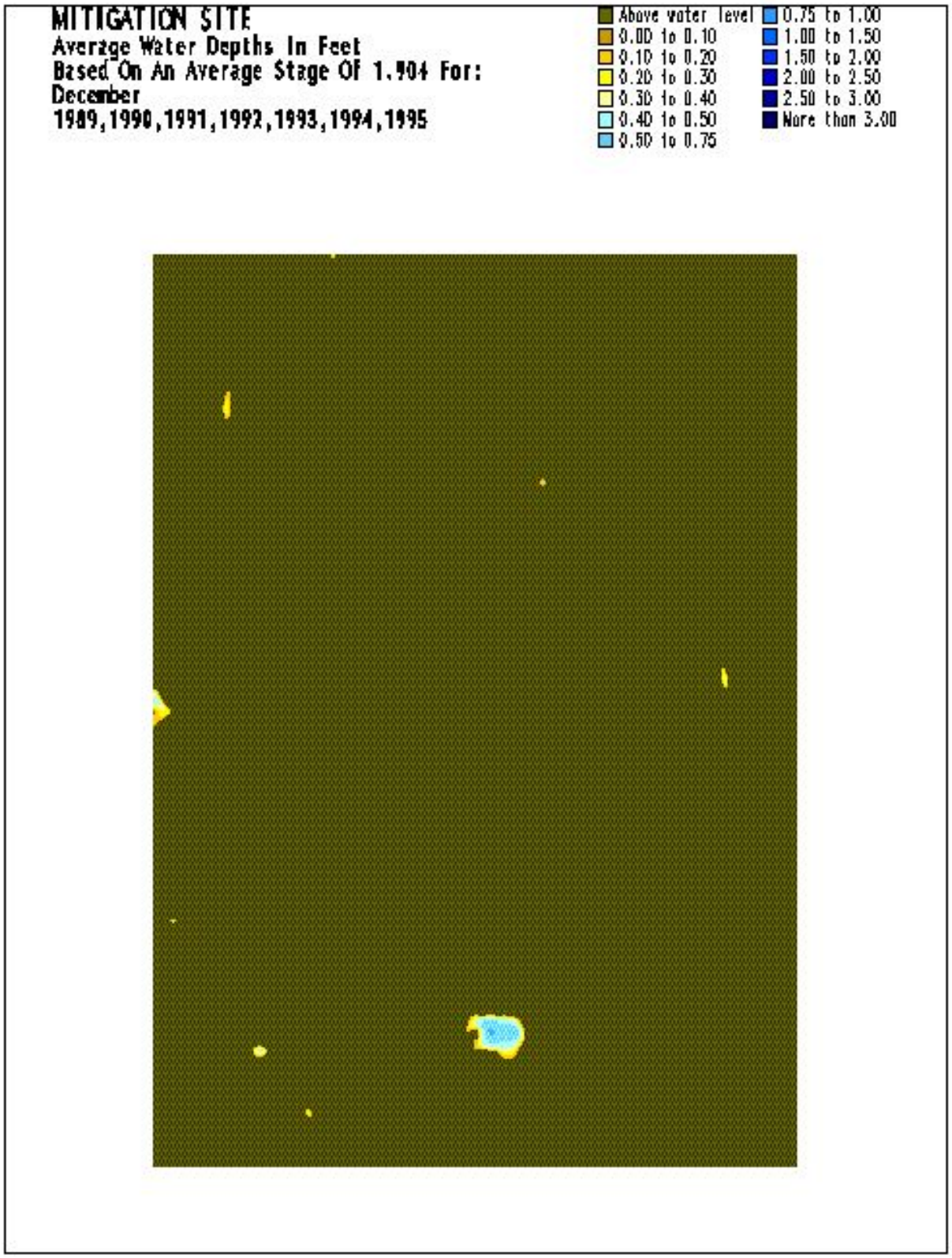
August


MITIGATION SITE
Average Water Depths In Feet
Based On An Average Stage Of 2.972 For:
August
1990,1991,1992,1993,1994,1995
Above water level
0.00 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
1.50 to 2.00
2.00 to 2.50
2.50 to 3.00
More than 3.00

November

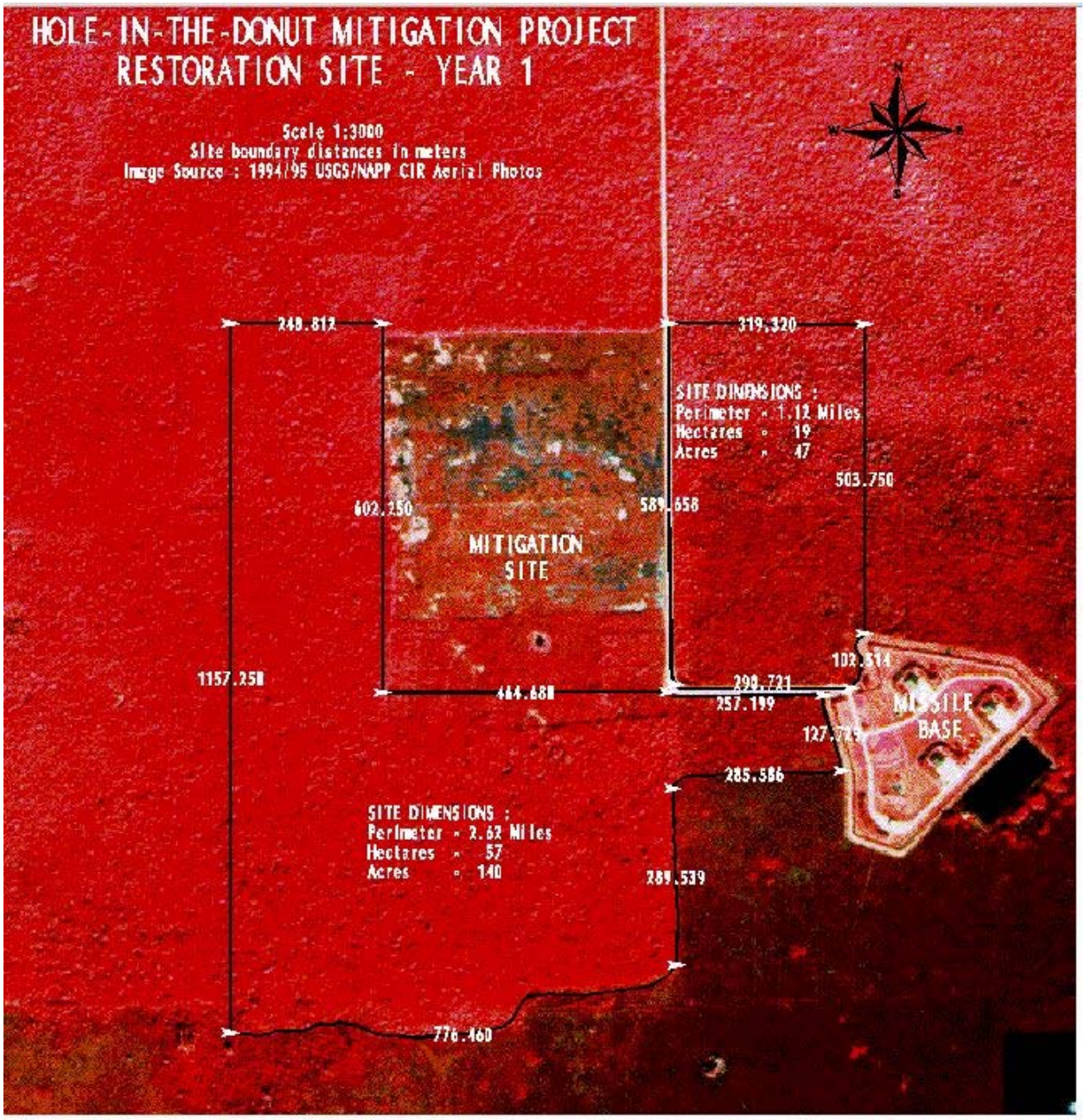

MITIGATION SITE
Average Water Depths In Feet
Based On An Average Stage Of 2.501 For:
November
1989,1990,1991,1992,1993,1994,1995
Above water level
0.00 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
1.50 to 2.00
2.00 to 2.50
2.50 to 3.00
More than 3.00

December

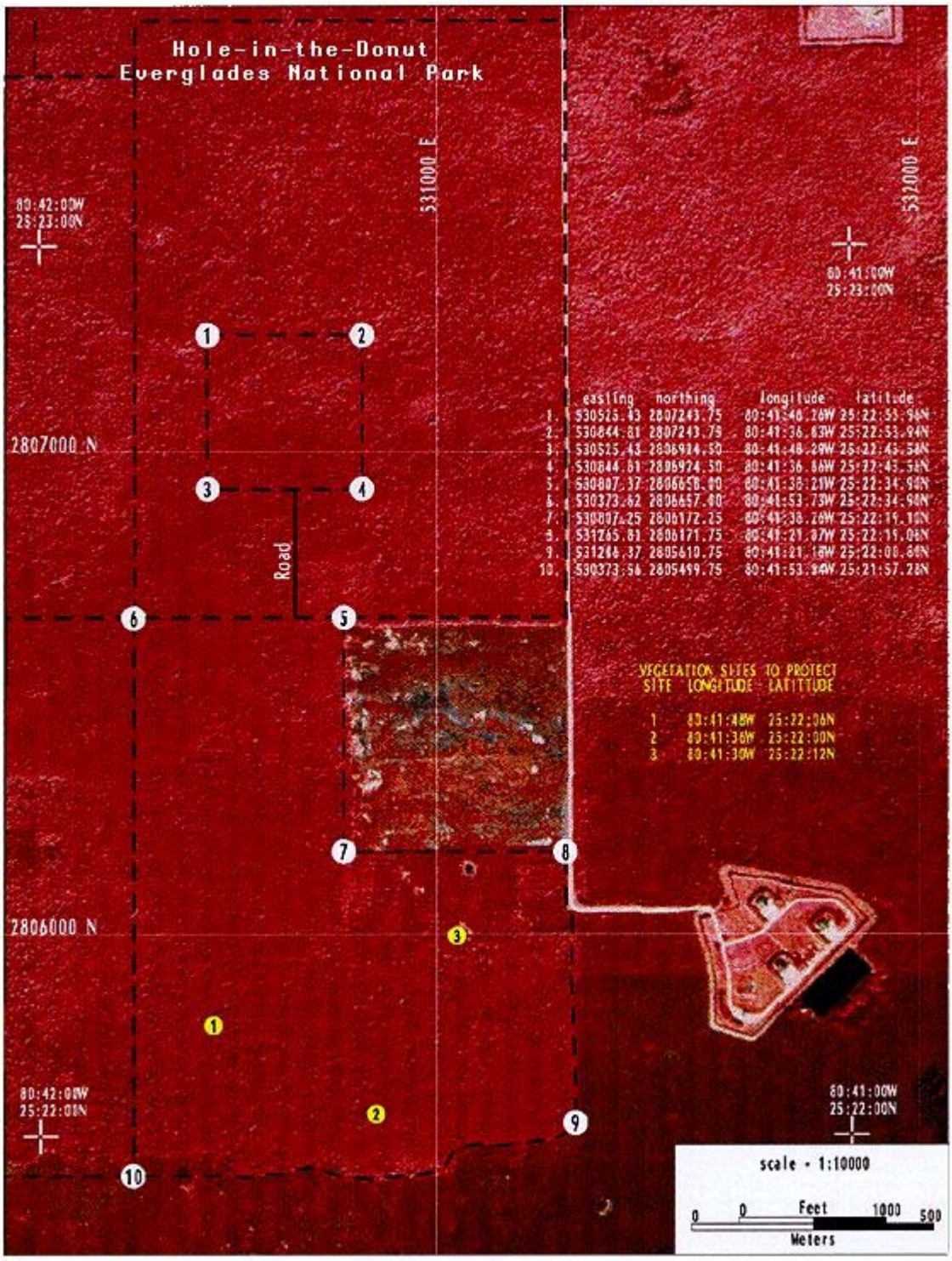

MITIGATION SITE
Average Water Depths In Feet
Based On An Average Stage Of 1.904 For:
December
1989,1990,1991,1992,1993,1994,1995
Above water level
0.00 to 0.10
0.10 to 0.20
0.20 to 0.30
0.30 to 0.40
0.40 to 0.50
0.50 to 0.75
0.75 to 1.00
1.00 to 1.50
1.50 to 2.00
2.00 to 2.50
2.50 to 3.00
More than 3.00

HID Remediation Sites

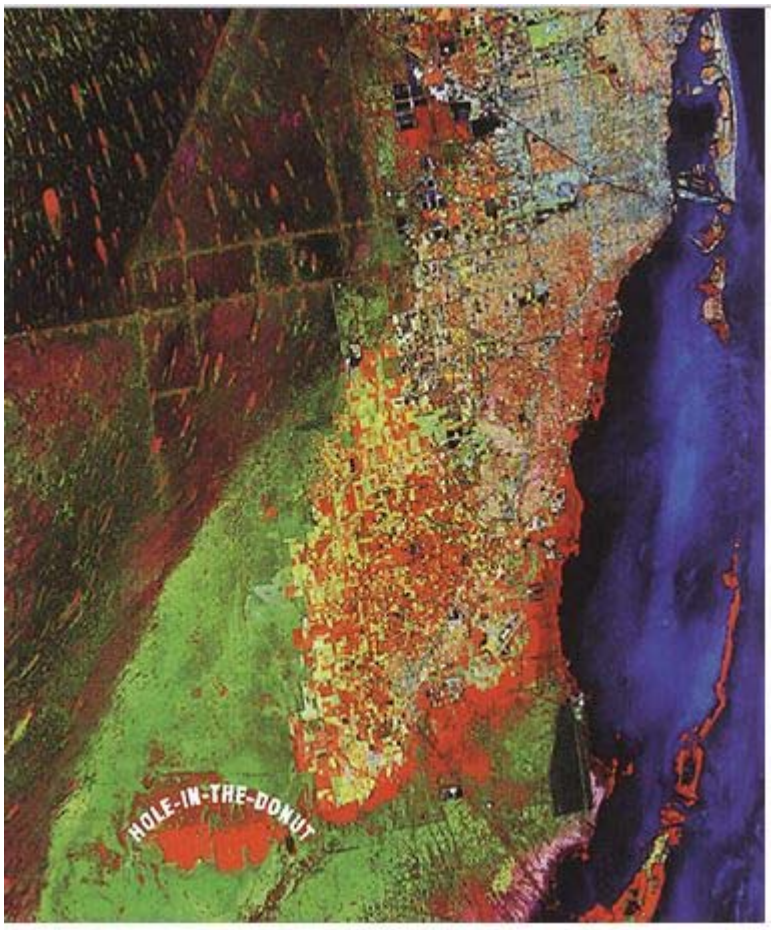
Restorations Site – Year 1

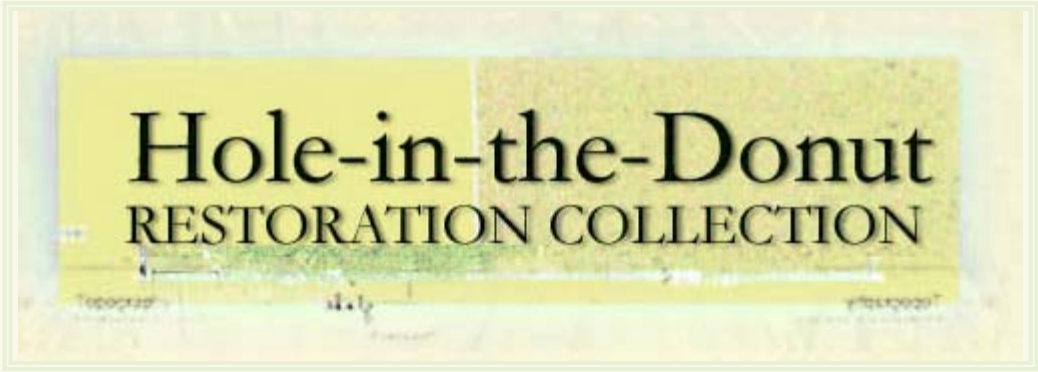


Vegetation Sites to Protect Site



Satellite Image of HID site within Larger Context of South Florida Ecosystem





Related Links

Department of Environmental Resources Management, Miami-Dade County

Florida Exotic Pest Plant Council

South Florida Natural Resources Center, Everglades National Park