Final Tarmac King Road Limestone Mine Environmental Impact Statement Levy County, Florida

Volume II
Appendices A-H

U.S. Army Corps of Engineers
Jacksonville District
August 2013

COVER SHEET

Responsible Agency: U.S. Army Corps of Engineers (USACE)

Title: *Final Tarmac King Road Limestone Mine Environmental Impact Statement (King Road EIS)*

Location: Levy County, Florida

For additional information or for copies of this Final King Road EIS*, contact:*

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U.S. Army Corps of Engineers
Regulatory Division
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Pensacola, Florida 32502-5794
Telephone: 850-439-9533

Comments or requests for information can also be submitted on the *King Road EIS* website at *http://www.kingroadeis.com.*

The official closing date for the receipt of comments is 30 days from the date on which the Notice of Availability of this *Final King Road EIS* appears in the *Federal Register*.

***Abstract*:** The USACE is evaluating proposals for limestone mining and related activities in an area of Levy County known as the King Road site. The USACE has analyzed both offsite and onsite alternatives for those that could reasonably satisfy the project purpose, and has carried forward seven alternatives for mining for further detailed analysis, along with a No Action Alternative (Alternative 1). The alternatives include (1) the No Action Alternative; (2) Mining Outlined in Permit Application with Dedicated No Mine Areas in Wetlands and Uplands; (3) Exclusion of Mining or Related Activities West of Butler Road; (4) Mining Outlined in Alternative 3 with Exclusion of Mining and Related Activities Immediately South of Spring Run and in Higher-Quality Wetlands in the North-Central Portion of the Site; (5) Exclusion of Mining or Related Activities Between the Two Southern No Mine Areas; (6) Mining Only West of the Central North-South Aligned No Mine Area; (7) Exclusion of Mining or Related Activities West of the Central North-South Aligned No Mine Area, Between the Two Southern No Mine Areas, and South of Spring Run; and (8) Exclusion of Mining or Related Activities Between the Two Southern No Mine Areas and the Extreme Western Mining Block. Under the No Action Alternative, no mining would be permitted in wetlands within the Tarmac King Road Limestone Mine site. If the proposed mining is not approved, it is expected that the ongoing timbering operations and hunting activities on the site would continue. Under the other alternatives, mining would be permitted on the King Road site in varying degrees over the next 30 to 100 years. The affected environment is primarily the area immediately surrounding the King Road site in eastern Levy County. Analyses indicate that the environmental impacts are closely tied to the number of acres proposed to be mined, with alternatives proposing the largest amount of mining having the largest environmental impacts for most of the areas of concern. The primary discriminators are natural cover types, including wetlands; habitat units; potential impacts on the eastern indigo snake; hydrology; water quality; and socioeconomics. A mitigation plan has been evaluated that could offset many of the potential environmental impacts.

Public Involvement: In preparation of this *King Road EIS*, the USACE considered comments received from the public during a 60-day scoping period ending April 26, 2008. Comments were received via U.S. mail, fax, email, and through the project's website. In addition, comments were taken from two public scoping meetings held on March 26 and 27, 2008, in Levy County, Florida. A summary of comments received is found in Chapter 1, Section 1.7.1.

In addition, the USACE considered comments received from the public on the *Draft King Road EIS*. A Notice of Availability for the *Draft King Road EIS* was issued in the *Federal Register* (77 FR 29617) (see Appendix A) on May 18, 2012. A 60-day public comment period began on May 11, 2012, and ended on July 11, 2012. A public hearing was held in Inglis, Florida, on May 31, 2012, where the USACE accepted both written and oral comments. In addition, the public was encouraged to submit comments via U.S. mail, email, or the *King Road EIS* website. There were 225 comments received from the public and Federal and state agencies during the public comment period, with an additional 11 comment letters received after July 11, 2012. Chapter 1, Section 1.7.2, of this final EIS includes a summary of the public comments on the draft EIS. Comment responses and individual comment letters are included in Appendix I.

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Final Tarmac King Road Limestone Mine Environmental Impact Statement

Volume II
(Appendices A–H)

U.S. Army Corps of Engineers
Jacksonville District
August 2013

TABLE OF CONTENTS
VOLUME II

APPENDIX A – H

Appendix A *Federal Register* and Other Public Notices A–1

A.1 Notice of Intent To Prepare a Draft Environmental Impact Statement on Rock Mining in Wetlands in Levy County, Florida A–1

A.2 Notice of Availability of the *Draft Environmental Impact Statement for the Tarmac King Road Limestone Mine Proposed in Levy County, Florida* A–4

Appendix B Mining Plan B–1

Appendix C Alternative Analysis C–1

Appendix D Tarmac King Road Groundwater Flow Modeling D–1

D.1 Introduction D–1
D.1.1 Conceptual Site Model D–1
D.2 Groundwater Flow Model Development D–2
D.2.1 Code Selection D–2
D.2.2 Model Discretization D–3
D.2.2.1 Model Area D–3
D.2.2.2 Model Layers D–3
D.2.3 Model Boundary Conditions D–4
D.2.4 Model Calibration and Simulation Periods D–5
D.2.5 Parameter Distributions and MODFLOW Packages D–6
D.2.5.1 Hydraulic Conductivity D–6
D.2.5.2 Recharge Determination D–6
D.2.5.3 Other Parameters and Inputs D–7
D.3 Model Calibration D–8
D.3.1 Calibration Targets D–8
D.3.1.1 Hydraulic Conductivity Zonation D–8
D.3.2 Calibration Results D–9
D.3.2.1 Estimated Hydraulic Conductivity Values D–9
D.3.2.2 Estimated Specific Storage and Specific Yield Values D–9
D.3.2.3 Predicted Water Levels in Target Wells D–10
D.4 Model Verification D–10
D.5 Model Application D–11
D.5.1 Seepage Analysis D–11
D.5.2 Impact on Wetlands D–17
D.5.3 Saltwater Intrusion Analysis D–17
D.5.4 Mitigation Effectiveness Analysis D–20
D.5.5 Cumulative Impact Analysis D–20
D.6 Sensitivity Analysis D–20
D.6.1 Sensitivity to Recharge Variation D–21
D.6.2 Sensitivity to Backfill Hydraulic Conductivity *(K)* Variation D–21
D.6.3 Sensitivity to Hydraulic Conductivity *(K)* Variation D–22
D.7 Model Assumptions/Limitations and Applicability D–25
D.7.1 Constraining Limitations/Assumptions D–25
D.7.2 Usefulness of the Model D–26
D.8 References D–27

Appendix E Biological Opinion E–1

Appendix F Florida Coastal Zone Management Program Federal Consistency Determination F–1

Appendix G Mitigation Plan G–1

Appendix H Soil Drainage Class Maps for Avon Park Formation Outcroppings in Levy County H–1

H.1 Introduction H–1

H.2 References H–2

List of Figures

Figure D–1. Model Boundary and Grid D–30
Figure D–2. Topography (Top of Layer 1) D–31
Figure D–3. Boundary Conditions for Layer 1 ....D–32
Figure D–4. Boundary Conditions for Layers 2 through 6 ....D–33
Figure D–5. Transect, Monitoring, and USGS Calibration Targets D–34
Figure D–6. Hydraulic Conductivity and Storage Zones for Layer 1 ....D–35
Figure D–7. Hydraulic Conductivity and Storage Zones for Layers 2 through 6 ....D–36
Figure D–8a. Plot of Observed Versus Simulated Water Level (Head) Results for Mine Site Transect Wells D–37
Figure D–8b. Plot of Observed Versus Simulated Water Level (Head) Results for Mine Site Monitoring Wells.... D–38
Figure D–8c. Plot of Observed Versus Simulated Water Level (Head) Results for Regional USGS Monitoring Wells D–39
Figure D–9. Selected Transects for Seepage Analysis D–40
Figure D–10. Baseline (Alternative 1) Water Level Contours During Dry Season D–41
Figure D–11. Baseline (Alternative 1) Water Level Contours During Wet Season D–42
Figure D–12. Alternative 2 Water Level Contours During Dry Season.... D–43
Figure D–13. Alternative 2 Water Level Contours During Wet Season.... D–44
Figure D–14. Results of Recharge Sensitivity Analysis for King Road Limestone Mine Site Groundwater Flow Model D–45
Figure D–15. Results of Backfill Material Hydraulic Conductivity Sensitivity Analysis for King Road Limestone Mine Site Groundwater Flow Model D–45
Figure D–16. Monitoring Wells for Manually Evaluating *K* Sensitivity of the Backfill Materials D–46

Attachment A – Figures

Figure A-1a. *King Road EIS* Model Boundary Area Showing Potentiometric Surface for May 16, 2006 .... D–65
Figure A–1b. *King Road EIS* Model Boundary Area Showing Potentiometric Surface for July 25, 2006.... D–66
Figure A–1c. *King Road EIS* Model Boundary Area Showing Potentiometric Surface for September 19, 2006.... D–67
Figure A–1d. *King Road EIS* Model Boundary Area Showing Potentiometric Surface for November 7, 2006.... D–68
Figure A–1e. *King Road EIS* Model Boundary Area Showing Potentiometric Surface for January 17, 2007 .... D–69
Figure A–1f. *King Road EIS* Model Boundary Area Showing Potentiometric Surface for March 20, 2007 .... D–70
Figure A–2. Recharge Zonation for King Road Limestone Mine Site Groundwater Flow Model in Layer 1 .... D–71
Figure A–3. Water Level Contours Under Dry Conditions, 02/14/07 – Baseline.... D–72
Figure A–4. Water Level Contours Under Dry Conditions, 02/14/07 – Alternative 2 .... D–73
Figure A–5. Water Level Contours Under Dry Conditions, 02/14/07 – Alternative 3 .... D–74
Figure A–6. Water Level Contours Under Dry Conditions, 02/14/07 – Alternative 7 .... D–75
Figure A–7. Water Level Contours Under Dry Conditions, 02/14/07 – Alternative 8 .... D–76
Figure A–8. Water Level Contours Under Wet Conditions, 09/07/04 – Baseline.... D–77
Figure A–9. Water Level Contours Under Wet Conditions, 09/07/04 – Alternative 2.... D–78
Figure A–10. Water Level Contours Under Wet Conditions, 09/07/04 – Alternative 3.... D–79
Figure A–11. Water Level Contours Under Wet Conditions, 09/07/04 – Alternative 7.... D–80
Figure A–12. Water Level Contours Under Wet Conditions, 09/07/04 – Alternative 8.... D–81
Figure A–13. Alternative 2 Drawdown Under Average Conditions (CY 2006 Simulation) D–82
Figure A–14. Alternative 2 Drawdown Under Dry Conditions (CY 2007 Simulation).... D–83
Figure A–15. Alternative 2 Drawdown Under Wet Conditions (CY 2004 Simulation) D–84
Figure A–16. Alternative 7 Drawdown Under Average Conditions (CY 2006 Simulation) D–85
Figure A–17. Alternative 7 Drawdown Under Dry Conditions (CY 2007 Simulation).... D–86
Figure A–18. Alternative 7 Drawdown Under Wet Conditions (CY 2004 Simulation) D–87

Figure A–19. Monitoring Station Monitoring Well 1 – Baseline vs. Alternative 2 ..... D–88
Figure A–20. Monitoring Station Monitoring Well 1 – Baseline vs. Alternative 3 ..... D–88
Figure A–21. Monitoring Station Monitoring Well 1 – Baseline vs. Alternative 7 ..... D–89
Figure A–22. Monitoring Station Monitoring Well 1 – Baseline vs. Alternative 8 ..... D–89
Figure A–23. Monitoring Station Monitoring Well 2 – Baseline vs. Alternative 2 ..... D–90
Figure A–24. Monitoring Station Monitoring Well 2 – Baseline vs. Alternative 3 ..... D–90
Figure A–25. Monitoring Station Monitoring Well 2 – Baseline vs. Alternative 7 ..... D–91
Figure A–26. Monitoring Station Monitoring Well 2 – Baseline vs. Alternative 8 ..... D–91
Figure A–27. Monitoring Station Monitoring Well 3 – Baseline vs. Alternative 2 ..... D–92
Figure A–28. Monitoring Station Monitoring Well 3 – Baseline vs. Alternative 3 ..... D–92
Figure A–29. Monitoring Station Monitoring Well 3 – Baseline vs. Alternative 7 ..... D–93
Figure A–30. Monitoring Station Monitoring Well 3 – Baseline vs. Alternative 8 ..... D–93
Figure A–31. Monitoring Station Monitoring Well 4 – Baseline vs. Alternative 2 ..... D–94
Figure A–32. Monitoring Station Monitoring Well 4 – Baseline vs. Alternative 3 ..... D–94
Figure A–33. Monitoring Station Monitoring Well 4 – Baseline vs. Alternative 7 ..... D–95
Figure A–34. Monitoring Station Monitoring Well 4 – Baseline vs. Alternative 8 ..... D–95
Figure A–35. Monitoring Station Monitoring Well 5 – Baseline vs. Alternative 2 ..... D–96
Figure A–36. Monitoring Station Monitoring Well 5 – Baseline vs. Alternative 3 ..... D–96
Figure A–37. Monitoring Station Monitoring Well 5 – Baseline vs. Alternative 7 ..... D–97
Figure A–38. Monitoring Station Monitoring Well 5 – Baseline vs. Alternative 8 ..... D–97
Figure A–39. Monitoring Station Monitoring Well 6 – Baseline vs. Alternative 2 ..... D–98
Figure A–40. Monitoring Station Monitoring Well 6 – Baseline vs. Alternative 3 ..... D–98
Figure A–41. Monitoring Station Monitoring Well 6 – Baseline vs. Alternative 7 ..... D–99
Figure A–42. Monitoring Station Monitoring Well 6 – Baseline vs. Alternative 8 ..... D–99
Figure A–43. Monitoring Station Transect Well 1snk – Baseline vs. Alternative 3..... D–100
Figure A–44. Monitoring Station Transect Well 1snk – Baseline vs. Alternative 7..... D–100
Figure A–45. Monitoring Station Transect Well 1snk – Baseline vs. Alternative 8..... D–101
Figure A–46. Monitoring Station Transect Well 2snk – Baseline vs. Alternative 3..... D–101
Figure A–47. Monitoring Station Transect Well 2snk – Baseline vs. Alternative 7..... D–102
Figure A–48. Monitoring Station Transect Well 6snk – Baseline vs. Alternative 2..... D–102
Figure A–49. Monitoring Station Transect Well 6snk – Baseline vs. Alternative 3..... D–103
Figure A–50. Monitoring Station Transect Well 6snk – Baseline vs. Alternative 7..... D–103
Figure A–51. Monitoring Station Transect Well 6snk – Baseline vs. Alternative 8..... D–104
Figure A–52. Monitoring Station Transect Well 7snk – Baseline vs. Alternative 2..... D–104
Figure A–53. Monitoring Station Transect Well 7snk – Baseline vs. Alternative 3..... D–105
Figure A–54. Monitoring Station Transect Well 7snk – Baseline vs. Alternative 7..... D–105
Figure A–55. Monitoring Station Transect Well 7snk – Baseline vs. Alternative 8..... D–106
Figure A–56. Monitoring Station Transect Well 8snk – Baseline vs. Alternative 2..... D–106
Figure A–57. Monitoring Station Transect Well 8snk – Baseline vs. Alternative 3..... D–107
Figure A–58. Monitoring Station Transect Well 8snk – Baseline vs. Alternative 7..... D–107
Figure A–59. Monitoring Station Transect Well 8snk – Baseline vs. Alternative 8..... D–108
Figure A–60. Monitoring Station Transect Well 9snk – Baseline vs. Alternative 2..... D–108
Figure A–61. Monitoring Station Transect Well 10snk – Baseline vs. Alternative 2..... D–109
Figure A–62. Monitoring Station Transect Well 10snk – Baseline vs. Alternative 3..... D–109
Figure A–63. Monitoring Station Transect Well 10snk – Baseline vs. Alternative 7..... D–110
Figure A–64. Monitoring Station Transect Well 10snk – Baseline vs. Alternative 8..... D–110
Figure A–65. Monitoring Station Transect Well 11snk – Baseline vs. Alternative 3..... D–111
Figure A–66. Monitoring Station Transect Well 11snk – Baseline vs. Alternative 7..... D–111
Figure A–67. Monitoring Station Transect Well 11snk – Baseline vs. Alternative 8..... D–112
Figure A–68. Monitoring Station Transect Well 12snk – Baseline vs. Alternative 3..... D–112
Figure A–69. Monitoring Station Transect Well 12snk – Baseline vs. Alternative 7..... D–113
Figure A–70. Monitoring Station Transect Well 12snk – Baseline vs. Alternative 8..... D–113

Figure H–1. Soil Drainage Classes in Southernmost Avon Formation Outcropping in Levy County...H–4
Figure H–2. Soil Drainage Classes in Central Avon Park Formation Outcropping in Levy County H–8
Figure H–3. Soil Drainage Classes in Westernmost Avon Park Formation Outcropping in Levy County H–13

List of Tables

Table D–1. MODFLOW Packages Used in the King Road Limestone Mine Site Groundwater Flow Model D–3
Table D–2. King Road Limestone Mine Site Groundwater Flow Model Layer Minimum and Maximum Elevations D–4
Table D–3. Hydrogeologic Properties Used in King Road Limestone Mine Site Groundwater Flow Model D–8
Table D–4. Hydraulic Conductivity and Anisotropic Ratios for Model Zones D–9
Table D–5. Estimated Specific Storage and Specific Yield D–9
Table D–6. Calibration Residuals for Model Output Results D–10
Table D–7. Model Verification Results D–11
Table D–8. Predicted 5-Year (Calendar Years 2004 through 2008) Average Seepage Rates from Different Sections for Multiple Scenarios D–13
Table D–9. Predicted Dry Period (Calendar Year 2007) Average Seepage Rates from Different Sections for Multiple Scenarios D–14
Table D–10. Predicted Wet Period (Calendar Year 2004) Average Seepage Rates from Different Sections for Multiple Scenarios D–15
Table D–11. Predicted 5-Year (Calendar Year 2004 through 2008) Average Seepage Rates Balance Around and Away from the Mine Site D–16
Table D–12. Predicted Dry Period (Calendar Year 2007) Average Seepage Rates Balance Around and Away from the Mine Site D–16
Table D–13. Predicted Wet Period (Calendar Year 2004) Average Seepage Rates Balance Around and Away from the Mine Site D–16
Table D–14. Predicted 5-Year (Calendar Year 2004 through 2008) Average Seepage Rates Toward the Gulf of Mexico and Lake Rousseau for Multiple Scenarios D–18
Table D–15. Predicted Dry Period (Calendar Year 2007) Average Seepage Rates Toward the Gulf of Mexico and Lake Rousseau for Multiple Scenarios D–19
Table D–16. Predicted Wet Period (Calendar Year 2004) Average Seepage Rates Toward the Gulf of Mexico and Lake Rousseau for Multiple Scenarios D–20
Table D–17. Results of Backfill Material *K* Sensitivity on Predicted Drawdown/Mounding Based on Simulation of Alternative 2 ..... D–23
Table D–18. Results of *K* Sensitivity on Seepage Rates for King Road Limestone Mine Site Groundwater Flow Model *K* Zones D–24

Attachment A – Tables

Table A–1. King Road Limestone Mine Site Groundwater Flow Model Zone 1 (Eastern Model Area) Recharge Values D–48
Table A–2. Tarmac King Road Limestone Mine Site Groundwater Flow Model Zone 2 (Western Model Area) Recharge Values D–56

List of Acronyms and Abbreviations for Appendices

CSM	conceptual site model
CY	calendar year
EIS	environmental impact statement
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
GHB	general head boundary
HELP	Hydrologic Evaluation of Landfill Performance
King Road EIS	*Tarmac King Road Limestone Mine Environmental Impact Statement*
LIDAR	Light Detection and Ranging
NGVD	National Geodetic Vertical Datum
PEST	parameter estimation software
SFWMD	South Florida Water Management District
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

APPENDIX A
FEDERAL REGISTER AND OTHER PUBLIC NOTICES

APPENDIX A
FEDERAL REGISTER AND OTHER PUBLIC NOTICES

A.1 NOTICE OF INTENT TO PREPARE A DRAFT ENVIRONMENTAL IMPACT STATEMENT ON ROCK MINING IN WETLANDS IN LEVY COUNTY, FLORIDA

Federal Register / Vol. 73, No. 33 / Tuesday, February 19, 2008 / Notices 9103

DEPARTMENT OF DEFENSE

Department of the Army

Availability for Non-Exclusive, Exclusive, or Partially Exclusive Licensing of Invention Described in U.S. Provisional Patent Application Concerning Treatment of Ischemia-Reperfusion Injury with Lipid, Annexin, and Lipid-Annexin Complexes

AGENCY: Department of the Army, DoD.

ACTION: Notice.

SUMMARY: In accordance with 37 CFR 404.4, 404.6 and 404.7, announcement is made of the availability for licensing of the invention described in U.S. Provisional Patent Application No. 60/786,527 entitled ''Treatment of Ischemia-Reperfusion Injury with Lipid, Annexin, and Lipid-Annexin Complexes,'' filed March 27, 2006. Foreign rights are also available (PCT/US2007/065125). The United States Government, as represented by the Secretary of the Army, has rights in this invention.

ADDRESSES: Commander, U.S. Army Medical Research and Materiel Command, *ATTN:* Command Judge Advocate, MCMR–ZA–J, 504 Scott Street, Fort Detrick, Frederick, MD 21702–5012.

FOR FURTHER INFORMATION CONTACT: For patent issues, Ms. Elizabeth Arwine, Patent Attorney, (301) 619–7808. For licensing issues, Dr. Paul Mele, Office of Research & Technology Assessment, (301) 619–6664, both at telefax (301) 619–5034.

SUPPLEMENTARY INFORMATION: Disclosed are lipids, annexin, and lipid-annexin complexes for use in the prevention and/or treatment of ischemia-reperfusion injury and reperfusion injury associated with a variety of diseases and conditions. Also disclosed are therapeutic targets and compositions for the prevention and treatment of ischemia-reperfusion injury and diseases and conditions associated with ischemia-reperfusion injury.

Brenda S. Bowen,

Army Federal Register Liaison Officer.

[FR Doc. E8–2980 Filed 2–15–08; 8:45 am]

BILLING CODE 3710–08–P

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Notice of Intent To Prepare a Draft Environmental Impact Statement on Rock Mining in Wetlands in Levy County, FL

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of intent.

SUMMARY: The U.S. Army Corps of Engineers (Corps) Jacksonville District intends to prepare a Draft Environmental Impact Statement (DEIS), referred to as the Tarmac King Road Limestone Mine DEIS, to evaluate potential impacts of rock mining within wetlands in southern Levy County, FL.

DATES: The Corps plans to hold two public scoping meetings on or about March 26 and 27, 2008 at 6 p.m. EST.

ADDRESSES: The first meeting will be held on March 26, 2008 at the Inglis Community Center, 137 Highway 40 West, Inglis, FL 34449, (352) 447–2203. The second meeting will be held March 27, 2008 at the Tommy Usher Community Center, 506 Southwest 4th Avenue, Chiefland, FL 32626–0121, (352) 493–6711.

FOR FURTHER INFORMATION CONTACT: Mr. Edward P. Sarfert, (850) 439–9533 or e-mail at edward.p.sarfert@usace.army.mil.

SUPPLEMENTARY INFORMATION:

a. *Background/Project Authorization.* The Corps is preparing this DEIS in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq.*), Council of on Environmental Quality (CEQ) Regulations (40 CFR 1500 *et seq.*), and Corps provisions for implementing the procedural requirements of NEPA (33 CFR 230, USACE Engineering Regulation ER 200–2–2). A primary purpose of a Corps Regulatory Program EIS is to provide full and fair discussion of the significant environmental impacts of a proposal or project seeking a U.S. Department of Army permit. The Draft and Final EIS are used to inform the public and agency decision-makers of alternatives to an applicant's project that might avoid or minimize adverse impacts or enhance the quality of the human environment. An EIS is not a Corps regulatory decision document. It is used by agency officials in conjunction with other relevant information in a permit application file, including public and agency comments presented in the Final EIS, to support the final decision on a permit application. In this instance, Tarmac America, LLC, has filed a permit application to mine areas that include wetlands within Levy County, FL.

b. *Need or Purpose.* The purpose of the proposed action is to provide construction-grade aggregate that meets the Florida Department of Transportation specifications for buildings and infrastructure. The proposed mine is to provide this aggregate for Tarmac's and its customers' use in the west central area of Florida. The Corps recognizes that there is a public and private need for this product. The purpose of the proposed DEIS is to evaluate the environmental effects of alternatives to meet these requirements while protecting the aquatic environment.

c. *Prior EAs, EISs.* None.

d. *Alternatives.* An evaluation of alternatives, including a No Action alternative and rock mining in other areas both inside and outside of Levy County and/or Florida will be done. The DEIS will analyze reasonable alternatives to obtaining construction grade limestone to meet the purpose and need. Alternatives will be determined through scoping, but are expected to vary according to timing, and breadth of mining, in addition to a ''no action'' alternative.

e. *Issues.* The following issues have been identified for analysis in the DEIS. This list is preliminary and is intended to facilitate public comment on the scope of the DEIS. The DEIS will consider the effects on Federally listed threatened and endangered species, health and safety, socioeconomics, aesthetics, general environmental concerns, wetlands (and other aquatic resources), historic properties, cultural resources, fish and wildlife values, land use, transportation, recreation, water supply and conservation, water quality, energy needs, mineral needs, considerations of property ownership, and, in general, the needs and welfare of the people, and other issues identified through scoping, public involvement, and interagency coordination. At the present time, our primary areas of environmental concern are the loss of wetland functions and value, mitigation of such losses, and the effect of proposed mining on groundwater and surface water quality and on transportation. We expect to better define the issues of concern and define the methods that will be used to evaluate those issues through the scoping process.

f. *Scoping Process.* CEQ regulations (40 CFR 1501.7) require an early and open process for determining the scope of a DEIS and for identifying significant

issues related to the proposed action. The public will be involved in the scoping and evaluation process through advertisements, notices, and other means. At a minimum, all parties who have expressed interest in the Tarmac King Road Limestone Mine project will be given the opportunity to participate in this process. Federal, state and local agencies, and other interested groups will also be involved. All parties are invited to participate in the scoping process by identifying any additional concerns on issues, studies needed, alternatives, procedures, and other matters related to the scope of the EIS.

The public scoping meetings are scheduled for (see **DATES** and **ADDRESSES**). The Corps will provide additional notification of the meeting time and location through newspaper advertisements and other means. Following a short presentation on the planned DEIS, verbal and written comments on the scope of the DEIS will be accepted. A transcript of verbal comments will be generated to ensure accuracy. To submit comments on the scope of the Tarmac King Road Limestone Mine DEIS or to request copies of materials related to this effort as they become available to the public, contact: Mr. Edward P. Sarfert, U.S. Army Corps of Engineers, Regulatory Division, 41 North Jefferson St., Suite 111, Pensacola, FL 32502–5794, by e-mail at edward.p.sarfert@usace.army.mil, or by telephone at (850) 439–9533.

Comments or requests for information can also be submitted on the Tarmac King Road Limestone Mine EIS Web site at *http://www.kingroadeis.com.* The Corps will consider all comments for the scope of the DEIS received by April 26, 2008.

g. *Public Involvement.* The Corps invites Federal agencies, American Indian Tribal Nations, state and local governments, and other interested private organizations and parties to attend the public scooping meeting and to comment on the scope of the planned Tarmac King Road Limestone Mine EIS.

h. *Coordination.* The proposed action is being coordinated with a number of Federal, state, regional, and local agencies including but not limited to the following: U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Environmental Protection Agency, Florida Department of Environmental Protection, Southwest Florida Water Management District, Florida State Historic Preservation Officer, Levy County, and other agencies as identified in scoping, public involvement, and agency coordination.

i. *Other Environmental Review and Consultation.* The proposed action would involve evaluation for compliance with guidelines pursuant to Section 404(b) of the Clean Water Act. This review will involve a detailed evaluation of alternatives to rock mining in the King Road area of Levy County, which is not a water dependent activity.

j. *Agency Role.* The Corps will provide extensive information and assistance on the resources to be impacted, mitigation measures, and alternatives. Although the Corps does not plan to invite any Federal agencies to be cooperating agencies, we expect to receive input and critical information from the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service and other federal, state, and local agencies.

k. *Tarmac King Road Limestone Mine DEIS Preparation.* It is estimated that the DEIS will be available to the public on or about July 2008. At least one additional public meeting will be held at that time, during which the public will be provided the opportunity to comment on the Draft EIS before it becomes final.

Dated: February 8, 2008.

David S. Hobbie,

Chief, Regulatory Division.

[FR Doc. E8–2979 Filed 2–15–08; 8:45 am]

BILLING CODE 3710–AJ–P

DEPARTMENT OF DEFENSE

Department of the Navy

[USN–2008–0006]

Privacy Act of 1974; System of Records

AGENCY: Department of the Navy, DoD.

ACTION: Notice to amend a system of records.

SUMMARY: The Department of the Navy is amending a system of records notice in its existing inventory of record systems subject to the Privacy Act of 1974, (5 U.S.C. 552a), as amended.

DATES: This proposed action will be effective without further notice on March 20, 2008 unless comments are received which result in a contrary determination.

ADDRESSES: Send comments to the Department of the Navy, PA/FOIA Policy Branch, Chief of Naval Operations (DNS–36), 2000 Navy Pentagon, Washington, DC 20350–2000.

FOR FURTHER INFORMATION CONTACT: Mrs. Doris Lama at (202) 685–6545.

SUPPLEMENTARY INFORMATION: The Department of the Navy systems of records notices subject to the Privacy Act of 1974, (5 U.S.C. 552a), as amended, have been published in the **Federal Register** and are available from the address above.

The specific changes to the record system being amended are set forth below followed by the notice, as amended, published in its entirety. The proposed amendments are not within the purview of subsection (r) of the Privacy Act of 1974, (5 U.S.C. 552a), as amended, which requires the submission of a new or altered system report.

Dated: February 12, 2008.

L.M. Bynum,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

NM08370–I

SYSTEM NAME:

Weapons Registration (June 14, 2006, 71 FR 34324).

CHANGES:

* * * * *

SYSTEM LOCATION:

At end of first para delete *http://neds.daps.dla.mil/sndl.htm* and replace with *http://doni.daps.dla.mil/sndl.aspx.*

CATEGORIES OF INDIVIDUALS COVERED BY THE SYSTEM:

At end of entry add: ''All individuals authorized access to individual armories.''

* * * * *

PURPOSE(S):

Delete entry and replace with ''To assure proper control of weapons on installations; to monitor and control purchase and disposition of weapons/accessories; and provide record of individuals authorized access to armory spaces.''

* * * * *

SYSTEM MANAGER(S) AND ADDRESS:

At end of entry delete *http://neds.daps.dla.mil/sndl.htm* and replace with *http://doni.daps.dla.mil/sndl.aspx.*

NOTIFICATION PROCEDURE:

At end of first para delete *http://neds.daps.dla.mil/sndl.htm* and replace with *http://doni.daps.dla.mil/sndl.aspx.*

RECORD ACCESS PROCEDURES:

At end of first para delete *http://neds.daps.dla.mil/sndl.htm* and replace with *http://doni.daps.dla.mil/sndl.aspx.*

* * * * *

NM08370–1

SYSTEM NAME:

Weapons Registration.

A.2 NOTICE OF AVAILABILITY OF THE *DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE TARMAC KING ROAD LIMESTONE MINE PROPOSED IN LEVY COUNTY, FLORIDA*

Federal Register / Vol. 77, No. 97 / Friday, May 18, 2012 / Notices 29617

DoD Blanket Routine Use 14 (Counterintelligence).

Any release of information contained in this system of records outside the DoD will be compatible with the purpose(s) for which the information is collected and maintained.

POLICIES AND PRACTICES FOR STORING, RETRIEVING, ACCESSING, RETAINING, AND DISPOSING OF RECORDS IN THE SYSTEM:

STORAGE:

Electronic storage media.

RETRIEVABILITY:

DIB Company POC information is retrieved primarily by company name and work division/group and secondarily by individual POC name.

DIB incident reports are primarily retrieved by incident number but may also be retrieved by company name. They are not retrieved by the individual name.

SAFEGUARDS:

Records are accessed by DIB CS/IA program office and DC3 personnel with security clearances who are properly screened, trained, under a signed confidentiality agreement, and determined to have "need to know." Access to records requires DoD Common Access Card (CAC) and PIN. Physical access controls include security guards, identification badges, key cards, cipher locks, and combination locks.

RETENTION AND DISPOSAL:

Disposition pending (treat records as permanent until the National Archives and Records Administration has approved the retention and disposition schedule).

SYSTEM MANAGER(S) AND ADDRESS:

Director, DIB Cyber Security/Information Assurance Office, 1235 South Clark Street, Suite 1500, Arlington, VA 22202.

NOTIFICATION PROCEDURE:

Individuals seeking to determine whether this system of records contains information on themselves should address written inquiries to Director, DIB Cyber Security/Information Assurance Office, 1235 South Clark Street, Suite 1500, Arlington, VA 22202.

The individual should provide their name, company name and work division/group, and correspondence must be signed.

RECORD ACCESS PROCEDURES:

Individuals seeking access to information about themselves contained in this system of records should address a written request to the Office of the Secretary of Defense/Joint Staff Freedom of Information Act Requester Service Center, 1155 Defense Pentagon, Washington DC 20301–1155.

The request should include the individual's name, company name and work division/group, the name and number of this system of records notice and correspondence must be signed.

CONTESTING RECORD PROCEDURES:

The OSD rules for accessing records, for contesting contents, and appealing initial agency determinations are published in OSD Administrative Instruction 81; 32 CFR part 311; or may be obtained from the system manager.

RECORD SOURCE CATEGORIES:

From the individual, participating DIB companies, and the Joint Personnel Adjudication System (JPAS).

EXEMPTIONS CLAIMED FOR THE SYSTEM:

None.

[FR Doc. 2012–12028 Filed 5–17–12; 8:45 am]

BILLING CODE 5001–06–P

DEPARTMENT OF DEFENSE

Department of the Air Force

Intent to Grant a Partially Exclusive Patent License

AGENCY: The United States Air Force, DOD.

SUMMARY: Pursuant to the provisions of Part 404 of Title 37, Code of Federal Regulations, which implements Public Law 96–517, as amended; the Department of the Air Force announces its intention to grant SCADA Security Innovation, Inc., a Delaware corporation, having a place of business at 33 West First Street, Dayton, Ohio 45402, a partially exclusive license, the exclusive portion limited to the field of cyber security for embedded applications outside of industrial controls, in any right, title and interest the Air Force has in: U.S. Patent Application No. 13/190,520, filed July 26, 2011, titled "Using Software-based Decision Procedures to Control Instruction-level Execution" by William B. Kimball.

FOR FURTHER INFORMATION CONTACT: The Air Force intends to grant a license for the patent application and resulting patents unless a written objection is received within fifteen (15) days from the date of publication of this Notice. Written objection should be sent to: Air Force Materiel Command Law Office, AFMCLO/JAZ, 2240 B Street, Rm D–14, Wright-Patterson AFB, OH 45433–7109; Facsimile: (937) 255–3733.

Henry Williams Jr.,

DAF, Acting Air Force Federal Register Liaison Officer.

[FR Doc. 2012–12056 Filed 5–17–12; 8:45 am]

BILLING CODE 5001–10–P

DEPARTMENT OF DEFENSE

Department of the Army, Corps of Engineers

Notice of Availability of the Draft Environmental Impact Statement for the Tarmac King Road Limestone Mine Proposed in Levy County, FL

AGENCY: U.S. Army Corps of Engineers, DoD.

ACTION: Notice of availability.

SUMMARY: The U.S. Army Corps of Engineers (USACE) is issuing this notice to advise the public that a Draft Environmental Impact Statement (Draft EIS) has been completed and is available for review and comment.

DATES: In accordance with the National Environmental Policy Act (NEPA), we have filed the Draft EIS with the U.S. Environmental Protection Agency (EPA) for publication of their notice of availability in the **Federal Register**. The EPA notice officially starts the 60-day review period for this document. It is the goal of the USACE to have this notice published on the same date as the EPA notice. However, if that does not occur, the date of the EPA notice will determine the closing date for comments on the Draft EIS. Comments on the Draft EIS must be submitted to the address below under FURTHER CONTACT INFORMATION and must be received no later than 5 p.m. Central Standard Time, Wednesday, July 11, 2012.

Scoping: Scoping Meetings were held in Inglis, FL and Chiefland, FL on March 26th and 26th, 2008 respectively, to gather information for the preparation of the Draft EIS. Public notices were posted in Levy, Citrus, Alachua and Pinellas County newspapers, and emailed and air-mailed to current stakeholder lists with notification of the public meetings and requesting input and comments on issues that should be addressed in the Draft EIS.

A public meeting for this Draft EIS will be held on Thursday, May 31, 2012 at 6:30 p.m. at the Inglis Community Center, 137 Highway 40 West, Inglis, FL 34449. The purpose of this public meeting is to provide the public the opportunity to comment, either orally or in writing, on the Draft EIS. Notification

of the meeting will be announced following same format as the Scoping Meetings announcements.

ADDRESSES: The Draft EIS can be viewed online at *http://kingroadeis.com.* Copies of the Draft EIS are also available for review at the following libraries:

Bronson Public Library—612 E Hathaway Ave., Bronson, Florida 32621.

Cedar Key Public Library—460 Second Street, Cedar Key, Florida 32625.

Luther Callaway Public Library—104 NE Third Street, Chiefland, Florida 32626.

Williston Public Library—10 SE First Street, Williston, Florida 32696.

A.F. Knotts Public Library—11 56th Street, Yankeetown, Florida 32698.

FOR FURTHER INFORMATION CONTACT: Mr. Ed Sarfert, Senior Project Manager, U.S. Army Corps of Engineers, Jacksonville District, 41 N. Jefferson Street, Suite 301, Pensacola, Florida 32502, Telephone: 850–439–9533, Fax: 850–433–8160.

SUPPLEMENTARY INFORMATION: Tarmac America L.L.C. (Tarmac) proposes to construct a limestone mine in Levy County, Florida to produce FDOT- and commercial-grade limestone aggregate for markets within west-central Florida. As proposed, direct impacts of up to 2,069 acres of wetlands and 1,818 acres of uplands would occur directly from limestone extraction, material stockpiling, roads, and other infrastructure over a period of approximately 100 years. At present, the majority of the property is an actively managed timber operation, with most of the site in varying developmental stages of pine plantation and mixed hardwood/pine forest. Much of the surrounding land is in silviculture use, with scattered residential parcels. The information compiled in this EIS will be used by the USACE to determine whether the proposed activities should be authorized and permitted by the USACE. Tarmac would need to obtain a Department of the Army permit pursuant to Section 404 of the Clean Water Act. This Draft EIS evaluates the potential environmental impacts associated with a no action alternative, and seven onsite action alternatives, including Tarmac's preferred alternative above. Under the seven other alternatives analyzed in the Draft EIS, mining activities involving discharges of fill material in wetlands could be authorized for varying acreages and lengths of time upon issuance of a Record of Decision.

Dated: May 8, 2012.

Tori K. White,

Deputy Chief, Regulatory Division, Jacksonville District, U.S. Army Corps of Engineers.

[FR Doc. 2012–12111 Filed 5–17–12; 8:45 am]

BILLING CODE 3720–58–P

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

The Release of the Draft Environmental Impact Statement and the Announcement of a Public Hearing for the Figure Eight Island Inlet and Shoreline Management Project, on Figure Eight Island, New Hanover County, NC

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of Availability.

SUMMARY: The U.S. Army Corps of Engineers (COE), Wilmington District, Wilmington Regulatory Field Office has received a request for Department of the Army authorization, pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, from Figure Eight Beach Homeowners' Association (HOA) to install a terminal groin structure along Rich Inlet and to conduct a supplemental beach nourishment on approximately 2.0 miles of oceanfront beach and 1,800 linear feet of back barrier shoreline to protect residential homes and infrastructures along the central and northern sections of Figure Eight Island. The terminal groin structure will be placed perpendicular on the northern tip of the island along the shoulder of Rich Inlet; and the proposed source of the material for the nourishment will be dredged from Nixon Channel, a back barrier channel. In case the quantity of material from Nixon Channel is not sufficient, material pumped from (3) nearby upland disposal islands will be used to supplement the nourishment needs. The majority of the material will be disposed within the fillet area, or down shore, of the groin. Pending storm events and shoreline changes, maintenance, or periodic nourishment, of the beach is proposed a maximum of once every five years. Nixon Channel and the upland disposal islands are the proposed material sources for the periodic maintenance, or renourishment, events.

DATES: The Public Hearing will be held at Ogden Elementary School Assembly Hall located at 3637 Middle Sound Loop Road, on June 7, 2012 at 6:30 p.m. Written comments on the Draft EIS and the proposed project must be received at (see **ADDRESSES**) no later than 5 p.m. on June 22, 2012.

ADDRESSES: Copies of comments and questions regarding the Draft EIS may be addressed to: U.S. Army Corps of Engineers, Wilmington District, Regulatory Division. ATTN: File Number 2006–41158, 69 Darlington Avenue, Wilmington, NC 28403. Copies of the Draft EIS can be reviewed, after it's posting on May 23, 2012, on the Corps homepage at, *http://www.saw.usace.army.mil/WETLANDS/Projects/index.html,* under Figure Eight Island Inlet and Shoreline Management Project.

FOR FURTHER INFORMATION CONTACT: Questions about the proposed action and DEIS and/or to receive CD or written copies of the Draft EIS can be directed to Mr. Mickey Sugg, Wilmington Regulatory Field Office, telephone: (910) 251–4811.

SUPPLEMENTARY INFORMATION:

1. *Project Purpose and Need.* Figure Eight Beach HOA has addressed the continuing oceanfront erosion problems associated with Rich Inlet and Nixon Channel erosion hot-spot on the estuarine side of the island over the past several decades. Past actions to protect the shorelines have provided some protection, however they are seeking a longer term solution to handle shoreline erosion in order to protect the island's $1,189,810,926 (based on the 2007 reappraisal) assessed property tax value. Their stated needs of the project are the following: (1) Reduce erosion along approximately 2.0 miles of oceanfront and 0.34 miles of back barrier shorelines, (2) Provide short-term protection to imminently threatened residential structures over the next five years, (3) Provide long-term protection to homes and infrastructure over the next 30 years, (4) Maintain the tax value of homes, properties, and infrastructure, (5) Use beach compatible material, (6) Maintain navigation conditions within Rich Inlet and Nixon Channel, (7) Maintain recreational resources, and (8) Balance the needs of the human environment with the protection of existing natural resources.

2. *Proposed Action.* Within the Town's preferred alternative, the installation of the terminal groin is the main component in the protection of the oceanfront shoreline. The location of the structure will be just north of the existing homes along the shoulder of Rich Inlet. Its total length is approximately 1,600 feet, which approximately 700 feet will project seaward of the existing mean high water

APPENDIX B
MINING PLAN

Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

June 9, 2010
File Number 05-086

Tarmac America, LLC
455 Fairway Drive
Deerfield Beach, FL 33441

Attention: Al Townsend

Subject: Hydrological and Hydrogeological Engineering Report for the Proposed King Road Mine Project, Levy County, Florida.

Dear Mr. Townsend:

As requested by Tarmac America, LLC, Ardaman & Associates, Inc. has prepared this summary hydrological and hydrogeological engineering report related to the King Road Mine project. It contains a description of the project and summarizes information concerning the regional and site-specific geology and hydrology, surface and groundwater quality, water balance analyses for the proposed mine and aggregate processing plant, the mining and reclamation plan, an analysis of the potential impacts resulting from the proposed mining and processing, as well as other supporting information focused on providing evidence of site conditions prior to the proposed mining operations and those following the rock extraction and subsequent reclamation of the mine pits upon completion of mining operations.

The report is based on information collected and analyses performed for this particular project. The report incorporates the most relevant results from discussions held with government bodies during the permitting process, such as the Southwest Florida Water Management District (SWFWMD) and the Florida Department of Environmental Protection (FDEP).

The attached report was prepared in accordance with generally accepted hydrological and hydrogeological engineering practices. It was prepared for the exclusive use of Tarmac America, LLC and Levy County solely for the subject project.

If there are any questions concerning the report, please do not hesitate to contact the undersigned.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.
Certificate of Authorization No. 5650

John E. Garlanger, Ph.D., P.E.
Principal Engineer
Florida License Number 19782

Reinaldo Rolo, Ph.D., P.E.
Project Engineer

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TABLE OF CONTENTS

1. INTRODUCTION 1
2. SITE CONDITIONS 1
2.1. Location 1
2.2. Topography 1
2.3. Drainage 2
2.4. Physiography 2
2.5. Geology 3
2.5.1. Stratigraphy 3
2.5.2. Geological Structure 4
2.5.3. Aquifer Properties 4
2.6. Hydrology 5
2.6.1. Rainfall 5
2.6.2. Lake Evaporation 5
2.6.3. Evapotranspiration 6
2.6.4. Soil Characteristics 6
2.7. Wetlands 7
2.8. Domestic and Public Supply Wells 7
3. FIELD INVESTIGATION 7
3.1. Test Borings and Monitor Wells 7
3.2. Water Level Data 8
3.3. Water Quality 8
3.3.1. Background Water Quality 8
3.3.2. Chloride Concentrations with Depth 9
3.3.3. Sulfate Concentrations with Depth 9
3.3.4. Surface Water Quality 10
3.4. Groundwater Monitoring Plan 10
4. ANALYSIS 11
4.1. Proposed Mine Plan 11
4.2. Water Balance 13
4.2.1. Pre-mining and During-mining 13
4.2.2. Post-reclamation 14
4.3. Salt Water Intrusion 14
4.4. Stormwater Analysis 16
4.5. Water Quality Evaluation 16
4.6. Steady-State Groundwater Model 19
4.6.1. Model Boundary Conditions 19

4.6.2. Model Calibration and Results 20
4.7. Transient Groundwater Flow Model 20
4.7.1. Model Results 21
4.8. Salt Water Intrusion 21

1. INTRODUCTION

Tarmac America, LLC is proposing to construct a limestone mine and processing plant on an approximately 4,750-acre parcel located in Levy County, Florida. There are approximately 2,700 acres of mineable land within the area proposed for mining.

Rock excavation will be performed using an electric-powered walking dragline, which will dig as deep as 120 feet below land surface. Once excavation begins, water will fill the excavated area and from then on, rock will be excavated under water. The excavated rock will be stockpiled, crushed, and a portion processed to meet Florida Department of Transportation aggregate specifications.

Of the approximately 5.2 million tons of rock excavated each year, 3 million tons will be sold. Sand, silt and clay-sized rock fragments resulting from the washing and screening process will be used to backfill and reclaim approximately one-half of the ±25 acres of mine cuts opened each year. The washing and grading process will require that approximately 13 million gallons of water per day (mgd) be re-circulated back and forth between the mine pits and the aggregate plant.

The following report describes the hydrology and hydrogeology of the proposed mine site, evaluates the potential impacts that could occur during mining and after reclamation of the mine site, provides recommendations for monitoring Floridan aquifer levels and groundwater quality during active mining, and presents our conclusions.

2. SITE CONDITIONS

2.1. Location

The proposed mine site is located within Sections 8, 9, 10, 11, 14, 15, 16, 17, 22 and 23 of Township 16 South, Range 16 East in Levy County, Florida. The eastern boundary of the site is approximately 1.2 miles west of US Highway 19 and the southern boundary is approximately 3 miles north of County Road 40. Entrance to the proposed mine site will be through King Road, which intersects US 19 approximately 5.1 miles north of the intersection of US 19 with County Road 40 in Inglis. The location of the proposed mine site is shown in Figure 1 and in Figure 2 on a copy of the USGS 7.5-minute quadrangle map. Waccasassa Bay State Preserve is located west of the proposed mine site.

2.2. Topography

The ground surface elevations on the site vary from a high of approximately 23 feet (NGVD) near the southeast corner of the site to a low of approximately 6 feet (NGVD) near the southwest corner of the site. The average slope across the site from east to west is approximately 4 feet per mile. The slope from north to south is negligible. A topographic map of the site and surrounding area is provided as Figure 3.

2.3. Drainage

Surface drainage is through intermittent streams that run approximately east-west through the property. The streams on the mine site are dry for most of the year and flow only during and after major storm events. These unnamed streams intercept the Floridan aquifer during wet weather periods and act as shallow relief points for groundwater outflow. The streams dry up after the water table drops below the bottom of the stream channel. The three primary stream channels on the property are shown in Figure 4. As shown, most of the surface runoff from the site drains out midway along the south boundary of the site into Section 21, T16S, R16E. Smaller tributaries flow north along the northern site boundary and west along the western site boundary. Surface runoff from the site eventually flows into Withlacoochee Bay primarily through Smith Creek. A small portion of the site drains to Spring Run which flows north and west of the proposed mine site. As shown in Figure 4, Spring Run comes within 600 feet of the north boundary of the project area.

A recent survey[1] of groundwater discharges in the proximity of the proposed mine site revealed the presence of a total of six springs (defined as features from which water could be clearly seen to be discharging from the ground). These are depicted in Figure 4.

Four of the six springs (SP-1 through SP-4 in Figure 4) were the spring vents comprising Big King Spring and Little King Springs, which are located approximately 1/2 to 1 mile to the northeast of the northeastern corner of the proposed mine site (head waters of Spring Run)[2]. During the field survey, the observed discharge from the springs was approximately 0.5 cfs from the group of vents comprising Little King Springs and approximately 1.2 to 1.5 cfs from Big King Spring. Only the largest of the three Little King Springs vents was discharging at the time of the survey. These estimates classify the springs as third and fourth magnitude (1 to 10 cfs and 0.2 to 1 cfs) for Big King Spring and Little King Springs, respectively.

The fifth spring (SP-5) was located in Spring Run approximately ¾ of a mile downstream of the furthest upstream point in the tidal range. An estimated flow of 45 gpm (0.1 cfs) was emanating from this spring, through a small karstified limestone cavity. The sixth one (SP-6) was a rise in Demory Creek approximately 200 feet downstream of a swallet where the entire creek disappeared. The flow could not be estimated but low salinity levels measured in the rise compared to the swallet indicated that the rise was receiving groundwater in addition to the lost stream flow.

For comparison of spring size, the flow of Wekiva Springs, which is a nearby second order spring, has a flow in the range of 20 to 70 cfs. The flow from Rainbow Springs (a first magnitude spring 15 to 20 miles east of the proposed mine site), is between 600 and 800 cfs. Average annual outflow from Lake Rousseau to Withlacoochee Bay is approximately 1,000 cfs.

2.4. Physiography

The proposed mine site is located within what Vernon (1951)[3] described as the Limestone Shelf

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[1] Kincaid, T. R. (2009). “Response to Florida Department of Environmental Protection Questions Submitted to Tarmac America, LLC, in Regard to the Proposed King Road Mine, Levy County, Florida”, March 2009.

[2] Scott, T. M., G. H. Means, R. P. Meegan, R. C. Means, S. B, Upchurch, R.E. Copeland, J. Jones, T. Roberts and A. Willet (2004) ASprings of Florida@. Bulletin 66, Florida Geological Survey, Tallahassee.

[3] Vernon, Robert O. (1951) AGeology of Citrus and Levy Counties, Florida@, Bulletin No. 33, Florida Geological

and Hammocks subdivision of the Terraced Coastal Lowlands of the Coastal Plain Province. The Pamlico age marine plain extends inland from the coast to approximately the 25-ft contour. According to Vernon, this surface is similar to the modern submarine plain and is covered with belts of sediment that parallel the Pamlico age coastline. A narrow band, up to a few miles wide, that extends seaward of the Pamlico coast line between elevation 15 and 25 feet is composed of sand that makes a poorly drained flat surface. Between the sand belt and the current coast line, a wide, eroded limestone shelf, up to several miles wide, makes up the Pamlico surface. Irregularities, created by solution weathering, have been obliterated by a thin covering of sediments of Pamlico age. The lower coastal margins of the limestone shelf have been drowned by salt-water marshes.

Because the limestone shelf is part of the Floridan aquifer system, the water levels in ponds and lakes of the coast areas fluctuate greatly. During high seasonal rainfall, the ponds and shallow streams coalesce to form large swamps. Springs and seeps are not uncommon as described above. In drought periods, most of the surface is dry.

East of the Pamlico terrace, which had a Pleistocene shore line at an elevation of about 25 feet (NGVD), are remnants of the Wicomico terrace, which had a Pleistocene shore line at an elevation of about 100 ft (NGVD). The shoreline of the Wicomico terrace abuts the Brooksville Ridge, which runs in a nearly north-south direction through eastern Citrus and Levy Counties. The Brooksville ridge is comprised of Miocene/Pliocene age deposits of the Alachua formation covered with thick deposits of Pleistocene sand.

2.5. Geology

2.5.1. Stratigraphy

The oldest rock formation outcropping at the proposed mine site is the Avon Park Limestone (Vernon, 1951). The Avon Park limestone is Late Middle Eocene in age and was deposited in a marine environment more than 35 million years ago. The upper portion of the Avon Park limestone is a cream to brown, highly fossiliferous, fragmental to pasty limestone that weathers cream to white. Numerous exposures are visible, particularly along the primary stream channels and roadside ditches that pass through the property. The limestone grades to dolomite with increasing depth and the entire formation has been dolomitized since deposition. The Avon Park limestone is over 300 feet deep at the proposed mine site. The hardness of the dolomitized limestone is what makes it a suitable source for construction aggregate.

Underlying the Avon Park limestone is the Lake City limestone of Early Middle Eocene age. The Lake City limestone is a chalky to granular limestone, containing chert and gypsum in some areas. The Lake City limestone has also been dolomitized throughout its depth. It occurs from about 350 feet to over 1000 feet below land surface at the proposed mine site. However, gypsum and anhydrite deposits within the lower 300 feet of the formation make the lower portion of the Lake City limestone relatively impermeable. The Avon Park limestone and the Lake City limestone make up the Avon Park formation. Deeper limestone deposits at the site include the Oldsmar limestone of Lower Eocene age and the Cedar Keys limestone of Paleocene age. These older deposits and the lower portion of the Lake City limestone are not part of the upper Floridan aquifer system. Younger formations, including most of the Ocala Group limestone of Late Eocene age and the Suwannee limestone of Oligocene age that are typically included in the Floridan aquifer system in central Florida, are not present at the site.

Survey, Tallahassee.

2.5.2. Geological Structure

The most important structural feature in Levy and Citrus counties is the Miocene age Ocala uplift, which is a broad flexure about 230 miles long and 70 miles wide. The flexure contains two well-defined shallow folds. In Citrus and Levy counties, the two folds are only a few miles apart. Both of the folds run northwest-southeast through the two counties. Tension cracks near the top of the folds and along the flanks of the folds created the fracture pattern shown in Figure 5. Differential movement along some of these fractures resulted in a number of faults, some with vertical movement in excess of 50 feet. At least seven such faults have been observed in the cross section drawn along the route of the previously proposed Cross-Florida Barge canal.

Movement during the Ocala uplift raised the Avon Park limestone above the current ground surface at the mine site. With time the overlying formations were eroded away exposing the Avon Park limestone at ground surface. Figure 6 is a cross section drawn through the mine site summarizing the topography, physiography and geology described above.

2.5.3. Aquifer Properties

The uppermost aquifer at the proposed mine site is the Floridan aquifer. The potentiometric surface of the Floridan aquifer at the mine site is the water table, which varies from at or slightly above the ground surface to about 6 feet below the ground surface. The Floridan aquifer at the mine site is comprised of the Avon Park limestone and the upper portion of the Lake City limestone. The thickness of the aquifer at the mine site is approximately 700 feet[4]. The transmissivity of the Floridan aquifer in the vicinity of the mine site is quite variable with reported values between 12,000 ft^2/day and 1,500,000 ft^2/day[4].

Seepage in the Floridan aquifer is along joints and bedding planes that have been enlarged through solution weathering (corrosion). Because the quantity of flow increases with distance from the groundwater divide, solution openings get larger and transmissivity increases as the flow approaches a discharge point, e.g., a spring or the coast. Figure 7 is a conceptualized view of a small element of the Floridan aquifer beneath the proposed mine site based on examination of cores from borings drilled at the site and descriptions and photographs of outcrops of the Avon Park formation elsewhere in Levy County. Note that the flow in the conceptualized drawing is from east to west and must follow a tortuous path through the weathered joints and bedding planes. The different sizes of the weathered joints result in longitudinal dispersion along a given flow path. The variability and tortuosity of the joints and bedding planes result in vertical and transverse dispersivity. The volume of the void space created by the weathered joints and bedding plans is unknown. However, the primary porosity of the upper portion of the Avon Park formation based on the measured dry density of cores is approximately 0.3. A secondary or fracture porosity (along the discontinuities in the rock formation, which control the seepage velocity) of 0.05 to 0.10 is probably a reasonable estimate for the Floridan aquifer[5].

The Floridan aquifer is the primary source of potable water in Levy and Citrus counties. Potable

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[4] Grubbs, J. W., and C.A. Crandall (2007) "Exchanges of Water between the Upper Floridan Aquifer and the Lower Suwannee and Lower Santa Fe Rivers", Florida: U.S. Geological Survey Professional Paper 1656-C.

[5] Davis, J. H., & B. G. Katz (2007) "Hydrogeologic Investigation, Water Chemistry Analysis, and Model Delineation of Contributing Areas for City of Tallahassee Public-Supply Wells, Tallahassee, Florida", U.S. Geological Survey Scientific Investigations Report 2007-5070.

wells located in the small community located near the southwest corner of the site are typically about 35 to 40 feet deep with 15-ft to 20-ft deep drop pipes. The public water supply wells for Yankeetown are approximately 100 feet deep and those for Inglis are approximately 230 feet deep. Both the Inglis and Yankeetown public supply wells are approximately 15,500 feet south of the southern boundary of the mine site.

2.6. Hydrology

Surface runoff and groundwater outflow from a site are a function of rainfall, evaporation and transpiration (evapotranspiration), drainage features, and aquifer properties. Runoff and evapotranspiration are related to surface features, depth to the water table, and vegetative cover.

2.6.1. Rainfall

The average annual rainfall in Levy and Citrus counties based on 90 years of data are 53.9 and 54.1 inches, respectively[6]. A hydrograph of annual rainfall for both counties is provided in Figure 8. The variation in annual rainfall is typical of Florida with maximum and minimum values for Levy County of 83.4 and 35.0 inches per year and for Citrus County of 84.6 and 32.12 inches per year. Average monthly rainfall for both counties is provided in Table 1. The rainy season is June through September.

Daily rainfall records within Levy County nearest to the mine site are available for the years 1998 to 2007 for the Usher Tower NOAA station, which is located some 25 miles north-west of the proposed King Road Mine, and for the years 2003 to 2008 at the Inglis Lock Meteorological Station, which is located approximately 6 miles southeast of the proposed mine. The annual average rainfall recorded for the Usher station during the 1998 to 2007 time period is 55.3 inches, very close to the county's 90-year average. The maximum and minimum yearly values are 74.1 and 41.7 inches per year respectively. Table 1 also summarizes the average monthly rainfall for the Usher Tower NOAA station. The average annual rainfall for the Inglis lock station during the 2003 to 2008 period is 52.3 inches.

2.6.2. Lake Evaporation

Visher and Hughes (1969)[7] indicate average annual lake evaporation for Levy and Citrus counties of approximately 48 inches per year. The nearest NOAA station with long-term Class A pan evaporation data is Gainesville. Using a pan coefficient of 0.735 to convert pan evaporation to lake evaporation[8], the average lake evaporation for the Gainesville NOAA station was 47.4 inches per year.

Records for this station, however, could not be found for years beyond 1998, and the nearest station found with available daily pan evaporation data was that at Lisbon, Lake County. Using the same pan coefficient as above, the average yearly lake evaporation from 1998 to 2007 for Lisbon is 45.0 inches per year.

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[6] Southwest Florida Water Management District (2008) "Historical Hydrological Data", Brooksville.

[7] Visher, F. N. & G.H. Hughes (1969) AThe Difference Between Rainfall and Potential Evaporation in Florida@, Map Series 32, Florida Geological Survey, Tallahassee

[8] Lee. T. M. & A. Swancar (1997) AInfluence of Evaporation, Ground Water, and Uncertainty in the Hydrologic Budget of Lake Lucerne, a Seepage Lake in Polk County, Florida@, United States Geological Survey Water-Supply Paper 2439.

A plot of the annual lake evaporation for the Gainesville and Lisbon stations is presented in Figure 9. Table 2 provides the average monthly values.

2.6.3. Evapotranspiration

Cherry (1970)[9] reported an average annual value of 39 inches per year for evapotranspiration in the middle Gulf area of Florida. This includes open water evaporation as well as evaporation from soil surfaces and transpiration from plants. Table 3 lists evapotranspiration for various types of landforms in south-central and north-central Florida obtained from numerous sources. Comparison of predicted and measured values of streamflow, both before and after development, has demonstrated the reasonableness of the tabulated values.

Daily evapotranspiration data is not available in the literature for the proposed mine site.

2.6.4. Soil Characteristics

The characteristics of the surficial soil on the site determine the quantity of daily evapotranspiration and direct surface runoff. Infiltration during storm events depends upon both soil permeability and available storage. Evapotranspiration is higher in soils with higher field capacities and lower wilting points (higher available moisture).

There are two soil types on the proposed mine site: Wekiva fine sand and Waccasassa-Demory complex, flooded[10]. Both of these soil types are within the wetland Hardwood Hammock ecological community. The Wekiva fine sand is a poorly drained, shallow, nearly level soil found primarily on low ridges. Slopes range from 0 to 2 percent. Typically, the surface layer is very dark gray fine sand about 4 inches thick. The subsurface layer, to a depth of about 9 inches, is grayish brown fine sand. The subsoil, to a depth of about 18 inches, is yellowish brown sandy clay loam overlying limestone bedrock. In most years the seasonal high water table is within 12 inches of the ground surface for 2 to 6 months. The water table is above the surface for 1 to 2 weeks following heavy rains. The water table recedes into joints and cracks in the bedrock during dry periods. Permeability (hydraulic conductivity) is moderately slow. Available water capacity is very low. Vegetation is primarily planted pine trees.

The Waccasassa-Demory complex consists of poorly drained, nearly level soils on low ridges. They are rarely to occasionally flooded. The surface soil is a very dark grayish brown sandy clay loam about 2 inches thick. The subsoil is dark yellowish brown sandy clay loam to a depth of 12 inches overlying limestone bedrock. The seasonal high water table is within a depth of 12 inches for 2 to 6 months in most years and is flooded for 2 to 7 days after heavy rainstorms. Permeability is moderately slow and available water capacity is very low. Vegetation on this soil is also primarily planted pine.

A soil map of the proposed mine site is provided in Figure 10. Table 4 summarizes the important physical properties for the predominant soil types[10].

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[9] Cherry, R.N., J. W. Stewart, & J. A. Mann (1970) AGeneral Hydrology of the Middle Gulf Area, Florida@, Report of Investigation No. 56, Florida Geological Survey, Tallahassee

[10] Slabaugh, J. D., A. O. Jones, W. E. Puckett, & J. N. Schuster (1991) ASoil Survey of Levy County, Florida, USDA NRCS, Washington, D.C.

2.7. Wetlands

A wetland map for the site developed from the SWFWMD wetlands database is presented in Figure 11. All wetland and surface waters on the mine site have been delineated and field verified as part of a formal wetland determination (Numbers 276629-001, 276628-001, 276624-001, 244771-001, and 276630-001). The majority of the wetlands on the mine site are hydric pine plantation wetlands. Conversion from historic mixed hardwood hammock to planted pine plantation and long-term silvicultural management has significantly reduced the value and productivity of these wetlands. The few remaining wetlands not used for silviculture and adjacent uplands on the proposed mine site are generally associated with flow ways. These areas have been set aside as ±850 acres of “no mine area” in the long-term conceptual mine plan for the 4,800-acre mine site.

2.8. Domestic and Public Supply Wells

Figure 12 shows the location of domestic and public supply wells as recorded in the well construction permits filed at SWFWMD. Note, however, that many historical sites do not have actual coordinates recorded in the permit and for these sites, address matching, quarter STR centroids, STR centroids, or county centroids were used by the District to show the location of the wells. According to data published by the District, there are a number of public-supply wells currently in use in the towns of Inglis and Yankeetown. Most of the wells at Inglis are installed to an average depth of about 235 ft, and have a combined withdrawal rate of 448,000 gpd. Generally shallower wells (i.e. 100 ft deep on average) are used at Yankeetown, where the cumulative daily withdrawals amount to about 256,000 gpd.

3. FIELD INVESTIGATION

3.1. Test Borings and Monitor Wells

More than 50 test borings with continuous core samples were drilled at the site to characterize the limestone within the upper 150 feet of the Avon Park limestone and to determine if sufficient hard rock was present to make mining feasible. Three additional deep borings (up to 380 feet deep) were drilled at the location of three proposed salt water monitors. Six relatively shallow borings were drilled to a depth of 20 feet as part of a background groundwater monitoring network for the site. These borings were converted to monitor wells and have been sampled to characterize background water quality at the site and to monitor background fluctuations in groundwater level with time. Three of the wells are equipped with continuous recorders that measure the water level every four hours. The locations of the deep borings and monitor wells are presented in Figure 13.

The prospect borings were used to classify the rock and estimate the quantity of saleable aggregate that will be produced at the facility. The rock was primarily classified into two categories: soft rock and hard rock. Specific gravity determinations were made on 136 rock cores. The results are provided in Table 5. The variability in the specific gravity of the cores is a result of the differences in the porosity of the cores.

Because the rock at the site is weathered (corroded) along joints and bedding planes, the specific gravity of the formation is substantially lower than the specific gravity of individual rock cores. Based on local experience and knowledge of other rock mines in the area, the best estimate of the overall specific gravity of the mineable rock is 1.63, which equates to a dry density of 101.8 lbs/ft^3 or 2,750 lbs/yd^3.

Product moisture is available from tests performed at the Mineral Research and Test Center in Milwaukee Wisconsin and at the Tarmac QC laboratory in Pennsuco, Florida on finished product from the crusher tests. The average moisture content from 13 tests was 5.6%, within a range of 3.4% to 8.3%.

3.2. Water Level Data

Manual readings of the water level in the six shallow monitor wells and the deep monitor well, along with the ground surface elevations and screen interval at each of the monitor wells, is provided in Table 6. Hydrographs of the data from 3 continuous water level recorders are presented in Figure 14. The water table fluctuates from at or slightly above the ground surface to approximately 6 feet below ground surface, i.e., the seasonal high groundwater level is at the ground surface and the seasonal low is about 5 to 6 feet below the ground surface.

Data on the elevation of the potentiometric surface of the Floridan aquifer is also available for other wells in the site vicinity. This data has been combined with the site-specific water levels to develop a potentiometric surface map for the proposed mine site and surrounding area during wet and dry periods. These maps are presented in Figures 15 and 16.

The potentiometric maps can be used to determine the size of the groundwater basin contributing groundwater to the site, the direction of groundwater flow in the site vicinity, and the direction of groundwater flow through the site. The approximate groundwater basin for the site is shown on Figure 17. Groundwater flows perpendicular to the potentiometric lines, i.e., in an east-west direction across the site. The slope of the water table across the mine site is approximately 4 feet per mile.

3.3. Water Quality

3.3.1. Background Water Quality

Groundwater from six shallow groundwater monitoring wells, four deep groundwater monitoring wells, Little King Spring, and from three different depths within a test pit excavated at the site was sampled and analyzed to determine groundwater quality prior to site development. The results are presented in Table 7 and graphically illustrated in Figure 18. The pH of the groundwater, including the spring, ranged from 6.5 to 7.9. Conductivity varied from 479 µS/cm to 2,940 µS/cm. The major dissolved constituents in the shallow groundwater are calcium, magnesium and bicarbonate. Sulfate in the shallow wells and Little King Spring was typically below 25 mg/L. In the deeper wells (>140 feet), sulfate increased to greater than 1000 mg/L. Sulfate concentrations in the test pit were between 85 and 100 mg/L. Total nitrogen varied from 0.3 mg/L to 1.4 mg/L. Little King Spring had the highest nitrogen concentration. Nitrogen in the spring was predominantly in the nitrate form. Phosphorous typically varied from 0.02 mg/L to 0.05 mg/L. Phosphorous in the spring sample was 0.05 mg/L. Chloride was in the range of 12 mg/L to 42 mg/L for the shallow wells, in the range of 13 mg/L to 51 mg/L for the deep wells and 9 mg/L for Little King Spring.

Elevated arsenic values (>10µg/L) were reported for some of the monitoring wells at the subject site during the initial sampling event. In four of the shallow wells, the reported arsenic values on the second sampling event were less than the Method Detection Limit of 4 µg/L. At the other two wells with elevated arsenic concentrations, the concentrations were 7.2 and 7.7 µg/L. The reason for the higher concentrations reported for the initial sampling is unknown. Because all of the samples over the several thousand acre site had higher concentrations on the initial sampling than on the second sampling, fluctuations in the calibration of the laboratory

equipment is the most logical explanation. The mean of the reported arsenic concentration in the shallow Floridan aquifer at the project site based on twelve samples was 8.35 μg/L. The standard deviation was 4.2 μg/L. The range in the population mean at the 95% confidence level for the sampling conducted to date is 5.98 μg/L to 10.72 μg/L

The samples from the test pit had pH values in the range of 7.48 to 7.95, with the shallow sample having the highest pH. The major dissolved constituents in the water in the pit were predominantly calcium, magnesium, sulfate and bicarbonate.

Gross alpha activity in the ten monitor wells and test pit averaged less than 4 pCi/L, which is well below the groundwater standard of 15 pCi/L. Combined radium 226+228 in the ten monitor wells and the test pit averaged approximately 1.1 pCi/L, which is well below the groundwater standard of 5 pCi/L

3.3.2. Chloride Concentrations with Depth

In an attempt to determine the depth to the salt water interface, a test boring (MW-7/MW-8) was drilled on the western property boundary at the location shown on Figure 13. The boring was advanced using the wire-line coring technique with continuous casing. At selected intervals, after the core was extracted but before the casing was advanced, the well was purged and a groundwater sample was obtained for chloride analysis. The results of the chloride analyses are plotted in Figure 19 as a function of depth. As shown, the chloride concentration increases gradually with depth from about 25 mg/L at a depth of 50 feet to about 50 mg/L at a depth of 370 feet. Sea water has a chloride concentration of about 19,000 mg/L. Although the interface was not encountered, two deep monitor wells were installed at this location, one with a collection zone between 140 feet and 150 feet (MW-7), and another with a collection zone between 353 feet and 373 feet (MW-8) A sample of the water from the collection zone had a chloride concentration of about 25 mg/L. Two additional deep monitors (MW-9 and MW-10) were installed at the locations show on Figure 13. These monitors are screened between 278 feet and 298 feet and 286 feet and 306 feet, respectively. The chloride concentrations from the screened zone of these two wells were 32 mg/L and 11 mg/L, respectively.

3.3.3. Sulfate Concentrations with Depth

Sulfate is relatively low in the shallow wells and increases with depth to approximately 1,350 mg/L at a depth of 350 feet. Figure 20 is a plot of the sulfate data as a function of depth.

Several sources of sulfate exist in the Floridan aquifer. According to Sacks (1996)[11], the most apparent source is dissolution of evaporite minerals (gypsum and anhydrite), which are found at the base of the Upper Floridan aquifer or in the underlying middle confining unit and Lower Floridan aquifer. This source requires an upward movement of water because the occurrence of evaporites is considerably deeper than zones in which most drinking water wells are finished. Trace evaporites have not been observed in well cuttings or cores in shallow parts of the aquifer. Analysis of the cores obtained for the King Road Mine indicated total sulfate concentrations of less than 0.1 percent. Saltwater mixing is not a likely source of sulfate in inland areas because chloride concentrations are low (less than 50 mg/L).

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[11] Sacks, Laura A. (1996) “Geochemical and Isotopic Composition of Ground Water with Emphasis on Sources of Sulfate in the Upper Floridan Aquifer in Parts of Marion, Sumter, and Citrus Counties, Florida”, U.S. Geological Survey Water-Resources Investigations Report 95–4251

3.3.4. Surface Water Quality

Water quality in the streams is good and, except for dissolved oxygen, meets applicable surface water quality standards. Entrix, fka Biological Research Associates[12], has been conducting monthly surface water quality sampling at 13 monitoring stations on the project site since November 2007. Dry conditions were encountered during most sampling events at most stations and all 13 stations were sampled only twice during the 2008 monitoring year. Measured pH values were fairly consistent, ranging from 6.2 to 7.6. Turbidity was in the range of 0.5 to 5.4 NTU. Conductivity varied from 171 μS to 2685 μS across the project area. The higher conductivities were measured on the mitigation portion of the site in close proximity to Withlacoochee Bay where salt water influences surface water quality. Dissolved oxygen was typically below 5 mg/L. Biological oxygen demand was typically between 2 and 6 mg/L. Chlorophyll-*a* values were near the method detection limits of 1.1 to 2.2 mg/m^3 at most stations and sampling events. Total nitrogen in the stream stations varied from 0.02 to 3.1 mg/L and was primarily in the form of organic nitrogen. Phosphorous was typically between 0.02 and 0.2 mg/L.

Chlorides and sulfates at most stations were typically below 15 mg/L. At the stations along the coast, the concentrations of these two parameters were in the range of 100 mg/L to 500 mg/L reflecting the influence of salt water. Gross alpha particle activity was below 3 pCi/L. Oil and grease was only detected at three of the 13 stations and, at 2 to 3 mg/L, was below the Class III standard of 5 mg/L. Total hardness at most stations was in the range of 100 mg/L to 300 mg/L. Arsenic, cadmium, chromium, copper, lead, nickel and zinc were all below their respective Class III standard. Iron exceeded the Class III standard at only one station with measured values of 2.3 mg/L in August 2008 and 13 mg/L in March 2008. The station with the elevated iron concentration is at the eastern entrance to the mine site.

3.4. Groundwater Monitoring Plan

As part of the field exploration program for the proposed project site, Tarmac America, LLC, will implement a comprehensive groundwater monitoring plan (GWMP) with the objective of measuring groundwater levels and quality both prior to and during mining operations. The objective of the groundwater monitoring program is to document compliance with permit conditions related to water quality and water quantity. Full details of the GWMP are described by Garlanger and Rolo (2010)[13].

The GWMP was prepared following the guidance for ground water monitoring plan design from the Florida Department of Environmental Protection (2008) and Rule 62-520.600, F.A.C.

Figure 21 shows the location of the proposed monitoring well network for the first ten years of mining. Two monitor wells will be provided at each water quality sampling location; one screened from 15 feet to 35 feet below existing grade (S well) and one screened from 50 to 70 feet below existing grade (D well). Monitor Wells MW-15S and MW-15D will serve as the ***Background Wells***. Wells MW-4, MW-6, MW-7, MW-11, MW-12, MW-13 and MW-14 will serve as ***Regional Wells*** (i.e. they are sufficiently far from the withdrawal points to ensure minimum drawdown effects from the mining operations). Wells MW-17S, MW-17D, MW-18S, MW-18D

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[12] Hammond, Daniel G. and Kristan M. N. Robbins (2008). "Surface Water Quality Assessment, Baseline Monitoring, Tarmac King Road Limestone Mine, 2008 Annual Report", Biological Research Associates, September 2008.

[13] Garlanger, J. and Rolo, R (2010). "Groundwater Monitoring Plan for Proposed King Road Mine". Ardaman & Associates, January 2010.

MW-19S, MW-19D, MW-20S, MW-20D, MW-21S, MW-21D, MW-22S and MW-22D will serve as ***Intermediate Wells*** (interceptor wells) located within the permitted zone of discharge, and monitor wells MW-2S, MW-2D, MW-7S, MW-7D, MW-16S and 16D will serve as ***Compliance Wells***. MW-8, MW-9 and MW-10 are existing salt water monitors screened below 300 feet. MW-1, MW-2, MW-3, and MW-5 are existing monitor wells used to obtain water levels and water quality during design and permitting of the project.

The following parameters will be monitored quarterly (or annually in the case of Gross Alpha Radium^{226}, and Uranium) in the background well, the intermediate wells and the compliance wells once mining operations start.

Field Parameters	Laboratory Parameters
pH	TDS
Conductivity	Sulfate
Temperature	Chloride
Turbidity	Total Nitrogen
Water level	Arsenic
	Gross Alpha
	Radium^{226} (*)
	Uranium

(*) To be measured if Gross Alpha exceeds 15 pCi/l.

The chloride monitors will be sampled and tested annually for the field parameters, TDS, sodium and chloride. Other chemical analyses may be performed if required by FDEP or the Water Management District.

Tarmac also proposes to install staff gauges in the active mine pit, tailings disposal area and in the plant pond and to install piezometers/staff gauges in preserved wetlands located within 500 feet of the active mine cut and tailings disposal area.

4. ANALYSIS

4.1. Proposed Mine Plan

The proposed mine plan was developed to generate approximately 3 million tons of saleable construction grade aggregate each year. The quality of the Avon Park limestone is such that approximately 5.2 million tons of the formation must be mined and processed each year to generate 3 million tons of aggregate.

Figure 22 is an illustration of the currently proposed mine plan for the first ten years of the mine life. The first production mine pit will be located just east of the proposed plant site. This area, totaling 50 acres, would be completely reclaimed by the end of the 10-yr period. After the area east of the plant site is mined, the dragline will cross the northernmost stream channel and walk approximately one mile to the west to begin mining the western end of the northern mine parcel. Mining will proceed from west to east for approximately 2.5 years after which the dragline will walk approximately 2 miles to the east to begin mining from east to west at the eastern end of the northern mine parcel. The cross-hatched areas in Figure 22 are the mine pits that will be backfilled and/or reclaimed by the end of the ten-year mining period.

The area that will be disturbed during the first ten years of the project is estimated at 590 acres (this includes mine pits, the 238-acre plant site and other operation-related disturbed areas). At

an assumed average mining rate of 24 acres per year, the area that could be mined during the first ten years is 240 acres (including the Plant Pond). A portion of the site development pit and approximately 95 acres of mine pits will be backfilled and partially or fully reclaimed during the initial ten years of mining. At the end of the first ten-year mining period, the area of open water is expected to be 145 acres, which includes 15 acres of shallow ponded water on the current tailings pond, 30 acres of ponded water in the two plant ponds, and 100 acres of deep water in the last mining area.

Although the dragline has the capability of mining to a depth of 120 feet, the mine plan for the first ten years of the mine life assumed an average mine depth of 100 feet. Using an *in situ* dry density for the rock of 1.375 tons/yd^3 and a design mining rate of 5.2 million tons per year, the number of acres mined each year will be a little less than 25 acres. Using an average dry density of 1.2 tons/yd^3, the 2.2 million tons of tailings are sufficient to backfill approximately one-half of the mined pits. Tailings consist of rock fragments and fines not meeting specifications.

The rock will be excavated using a large, electric-powered walking dragline. The mine pit will not be de-watered before, during or after mining. The rock will be removed, cast into large windrows (stockpiles) and allowed to drain before processing. Drainage water will be directed back to the mine pit or allowed to seep back into the aquifer.

After the excavated rock has drained for several weeks, it will be removed from the stockpile, crushed, and then conveyed to the plant for further processing. Processing consists of additional crushing, washing and screening to meet the required specifications. Water for washing the aggregate and transporting the tailings will be pumped from the plant pond, which will also be used to receive return flow from the mine pit being filled. The recirculation flow will be approximately 9,000 gpm (13 MGD). The average water content of the aggregate being trucked from the site is expected to be about 6 percent.

After the excavated rock has drained for several months, it will be removed from the stockpile, crushed, and then conveyed to the plant for further processing. Processing consists of additional crushing, washing and screening to meet FDOT specifications.

Some of the rock removed from the initial 14-acre site development pit will be used to construct roads and berms and to provide fill for the plant site. Berms up to 4 or 5 feet high will be constructed adjacent to all of the undisturbed areas using the overburden stripped from the areas to be mined. A layer of limerock fill approximately 2 to 3 feet thick will be placed over the areas to be mined. This will provide a working pad for the dragline.

The net volume of the aggregate removed from the mine pit, using a specific gravity for dolomitic limestone aggregate of 2.75, is about 800 acre-ft per year. This volume of excavated rock will be replaced by groundwater pumped into the active mine pit from the plant pond or directly seeping into the active pit from the surrounding Floridan aquifer. The quantity of water that must be pumped or allowed to seep into the mine pit to replace the net volume excavated is 720,000 gpd. Note that this water is not consumed or used by the mining process; it is the annual change in storage within the aquifer resulting from extracting the aggregate.

As described earlier and illustrated in Figures 15 and 16, the water table (potentiometric surface) slopes from east to west across the site with a gradient of about 4 feet per mile. Because the water level in a mine pit is horizontal, the water table will be lowered on the east side and raised on the west side of each mine pit. The magnitude of this raising and lowering of the water table at the east and west end of the mine pit depends on the actual slope of the water table at each pit and the width of the opening. The mining and reclamation plan was

designed to minimize changes in the water table during mining and reclamation. Tarmac will maintain the difference in water level between adjoining mine cuts to a maximum of 12 inches, i.e., the water level will be allowed to drop by no more than 6 inches on the east end of the mine cut and rise by no more than 6 inches on the west side of the mine cut. This will keep the average water level in the mine cut at or very near the natural pre-mining water level.

4.2. Water Balance

4.2.1. Pre-mining and During-mining

As discussed in the hydrology section, the average surface water and ground water outflow from the site on a long-term basis can be calculated from the hydrology mass balance equation:

Runoff + Groundwater Outflow = Rainfall - Evapotranspiration.

Figure 23 is the flow diagram for the proposed King Road Mine. The water budget for the proposed mine under annual average conditions is provided in Table 8. All of the quantities are based on 24 hours per day and 365 days per year.

Figures 24 and 25 are diagrams illustrating the water balance for the King Road Mine catchment area for the pre-mining and during-mining condition. In the pre-mining condition, rainfall on the catchment area is balanced by evapotranspiration from the pre-mining landform, groundwater outflow to the surrounding Floridan aquifer, and runoff to streams. In the during-mining condition, rainfall on the catchment area must be supplemented with water seeping into the catchment area from the surrounding Floridan aquifer to balance the evaporation from the mine pits and plant pond, evaporation from paved/roofed areas and the plant area/stockpiles, evapotranspiration from reclaimed areas and other vegetated surfaces, groundwater outflow to the Floridan aquifer, water leaving the site as product moisture, and the change in storage created by the removal of aggregate from the site. Note that during mining, runoff from the catchment area is collected and directed to the mine pit or plant pond.

The Floridan aquifer withdrawal is the amount of water required to balance the budget and is equal to the difference between the sum of the users and the sum of rainfall and recycled water (i.e. 0.34 mgd). Please note that an earlier mining plan produced a more conservative estimate of Floridan aquifer withdrawal of 0.38 mgd, which is the value used for the steady-state groundwater impact analyses described later in this report. Recycle water is the water used to transport the mine tailings to the tailings disposal area. It was calculated from the total tailings generated in an average production year and assumed solids content in the slurry of 10 percent. The total tailings volume generated during an average year is the difference between the amount of rock mined and the amount of product sold.

To prevent any deterioration in surface water quality and to comply with permit conditions, all of the active areas of the mine site will be surrounded by an engineered berm designed to prevent surface water discharge during all storm events up to and including the 25-year storm, i.e. average annual runoff from the catchment area is zero. The stormwater captured behind the perimeter berms will be used as makeup water in the plant recirculation system. The average annual quantity of surface water runoff captured and used as makeup in the mine recirculation system is estimated at 0.48 million gallons per day (mgd). The reduction in surface water discharge to Withlacoochee Bay from the mine site is minimal compared to the average annual discharge from Lake Rousseau to the Withlacoochee River and Withlacoochee Bay, which is reported by the US Geological Survey to be in excess of 650 million gallons per day.

Change in Storage is the water that is needed to fill the void left by excavating the rock and removing a portion of it from the site. The amount of rock that is excavated from the quarry each year is 5.2 million tons. Product sales will remove 3.0 million tons of rock from the site. The volume of water needed to fill the void left by removing 5.2 million tons of rock from the quarry is calculated by dividing the mass of rock removed by the dry density of the solid portion of the rock (the water in the void space does not leave the site). The solid rock, which is primarily dolomite, is estimated to have a specific gravity of 2.75 and a solids density of 172 lbs/ft^3 (2.75*62.4 lbs/ft^3). The volume of solid rock removed is 1,390 acre-ft per year. The volume of tailings, which is also estimated to have a specific gravity of 2.75, is calculated by dividing the mass of tailings returned to a previously-mined quarry (the tailings disposal area) by the dry density of the tailings grains, i.e., 172 lbs/ft^3 and is equal to 587 acre-ft per year. The difference between these two volumes is the net change in storage, i.e. 803 acre-ft per year, or 720,000 gpd.

As shown on the flow diagram, ground water withdrawals will be from the mine and the plant pond. The relative volumes from each of these withdrawal points depend on how much plant flow is diverted to the mine pit. For the conditions shown, most of the ground water withdrawal is from the mine pit. If more water is pumped to the mine pit (or in the case of the first 5 years, less water is pumped back to the plant pond, more of the withdrawal will be from the plant pond. On the flow diagram, net rainfall (rainfall - ET) is proportioned by area.

During a meeting on May 28, 2008, SWFWMD staff indicated that although changes in natural ET resulting from project development (and the water used to replace the volume of aggregate leaving the site) would be included in the evaluation of impacts resulting from the project, the ET changes would not be included in the water use permit. Therefore, Tarmac requested a general water use permit to consume 120,000 gpd from the Floridan aquifer. There is no source of lower water quality available for use as makeup in the mine recirculation system.

4.2.2. Post-reclamation

At the end of the 110-year mine life, approximately one-half of the mine pits will have been reclaimed as uplands and one-half will remain as lakes. A daily water balance analysis of the watershed performed prior to mining and after reclamation was used to demonstrate to FDEP and the Water Management District that groundwater outflow from the mine site would not be significantly altered as a result of the proposed mining/reclamation and that the only impact from the expected 10-in/yr increase in evaporation resulting from the change in land use from planted pine to lakes would be a decrease in surface runoff from the Mine site to Withlacoochee Bay of 1.0 million gallons per day. When compared to the average annual discharge from Lake Rousseau to Withlacoochee Bay of 650 million gallons per day, the 1.0-mgd change in surface water runoff resulting from the increased evaporation is minimal. Groundwater levels are not predicted to change significantly as a result of the increased evaporation.

In conclusion, neither surface water nor groundwater resources at and in the vicinity of the site will be adversely impacted by development of the King Road Mine.

4.3. Salt Water Intrusion

Decreased groundwater outflow from the site has the potential to increase salt water intrusion. Under steady-state conditions, salt water inflow is balanced by fresh water outflow. Figure 26 is a conceptual cross section of the salt water\fresh water boundary. If neither the freshwater nor the salt water is flowing, the depth to the salt water\fresh water interface could simply be computed from the density of the two fluids. Under no flow conditions, the thickness of fresh

water, h_{fw}, required to balance a given thickness of salt water, h_{sw}, can be computed from the following equation:

$$\gamma_{fw}*h_{fw} = \gamma_{sw}*h_{sw},$$

where γ_{fw} and γ_{sw} are the density of fresh water (1.00 g/cc) and sea water (1.025 g/cc).

Assuming water levels are measured relative to sea level and $\Delta h = h_{fw} - h_{sw}$, the depth of the salt water\fresh water interface below sea level, z, can be computed by substituting $z = h_{sw}$ and re-arranging as follows:

$$\gamma_{fw}*(z + \Delta h) = \gamma_{sw}*z$$
$$z = \Delta h/(\gamma_{sw} - \gamma_{fw}),$$

which leads to the well known Ghyben-Herzberg relationship:

$$z = 40*(\Delta h).$$

Application of this relationship at the westernmost boundary of the site (located more than 3 miles from the coast) would result in a depth to the salt water interface when the water table was 3.5 feet above mean sea level of 140 feet. As described earlier, data collected as part of the field investigation did not encounter the salt water interface at a depth of 380 feet at Monitor Well Cluster MW-7/8.

The reason for this contradiction is that neither the salt water nor the fresh water is static. Fresh water is always flowing out to the coast and sea water is always flowing in to the shore. At the location where the two flows meet, there is a transition zone where fresh water and sea water mix. For salt water to flow toward the shore the potential energy (head) in the water must be higher off shore than at the location where the two flows meet. Since the energy in sea water at the coast at mean tide is 0 feet, MSL, the energy at the salt water\fresh water interface must be below mean sea level.

A deep well installed by the U. S. Geological Survey in the salt water wedge approximately 3,700 feet from the coastline near Aripeka in Hernando County had a water level of -3.4 feet, NGVD[14]. Two other wells in the same cluster, one in the transition zone and one in fresh water, had water levels of 2.54 feet, NGVD and 8.2 feet, NGVD, respectively. The salt water contact was at a depth of 561 feet, which is approximately 225 feet deeper than predicted using the Ghyben-Herzberg relationship. As shown in Figure 27, the transition zone at the well was approximately 70 feet thick. Based on this data, the salt water interface beneath the King Road Mine site is expected to be deeper than 700 feet.

The data presented by Mahon (1989)[14] also documented a dampening of the magnitude and a delay in the time of occurrence of tidal fluctuation inland from the coast. A tidal fluctuation of 3.4 feet resulted in a water level fluctuation of only 0.4 feet and a lag time of about 90 minutes at the well located 3,700 feet from the coast and a water level fluctuation of only 0.14 feet and a lag time of almost 5 hours at a well located 11,000 feet from the coast. The fluctuations in water level at MW-1, which, at a distance of 4 miles, is the closest continuously-monitored well to the coastline at the mine site, are less than 0.1 feet.

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[14] Mahon, Gary L. (1989) APotential for Saltwater Intrusion into the Upper Floridan Aquifer, Hernando and Manatee Counties, Florida@, U.S. G. S. Water-Resources Investigations Report 88-4171, Washington, D.C.

Natural fluctuations in aquifer recharge (groundwater outflow), which are reflected in fluctuations in the water table at the site of 4 to 6 feet, result in some upward and downward movement of the salt water interface but not the 160 to 240 feet predicted by the Ghyben-Herzberg relationship. Inward movement of the salt water interface requires a long-term decrease in groundwater outflow and sufficient time to re-establish dynamic equilibrium with the inward and outward moving water. The water level in the salt water wedge has to decrease (become more negative) to move additional salt water toward shore. A more negative water level in the salt water wedge increases the depth to the salt water wedge resulting in a retreat of the interface.

4.4. Stormwater Analysis

Runoff on the 218 acre plant site will be directed toward the plant pond. The estimated runoff from a 25-yr, 24-hr storm event of 8.4 inches is 6.7 inches. The stormwater storage requirement is, therefore, 122 acre-ft. During normal operations, the seasonal high water level in the pond is projected to be about 1 foot below the re-graded ground surface. Under this condition, the plant pond can hold about 30 acre-feet of stormwater or about 1.7 inches of runoff. The remaining 92 acre-ft will pond behind the perimeter berm at the low end of the site. The plant site will be sloped from east to west at an average slope of 0.2 percent. The maximum height of water against the perimeter berm under these conditions is 2.6 feet. This is likely to be the worst-case scenario for such a storm, as the groundwater table is estimated to be, on average, about 4 to 5 feet below ground level. The berms will be constructed with a minimum crest elevation of 19 feet, NGVD. An emergency overflow structure will be constructed to discharge storm water runoff for events larger than the 25-yr, 24-hr storm event. After a storm event, water ponded above the ground surface will be pumped to one of the mine pits.

Runoff from active mining areas will be directed back to the active pit. Runoff from waste disposal areas will also be directed toward the active pit. The maximum catchment ratio will be approximately 2.0. The berm around the mining areas will be constructed to an elevation 3 feet above the seasonal high water level in the mine pits or to an elevation of 19 feet, NGVD, whichever is higher. This will provide a minimum freeboard of 2 feet. An overflow spillway may also be constructed through the perimeter berm surrounding the mining areas to discharge runoff for events greater than the 25-yr, 24-hr storm event.

4.5. Water Quality Evaluation

Activities at an aggregate mine include overburden stripping, work pad construction, blasting, excavating and stockpiling, primary crushing, conveying, washing, screening, secondary crushing, sorting, and product stacking. Water is used during washing, screening, sorting, and tailings transport. The water is recycled between the plant pond, the processing plant, and tailings pond. Excavation and stockpiling is performed using a large, electric walking dragline. The only chemicals used in the mining process are a mixture of ammonium nitrate and mineral oil used in the blasting explosives. Detonation converts the explosive mixture to nitrogen, carbon dioxide, and water:

$$76NH_4NO_3 + C_{25}H_{52} \rightarrow 75N_2\uparrow + 25CO_2\uparrow + 178H_2O$$

Although it is possible that not all of the ammonium and nitrate nitrogen is converted to nitrogen gas, analysis of the water in a 60-ft deep test pit blasted and excavated to obtain rock for metallurgical testing indicated total nitrogen concentrations of about 1.0 mg/L, which is approximately the same concentration as found in unaffected groundwater at the site and slightly lower than the concentration found in Little King spring.

The only analyte found in the test pit at elevated concentrations was sulfate detected at concentrations between 85 and 100 mg/L. As indicated in Figure 20, the natural concentration of sulfate in Floridan aquifer groundwater at the site varies from approximately 20 mg/L near the ground surface to approximately 1,350 mg/L at a depth of 145 feet. The elevated sulfate concentrations in the test pit are likely the result of vertical seepage of this mineralized water from deeper in the Floridan aquifer into the bottom of the test pit. Analysis of the rock cores for soluble sulfate indicated an average concentration of 700 mg/kg (0.07%). The sulfate in the rock is probably associated with nodules of gypsum or anhydrite encapsulated within the Avon Park limestone. Dissolution of the sulfate from the encapsulated gypsum nodules during excavation of the test pit was probably small.

Although the sulfate concentrations in the test pit were well below the groundwater standard of 250 mg/L (there is no surface water standard for sulfate), the concentration of sulfate in the plant pond, the tailings ponds, and the mine pits is expected to increase during full scale production. Sulfate is expected to increase for two reasons: potentially greater dissolution of the gypsum nodules during crushing and washing and potentially larger quantities of mineralized groundwater entering the bottom of the production mine pits (the production mine pits will be 40 to 60 feet deeper than the test pit). Our best estimate of the sulfate concentration in the plant pond and tailings ponds is between 300 mg/L and 700 mg/L (best estimate about 350 mg/L).

Figure 28 illustrates the typical path of flow lines based on the boundary conditions that are, on average, predominant at the site. As shown, groundwater on the mine site flows from east to west toward Withlacoochee Bay. The recharge water comes from rainfall precipitation. The magnitude of the recharge and hydrogeological properties of the aquifer influence the exact flow paths followed by the groundwater but, in general, the water enters the ground at the recharge points and travels through the aquifer at various depths depending on the distance between the recharge point and the main outflow location along the gulf coastline.

Seepage from the pits will disperse into the groundwater down-gradient from the pits potentially increasing the sulfate concentrations in the uppermost portion of the aquifer west of the proposed mining. According to Darcy's law the flow through a saturated soil may be expressed as:

$$Q = k \cdot i \cdot A$$

Where:

Q = flow rate
i = hydraulic gradient
K = hydraulic conductivity
A = cross sectional area of flow channel

The flow rate, Q, can be estimated as the product of the recharge rate times the surface area (or the length of the flow channel if calculated per unit width). As depicted in Figure 28, the net average recharge near the westernmost pit in the 10-yr plan is estimated to be between 4 and 8 inches per year. The hydraulic gradient from the potentiometric lines is calculated to be about 4 ft per mile. The cross sectional area, A, if calculated for a unit width, is equal to the depth of the flow channel, d. The hydraulic conductivity varies throughout the site (increasing towards the coastline) but is approximately 70 ft/d on average near the westernmost pit shown in the figure.

To make an estimate of the depth above which there would be little dispersion of the sulfate water seeping directly from the pit, the Darcy equation can be rewritten so that (see also Figure 28):

$$d = \frac{R \cdot L}{k \cdot i}$$

With R being the recharge rate, L the distance from the pit edge and d the depth of the flow channel.

For a distance, L, of about 5,000 ft between the active pit and the property boundary on the west side, the depth, d, would be between about 80 ft and 160 ft, for recharge rates of 4 to 8 inches per year. Water flowing above this depth is unlikely to be impacted by the sulfate content in the water from the pit. However, and as mentioned above, the sulfate concentration in the aquifer increases naturally to about 1,350 mg/L at a depth close to 145 ft and, therefore, any groundwater flowing close to this depth will have a natural increase in the sulfate concentration caused by the dissolution of the gypsum or anhydrite present in the aquifer.

Most domestic wells near the King Road Mine site are installed to a depth of no more than about 50 feet. Using the same approach described above, a well at this depth would have to be installed at a distance, L, from the mine pit of 1,500 ft to 3,000 ft to see any increase in sulfate concentration as a direct result of the water seeping from the active quarry.

As a result of the potential to locally increase sulfate concentrations in the upper part of the Floridan aquifer, Tarmac requested a zone of discharge for the proposed King Road Mine extending laterally to the property boundary and vertically within the Floridan aquifer to a depth of 140 feet. There are no existing or proposed potable water wells on the proposed mine site. Consequently, the requested zone of discharge will not cause violations of applicable ground water standards in present and future potable water supplies. The Florida groundwater standard is based on the EPA secondary maximum contaminant level (SMCL) of 250 mg/L, which was established for aesthetic reasons, i.e., taste and odor. The SMCL regulation is not a federally enforceable standard, but is provided as a guideline for States and public water systems. EPA estimates that over 3% of public drinking water systems in the U.S. have sulfate concentrations above the SMCL. Sulfate can be removed from affected potable water supplies using an ion exchanger.

As described above, Tarmac has prepared a GWMP to monitor the quality of the surface water in the active mine pit and tailings pond and will install monitor wells within the zone of discharge to determine the concentrations of sulfate in both surface water bodies and within the zone of discharge.

As stated earlier, there is no surface water standard for sulfate in Class III surface water. Consequently, the requested zone of discharge will not interfere with existing or designated uses of contiguous waters, or cause a violation of applicable surface water quality criteria of contiguous waters outside a permitted mixing zone.

Fine rock, silt and clay (tailings) from the crushing, washing and screening operations will be pumped back to the mine pits. The finer particles will take some time to settle out and both the active mine pit and the mine pit receiving the tailings will be turbid. Because the groundwater level to the west of the mine cuts is lower than the groundwater level to the east of the mine cuts there will be seepage out of the mine pits. However, because of the low seepage velocities,

suspended silt particles in the water will not travel far in the aquifer. Seepage velocities in the Floridan aquifer at the site are expected to be in the range of 0.2 to 40 feet per day. Velocities in excess of 85,000 feet per day (one foot per second) are required to keep silt in suspension.

4.6. Steady-State Groundwater Model

A site specific groundwater model was developed for the subject site to determine the extent of the drawdown in the potentiometric surface of the Floridan aquifer as a result of the average annual groundwater withdrawals associated with the facility, as a result of cumulative withdrawals associated with the facility and other groundwater users in the site vicinity, and as a result of reclamation of approximately one-half of the mine pits (quarries) as lakes.

An engineering report titled “Engineering Report in Support of General Water Use Permit, Proposed King Road Mine, Levy County, Florida” was prepared by Ardaman and Associates, Inc. and submitted in June 10, 2008 in support of the general water use permit application for the subject project. The report contains, among other things, a detailed description of the groundwater analyses carried out to assess the potential impacts resulting from the proposed mining and processing. The main assumption of the model and results are summarized in the following sections.

The groundwater flow beneath and surrounding the proposed King Road Mine was simulated using Version 6.0 of the Department of Defense Groundwater Modeling System (GMS), which is a comprehensive graphical user environment for performing groundwater simulation using the MODFLOW analysis code.

4.6.1. Model Boundary Conditions

The model is bounded by the Gulf of Mexico along its western boundary, about 2 miles from the westernmost property boundary. The Withlacoochee River and Lake Rousseau extend along the southern boundary, about 3 miles south from the proposed mine location. Because the northern boundary of the model is drawn perpendicular to the measured potentiometric contours in this area, a “no flow” boundary was used to represent the hydraulic conditions along the northern boundary of the model. Because the eastern boundary of the model is along the groundwater divide between the Rainbow River and the Gulf coast, a “no flow” boundary was also used to represent the hydraulic conditions along the eastern boundary of the model. These boundaries were selected so that the only water that can enter the modeled area is vertical recharge into the upper cells in the model or horizontal seepage from Lake Rousseau. By defining the model boundaries in this way, the only variables that affect the steady-state Floridan aquifer potentiometric levels throughout the greater part of the modeled area are steady-state recharge and Floridan aquifer transmissivity.

The natural ground level is relatively flat towards the central and western portion of the model area, with elevations that go from about 20 ft down to about 5 ft over a 4 mile distance, representing an elevation drop of less than 4 ft per mile. Ground elevations of up to 100 ft are observed on the north-east model boundary line, dropping to about 55 ft towards the south-east limit with Lake Rousseau.

The range of net recharge rates were estimated based on the relationship between groundwater chloride concentration and groundwater recharge (see Engineering Report for full details). Estimated recharge rates ranged between 3 and 15 in/year depending on the area and proximity to the springs. In areas with well drained soils, e.g., on the Brooksville Ridge, recharge rates in the range of 20 to 25 inches per year were estimated.

Based on published data, the Floridan aquifer is believed to have a thickness between 500 and 800 ft in central-southern Levy County, where the hydraulic permeability of the aquifer can normally be expected to vary between 30 and 350 ft/d.

4.6.2. Model Calibration and Results

The model was calibrated so that the best possible agreement was obtained between the average water levels measured in installed wells and the simulated water levels under steady state conditions. Most recharge rates ranged between 4 and 9 in/yr, with areas of higher recharge (17.5 to 22 in/yr) towards the eastern side of the model, where the potentiometric surface is highest and the soils are believed to have lower runoff potential. Increasingly higher hydraulic conductivity was modeled near the Gulf Coast as the aquifer is more weathered than further inland.

Based on the water balance analysis, the maximum expected groundwater withdrawal from the mine is 380,000 gpd. This withdrawal was simulated in the groundwater model by defining a well cell in the estimated location of the proposed plant pond. Water is extracted over the three layers that cover the proposed 100 ft average depth of mining.

Figure 29 includes the drawdown contours corresponding to 0.38 mgd steady-state withdrawals from the plant pond. The figure shows that the drawdown at the property boundary is typically less than 2.5 inches. However, any drawdown effects rapidly dissipate and are predicted to be only 0.06 inches and 0.3 inches at the Yankeetown and Inglis wellfields, respectively. It is important to point out that these drawdown values represent worst-case scenario conditions, as all ground water withdrawals are concentrated at the geometric center of the plant pond. Some of the groundwater required by the mine will seep directly into the mine pits.

The normal fluctuation in the groundwater table (potentiometric surface) on the proposed mine site is from near the existing ground surface to 6 feet below ground surface. As long as the drop pipe or submersible pump in a neighboring well is deeper than 8 feet, the expected drawdown will have no adverse impact on existing legal users.

Given the relatively low magnitude of the predicted drawdowns, potential effects on domestic wells located outside of the King Road Mine property will be negligible. Furthermore, no perceivable changes should be noticed at distances beyond 3 miles from the property line.

Tarmac will develop a plan for investigating complaints from neighboring property owners. All complaints will be investigated and a written report describing the results of the investigation and any mitigative action to be taken by Tarmac will be provided to the complainant and to the Director, Resource Regulation Department, SWFWMD, for review and approval within 30 days of the receipt of any complaint.

4.7. Transient Groundwater Flow Model

Transient surface and groundwater simulations were performed to evaluate the daily rainfall-related changes in groundwater levels under natural, pre-mining conditions and how these may be affected over the long-term once excavation activities have ceased and the area has been reclaimed according to the proposed mining and reclamation plan, which assumes that silt, clay and fine rock fragments from the washing and screening process will be used to backfill and reclaim approximately one-half of the ±25 acres of mine cuts opened each year.

Tarmac America, LLC, requested Ardaman and Associates, Inc to prepare a detailed report

explaining the assumptions, boundary conditions, model details and results of the transient simulation. The report, dated September 27, 2008, is titled “Results of Transient Simulation, Pre-Mining and Post-Reclamation Groundwater Systems, Proposed King Road Mine, Levy County, Florida”.

Ten years (1998-2007) of actual daily rainfall data from the Usher Tower station were used in the model. Daily temperature and solar radiation data were generated using stochastic weather-generation techniques. Potential evapotranspiration was calculated using the concept of potential evapotranspiration as the basis for prediction of the surface and soil water evaporation and the plant transpiration components. Energy available for evapotranspiration and seasonal vegetative growth variations were also considered in the calculations. The rainfall-runoff processes were modeled using the SCS curve-number method. Vertical drainage was considered to be driven by hydraulic head following Darcy’s law. Actual surface topography was taken into consideration in the model. As with the steady-state analyses, the GMS/MODLOW computer model was used to simulate the transient groundwater conditions

4.7.1. Model Results

Figure 30 compares, in the form of stage duration curves, the predicted potentiometric elevations for the mine site at the locations of wells MW-3, MW-5 and MW-1(see Figure 21) using the pre-mining and post-reclamation conditions. One of the effects of mining and reclamation on the potentiometric surface is a slight reduction in the predicted range of fluctuation of the water levels, i.e., the post-reclamation maximum and minimum elevations have a smaller range than those predicted for pre-mining conditions. The median elevations, however, are predicted to increase slightly (by about 3.5 inches according to the model) as a result of mining and reclamation.

During the heaviest rainfall periods, when the groundwater elevations are higher, the increased storage capacity created by the lakes precludes the otherwise natural rise in the potentiometric level in the area. Furthermore, since the water levels in the ground (because of the lower available storage) would be higher than those in the lakes, seepage flow toward the lakes would occur during these periods, further preventing a rise of the groundwater table. On the other hand, when rainfall is low, the water level in the ground would tend to drop faster than in the lakes and, therefore, the seepage flow direction would be reversed, which would create a source of groundwater recharge non-existent in the natural, un-mined conditions, thus, resulting in higher potentiometric elevations. It is also possible that during long drought periods, certain areas (particularly those closest to open, un-reclaimed pits) could experience slightly lower water levels as a result of mining and reclamation. The slight reduction in the predicted water level results from the fact that lake evaporation rates are higher than natural evapotranspiration rates for the pre-mining condition.

In general, the average impact of the proposed mining and reclamation plan would be to marginally increase the groundwater table by about 3 to 4 inches in most locations, within and in close proximity to the proposed mine. Figure 31 illustrates the difference between the predicted before and after mining groundwater elevation across the mine for a late June 2000 simulation.

4.8. Salt Water Intrusion

The groundwater withdrawals associated with the proposed mine and aggregate plant will have no adverse impact on the current salt water interface. The nearest mine pit is more than 3 miles from the coast and more than 2 miles from the SWFWMD saline water monitoring zone. The plant pond is even further east. A minimal increase in groundwater levels (and hence,

groundwater outflow) at the proposed mine site is expected as a result of the mining operations. The potential impact of this increase on movement of the salt water would be to push the interface deeper and further towards the coastline.

SUMMARY AND CONCLUSIONS

1. Titan America proposes to extract approximately 3 million tons of aggregate per year from the proposed mine. An electric dragline will excavate approximately 5.2 million tons of limestone from 100-ft deep (average) mine cuts to achieve this objective. Approximately 25 acres of land will be mined each year. The tailings from the crushing and screening operations will be used to backfill and reclaim approximately 12.5 acres of mine pits annually. Extraction of the 3 million tons of aggregate will result in a net excavated volume of 800 acre-ft, which will be replaced with groundwater from the surrounding Floridan aquifer and captured stormwater runoff.

2. The proposed mine site contains approximately 4,800 acres. None of the more than 425 acres of wetlands associated with the shallow streams that pass through the property will be disturbed. Current plans envision a mine life of approximately 110 years with a total mined area of 2,800 acres. After mining and reclamation, the mine site will contain approximately 1,400 acres of lakes. Change in land use from hydric planted pine to lakes will increase evaporation and decrease surface runoff by approximately 1 million gallons per day (mgd).

3. The water table is approximately 12.5 feet higher on the east end of the mine site than on the west end. Because the water in a mine pit is level, the water table will be lowered on the east side and raised on the west side of each mine pit. The magnitude of this rising and lowering of the water table can be adjusted by varying the width of the openings and providing “plugs” between each of the pits. The proposed mining and reclamation plan was designed to minimize these changes in the water table by strategically filling in certain pits to maintain water levels at or close to pre-mining elevations.

4. The drawdown associated with the net groundwater withdrawal of 0.38 mgd and the proposed mining and reclamation plan is expected to decrease the median water level in surrounding wetlands by less than 4 inches. However, maximum wetland water levels are expected to remain essentially the same. Since the water table naturally fluctuates a maximum of about six (6) feet between the wet and dry periods, the expected change in the stage-duration curve of surrounding wetlands will not adversely impact the wetlands.

5. Surface drainage is through intermittent streams that run approximately east-west through the property. Smaller tributaries flow to the north from the northern site boundary and to the west from the western site boundary. There are no rivers located on the proposed mine site. Surface runoff from the site eventually flows into the Withlacoochee Bay primarily through Smith Creek. A small portion of the site drains to Spring Run which flows north and west of the proposed mine site. Little King Spring, which is located approximately 5,200 feet NE of the site, is the closest spring known to exist in the area of the proposed mine. Big King Spring is located further north of the site. Neither the springs nor Spring Run will be adversely impacted by the proposed mine. Approximately 425± acres of flow-ways and other high-quality wetlands on the mine site will be preserved and enhanced to maintain the hydrologic connections entering the property from the east and draining westerly into the Withlacoochee Bay on

the Waccasassa Bay State Preserve. Because the existing flow-ways will be maintained, preserved or enhanced, mine activities will have no adverse impacts on any existing springs, rivers or tributaries.

6. The Floridan aquifer at the site extends from near ground surface to a depth of 700 feet. The water table slopes from east to west across the property from an average of about 16 feet, NGVD at the eastern property line to an average of about 3.5 feet, NGVD at the western property line. The maximum fluctuation of the water table between wet and dry periods is about six feet. Along the western boundary of the site, the saltwater interface is at a depth substantially greater than 400 feet. As the elevation of the water table increases toward the east, the depth to the salt water interface increases to 700 feet, the base of the aquifer. Because the mining depth will not exceed 120 feet and the water levels in the mine pits will remain at approximately the pre-mining water level, mining will have no effect on saltwater intrusion.

7. The drawdown associated with the 0.38 mgd of water that seeps or is pumped into the active mine pit to replace the net volume of rock removed from the aquifer is not expected to exceed 3 inches at the nearest domestic well and is not expected to exceed 0.06 inches at the Yankeetown wellfield and 0.3 inches at the Inglis wellfield. The expected drawdowns are small compared to the natural fluctuation of the potentiometric surface, (approximately six feet) and will not adversely impact the neighboring wells. Before conducting mining operations in the vicinity of domestic wells, Tarmac will conduct a thorough analysis of all adjacent wells and take preemptive action to protect them from any potential impacts from its mining operations to ensure no negative impact.

8. The only chemicals used at the mine site in significant quantities are ammonium nitrate and a mineral oil emulsion used in the blasting gel. Essentially all of the ammonium nitrate and mineral oil will be converted during blasting to relatively small amounts of nitrogen gas, carbon dioxide, and water vapor, all of which will escape to the atmosphere. None of these gases are groundwater contaminants.

9. Fine rock, silt and clay (tailings) from the crushing, washing and screening operations will be pumped back to the mine pits. The finer particles will take some time to settle out and both the active mine pit and the mine pit receiving the tailings will be turbid. There will be seepage out of the mine pits from east to west due to the groundwater level differential, however, because of the low seepage velocities, suspended silt particles in the water will only travel a short distance and are not expected to leave the boundaries of the mine property.

10. Upward seepage of the more mineralized water from the deeper Floridan aquifer will increase the TDS and sulfate concentrations in the water in the mine pit. FDEP has permitted a zone of discharge for the King Road Mine that will provide sufficient distance for the sulfate concentration in shallow lateral seepage from the mine pit to attenuate to below the groundwater MCL before it leaves the property. An extensive groundwater monitoring program is required by both FDEP and the Water Management District to monitor the water quality with depth and distance from the mine pits.

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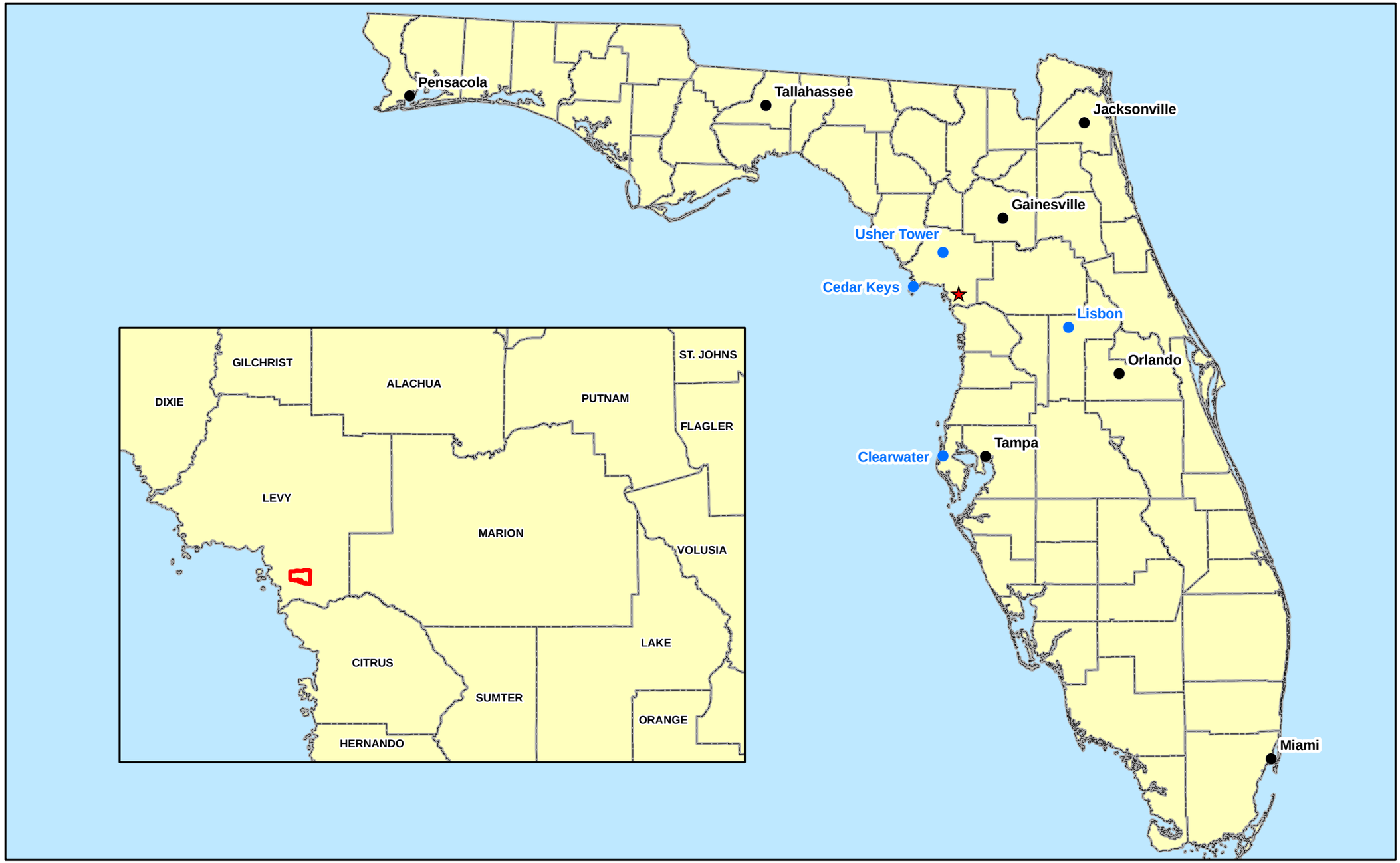

N
W E
S

Site Location
Property Boundary

FIGURE 1

PROPOSED MINE LOCATION

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

Project: 05-086	Projection: State Plane Florida West	
Prepared: 08-07-08	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by:	Modified:
File: _ArcLayouts\20080806- New Report Figures\Figure1 Mine Location.mxd		

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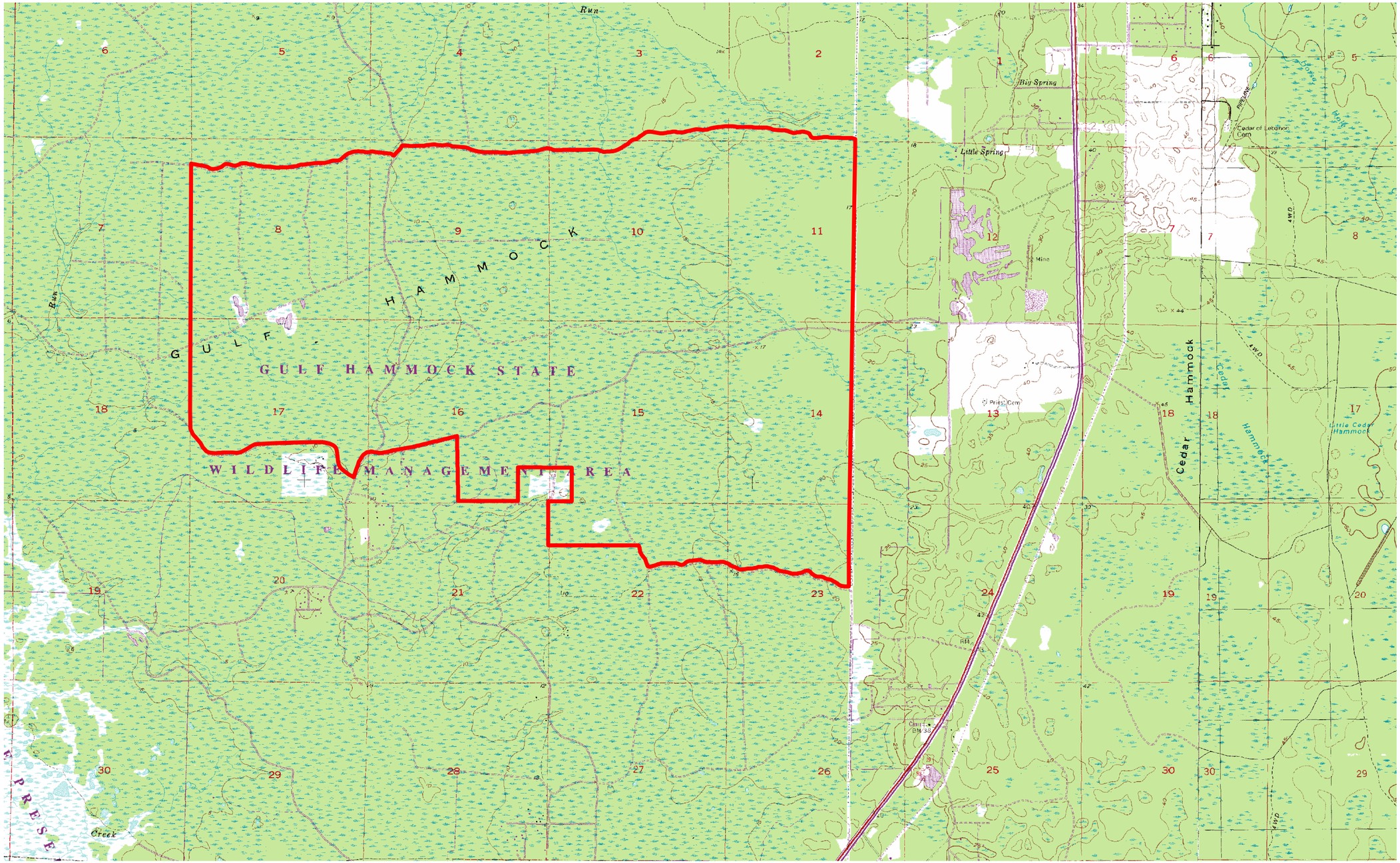
Orlando, Florida 32809



N
W E
S

Scale: 1" = 3,000'

Feet
0 1,000 2,000 3,000

Property Boundary

FIGURE 2

SITE LOCATION MAP

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

Project: 05-086	Projection: State Plane Florida West	
Prepared: 08-07-08	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by:	Modified:
File: _ArcLayouts\20080806- New Report Figures\Figure2 Site Location.mxd		

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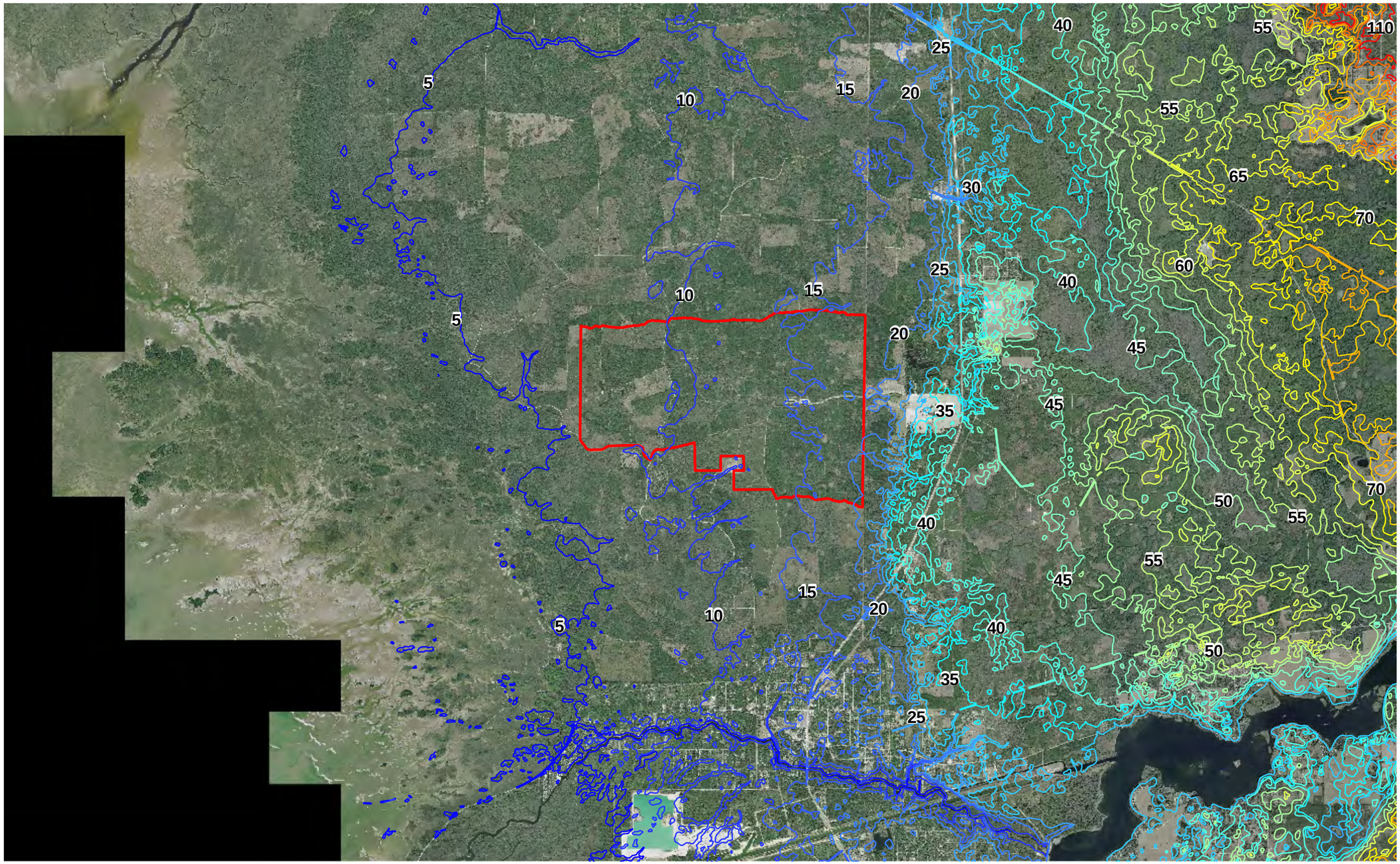

N
W E
S

Scale: 1" = 6,000'

0 3,000 6,000
Feet

Property Boundary

35 Ground Surface Elevation (NGVD)

FIGURE 3

USGS TOPOGRAPHIC MAP

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

Project: 05-086	Projection: Florida West Stateplane	
Prepared: 08-07-08	Horizontal Datum: NAD83	Vertical Datum: NGVD29
Prepared by: RMC	Modified by:	Modified:
File: \\2005\05-086\ArcGIS_ArcLayouts\20080806- New Report Figures\Figure3 Topo Map.mxd		

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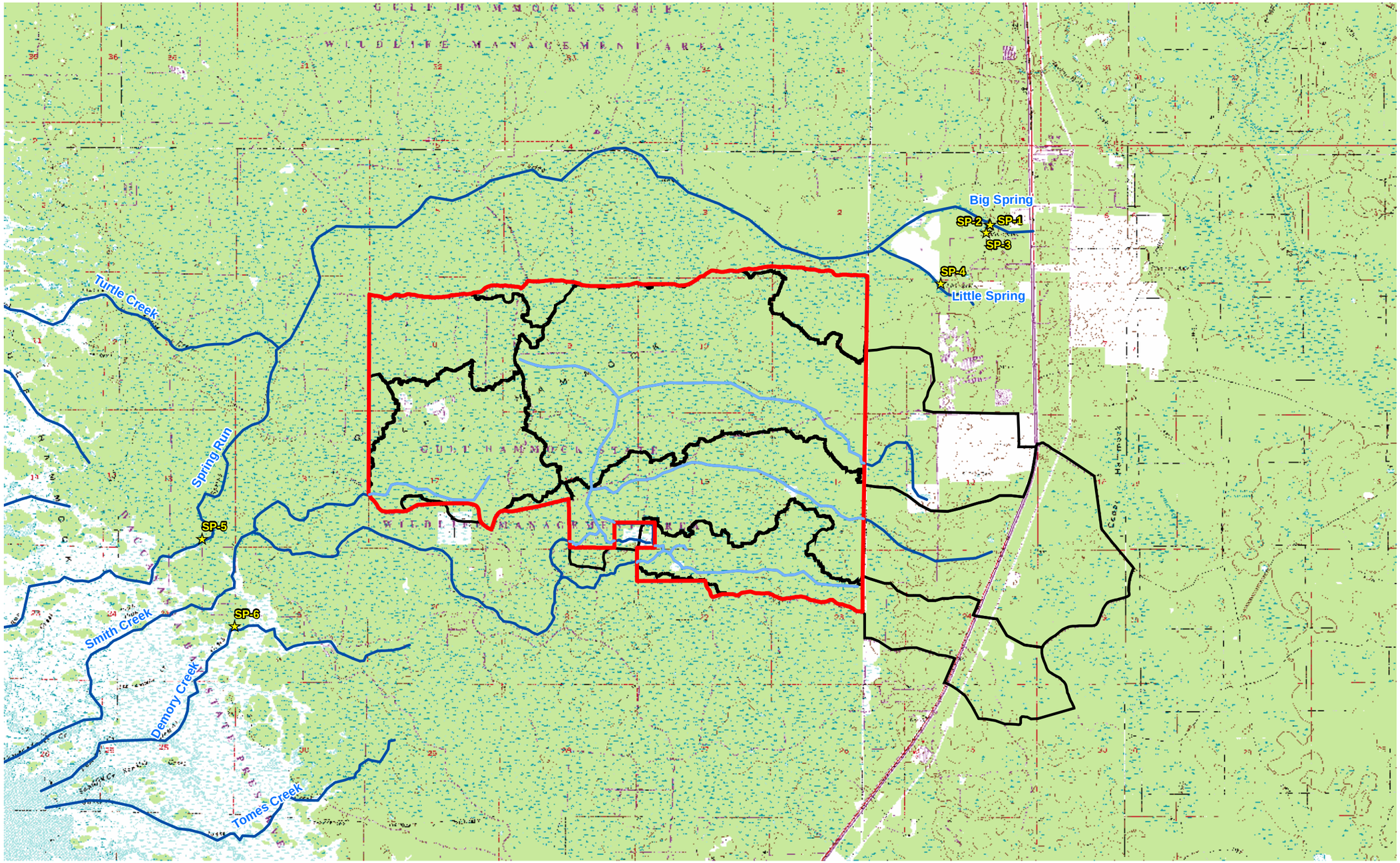

N
W E
S

Scale: 1" = 4,000'

0 2,000 4,000
Feet

- Spring Locations
- Inner Arterial Streams
- Arterial Streams
- Basins
- Property Boundary

FIGURE 4

DRAINAGE BASIN AND SPRINGS LOCATION MAP

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

Project: 05-086	Projection: Florida West Stateplane	
Prepared: 05-07-09	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by:	Modified:
File: \\05-086\ArcGIS_ArcLayouts\20100602 - Compiled Report Figures\Figure4 Drainage Map.mxd		

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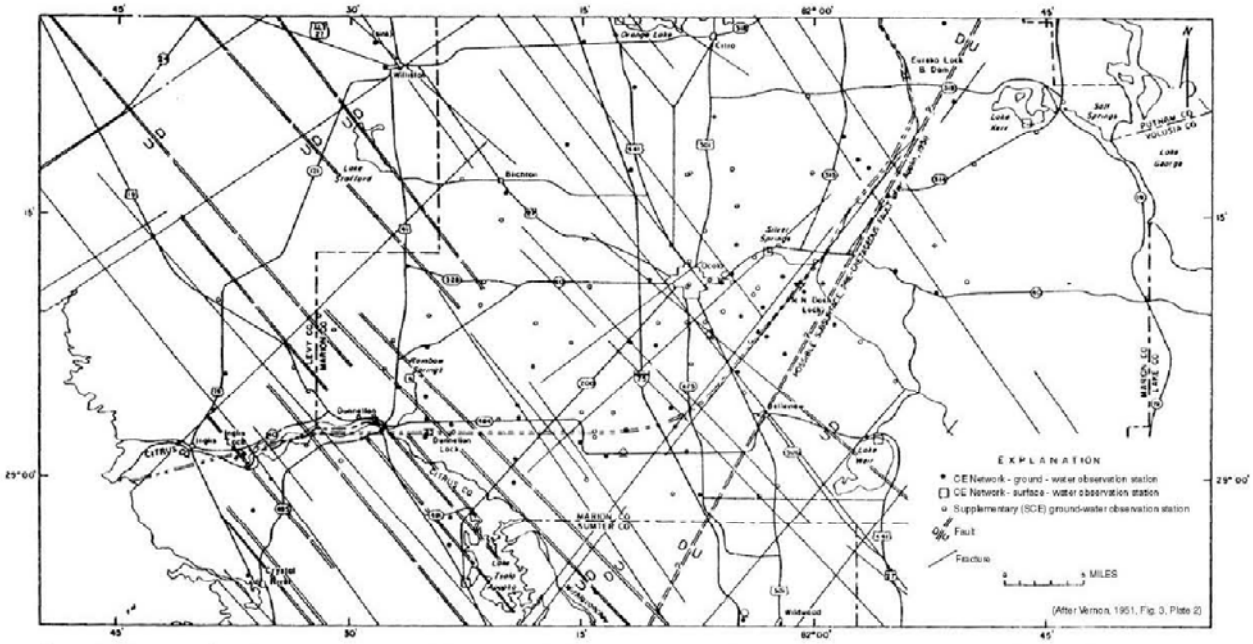

(AFTER VERNON, 1951)

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FAULTS AND FRACTURE TRACES			
Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants			
KING ROAD MINE TARMAC AMERICA, LLC LEVY COUNTY, FLORIDA			
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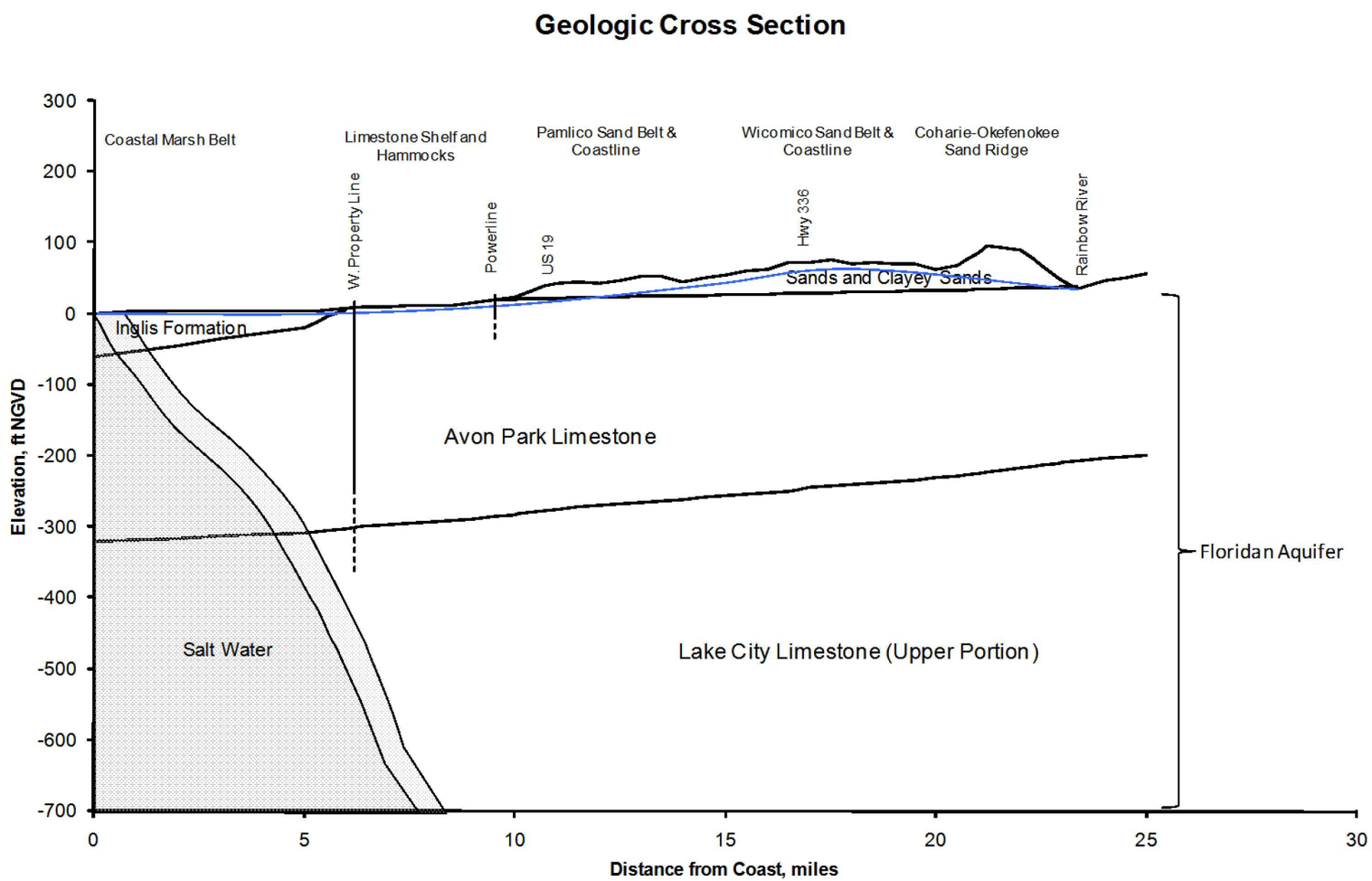


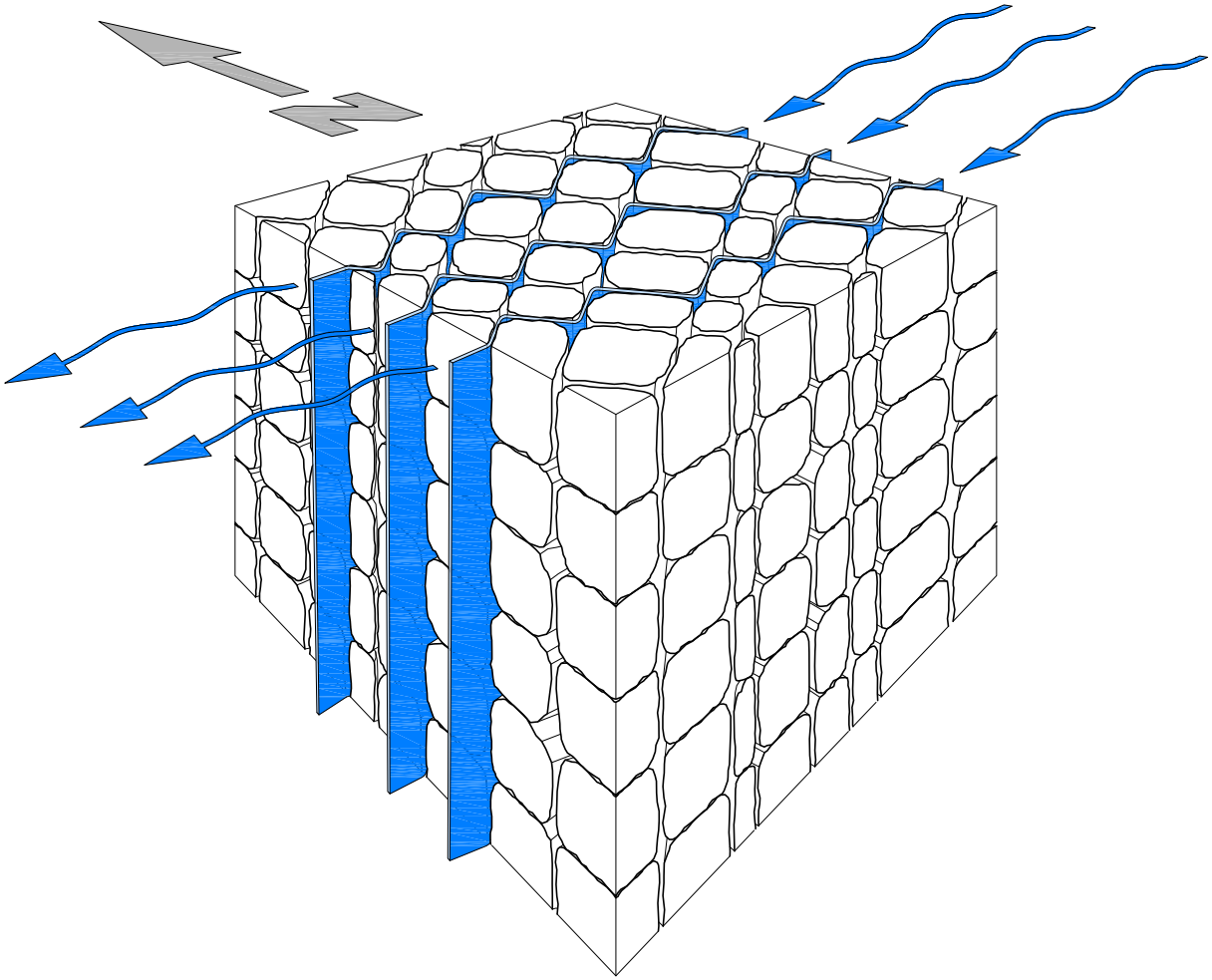
GEOLOGIC CROSS SECTION

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

KING ROAD MINE
TARMAC AMERICA, LLC
LEVY COUNTY, FLORIDA

DRAWN BY: AAD	CHECKED BY:	DATE: 06/7/11
FILE NO. 05-086	APPROVED BY:	FIGURE: 6

\\Aaiwater2\CAD\Corporate\05\05-086\Report\Compiled Report\FIGURE 6 Geologic Cross Section.dwg 6/07/2010 11:39:56 AM, archie.dodge



FRACTURE FLOW

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

KING ROAD MINE
TITAN AMERICA, LLC
LEVEE COUNTY, FLORIDA

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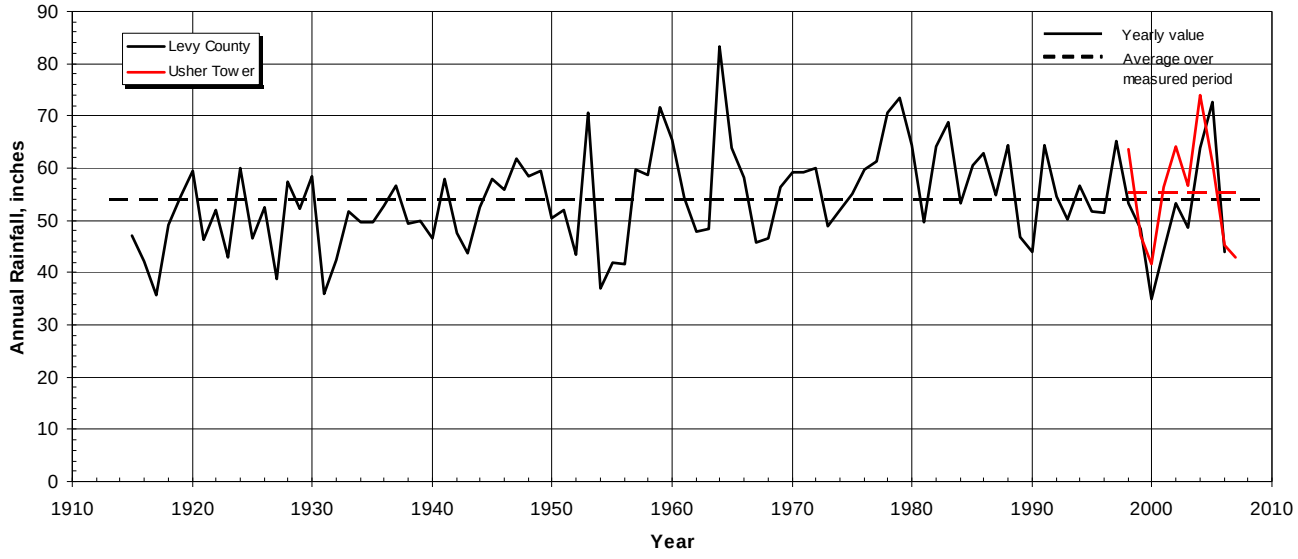
FILE NO. 05-086	APPROVED BY:	FIGURE: 7	

T:\Corporate\05\05-086\Report\Compiled Report\Figure 7 FRACTURE FLOW.dwg 6/08/2010 5:33:40 PM, reinaldo.rolo



T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 8 annual rainfall.dwg 6/07/2010 11:54:32 AM, reinaldo.rolo

ANNUAL RAINFALL

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

KING ROAD MINE
TARMAC AMERICA, LLC
LEVY COUNTY, FLORIDA

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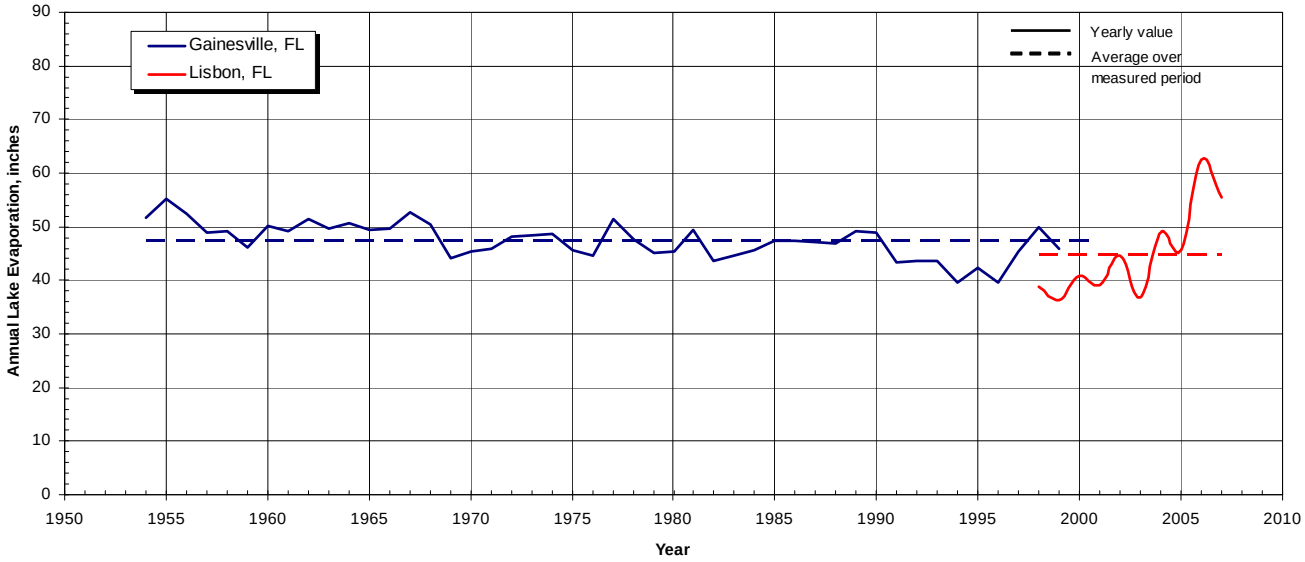
FILE NO. 05-086	APPROVED BY:	FIGURE: 8



T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 9 Lake Evap.dwg 6/07/2010 11:56:43 AM, reinaldo.rolo

ANNUAL LAKE EVAPORATION

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LEVY COUNTY, FLORIDA

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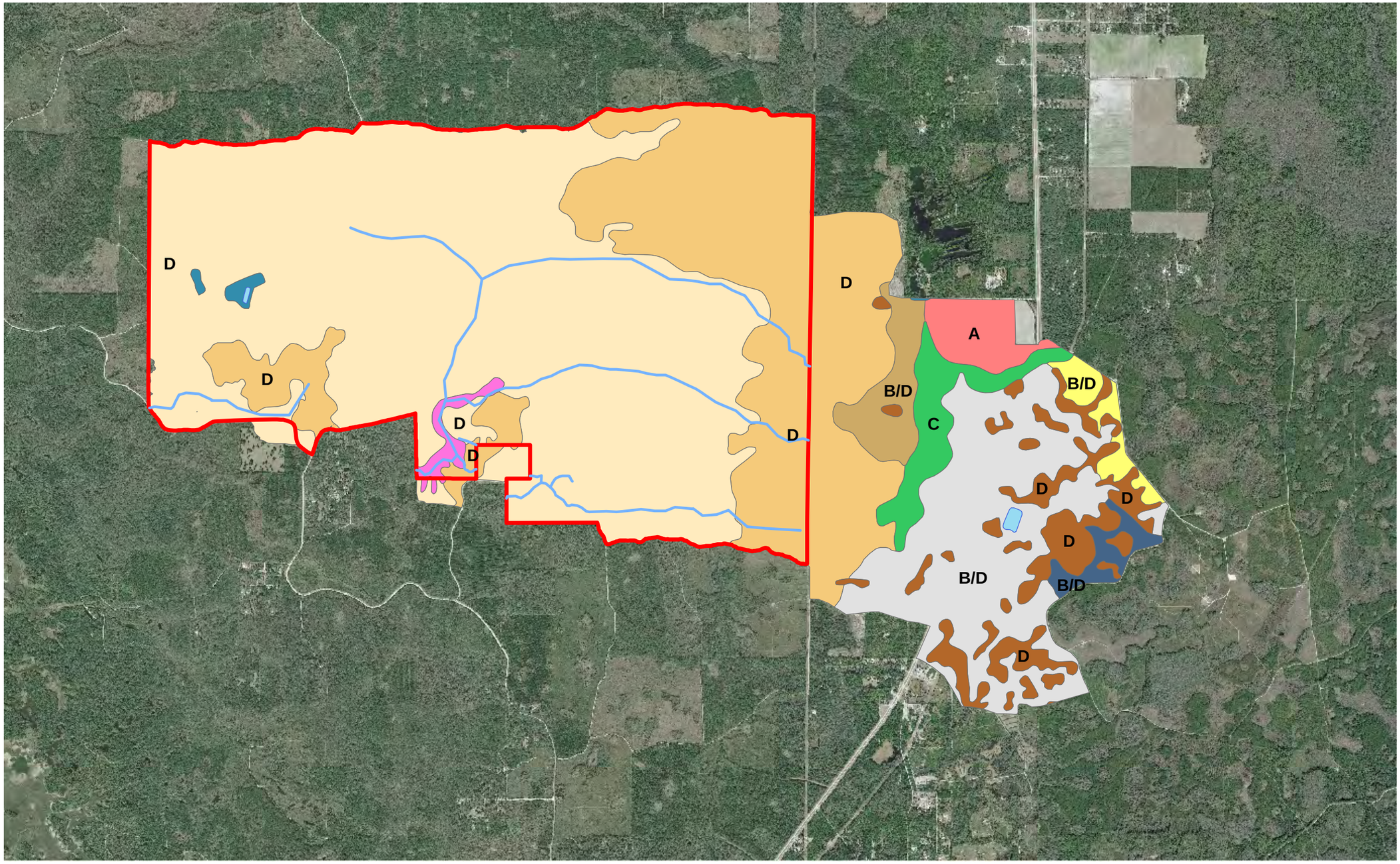
FILE NO. 05-086	APPROVED BY:	FIGURE: 9



N
W E
S

Scale: 1" = 3,000'

0 3,000
Feet

- Inner Arterial Streams
- Property Boundary
- Chobee muck, limestone sub-stratum
- Myakka sand
- Pits and Dumps
- Placid and Samsula soils, depressional
- Pomona fine sand
- Smyrna fine sand
- Tavares fine sand
- Waccasassa-Demory complex
- Wauchula fine sand
- Wekiva fine sand
- Zolfo sand
- Water

FIGURE 10

SOILS MAP

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

Project: 05-086	Projection: Florida West Stateplane	
Prepared: 05-07-09	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by:	Modified:
File: \\2005\05-086\ArcGIS_ArcLayouts\20100602 - Compiled Report Figures\Figure10 Soil Map.mxd		

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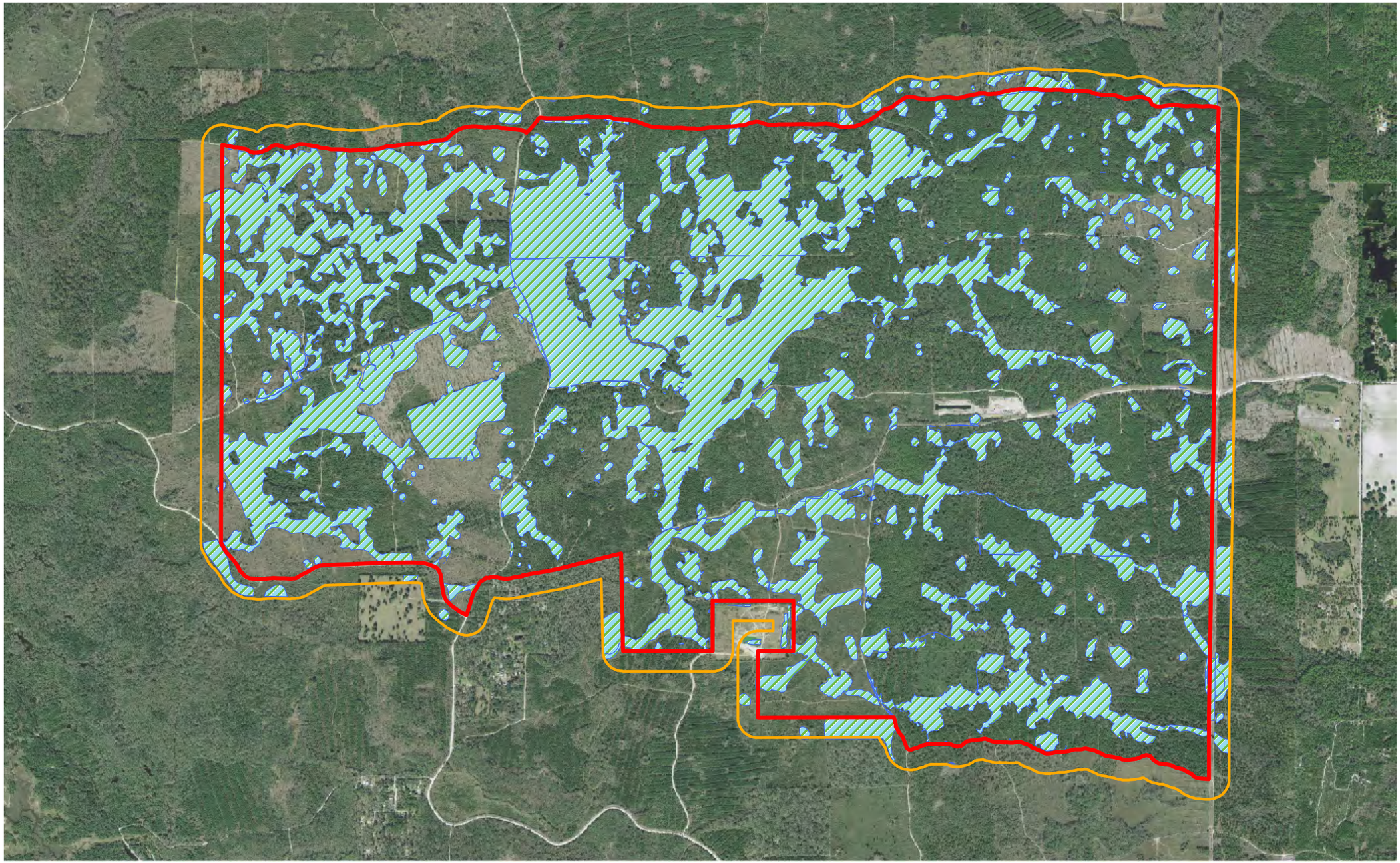

N
W E
S

Scale: 1" = 2,000'

0 1,000 2,000
Feet

Property Boundary
400 ft Buffer
Wetlands

FIGURE 11

WETLANDS MAP

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

Project: 05-086	Projection: Florida West Stateplane	
Prepared: 08-07-08	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by:	Modified:
File: \\05-086\ArcGIS_ArcLayouts\20100602 - Compiled Report Figures\Figure11 Wetlands Map.mxd		

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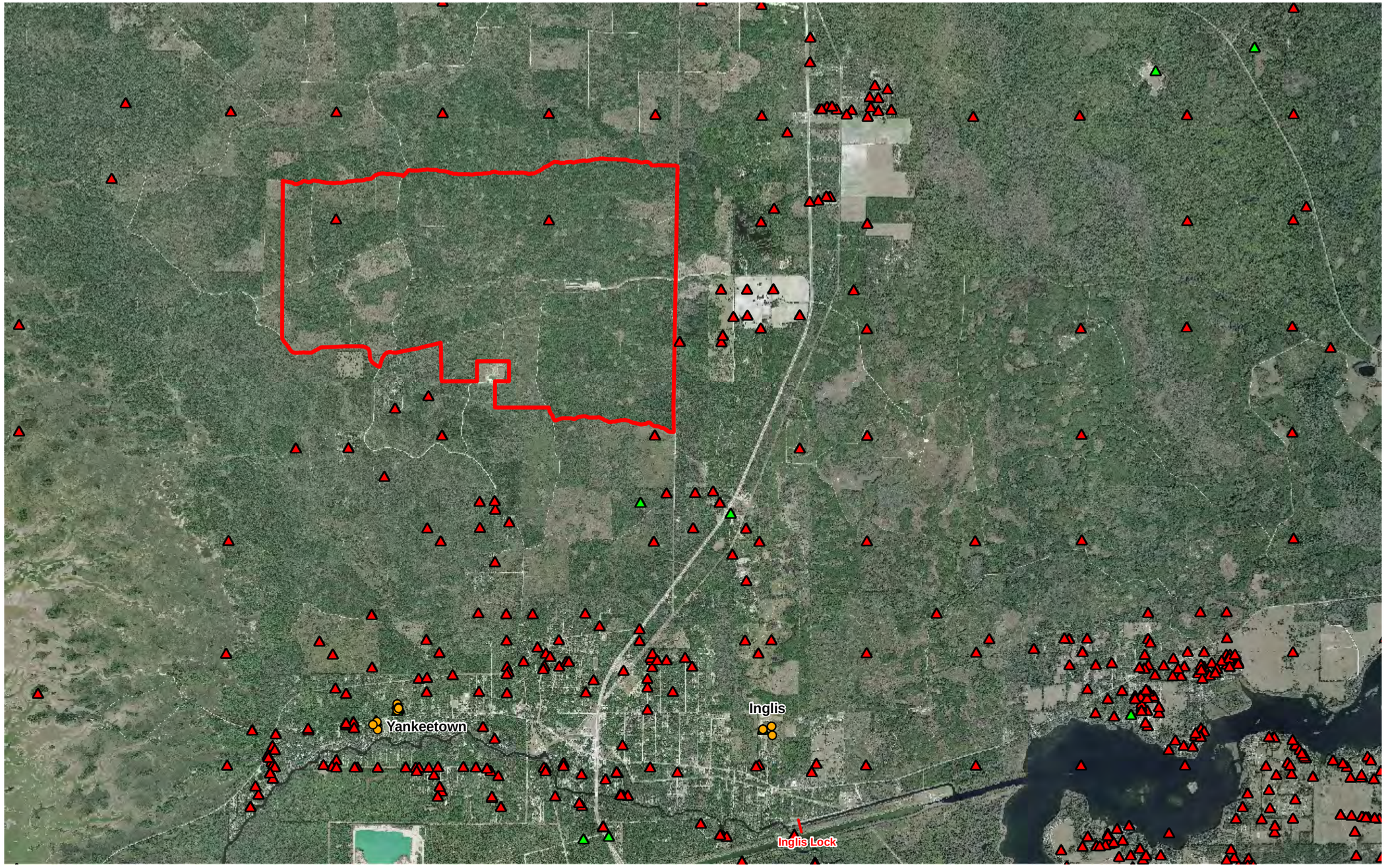

N
W E
S

Scale: 1" = 5,000'

0 5,000
Feet

SWFWMD Well Construction Permits

- Domestic
- Public Supply
- Public Supply Wells at Inglis & Yankeetown
- Property Boundary

FIGURE 12

DOMESTIC & PUBLIC SUPPLY WELLS

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

Project: 05-086	Projection: State Plane Florida West	
Prepared: 05-07-09	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by:	Modified:
File: \\20100602 - Compiled Report Figures\Figure12 Public Supply Wells Map.mxd		

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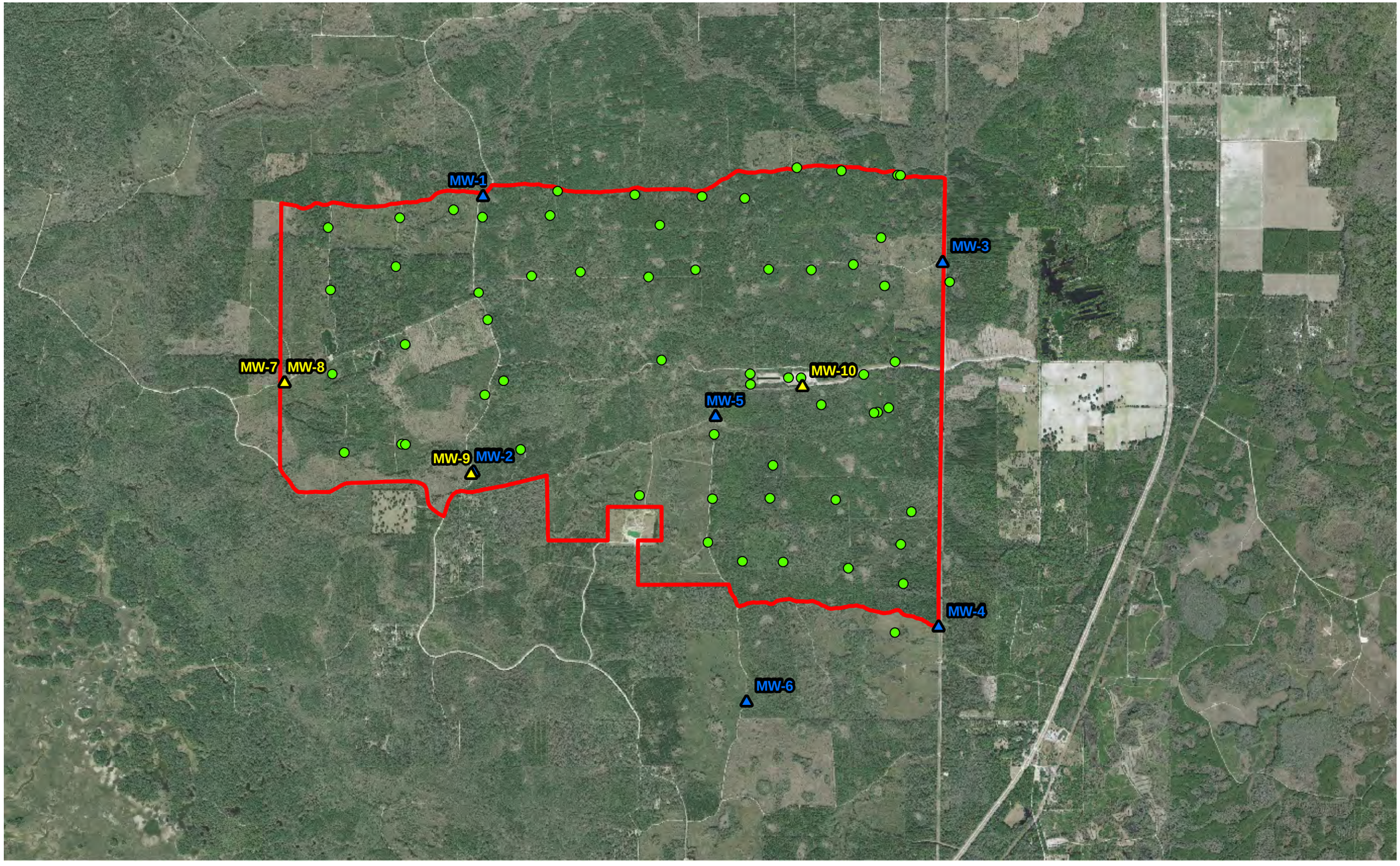

N
W E
S

Scale: 1" = 3,000'

0 3,000
Feet

TARMAC America Monitor Wells

- Shallow Wells
- Deep Wells (≥150')
- Property Boundary
- Rock Borings

FIGURE 13

MONITOR WELL AND BORING LOCATION MAP

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

Project: 05-086	Projection: Florida West Stateplane	
Prepared: 08-07-08	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by: RMC	Modified: 06-05-08
File: \\ArcGIS_ArcLayouts\20100602 - Compiled Report Figures\Figure13 Well Location Map.mxd		

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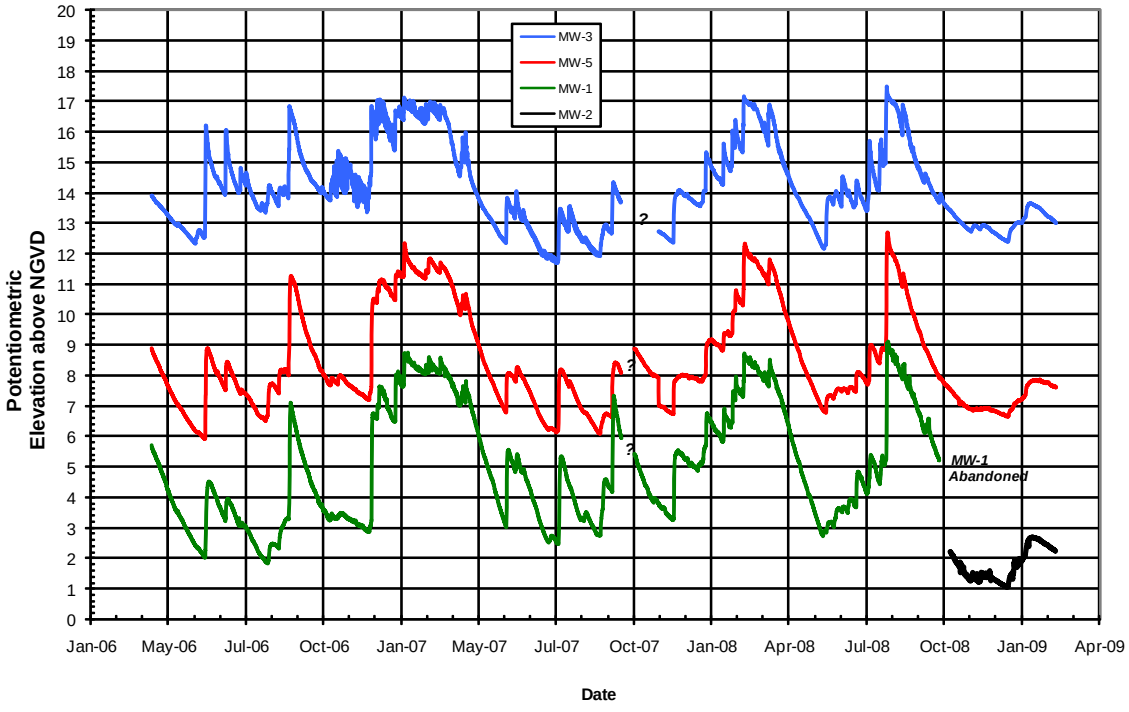

MONITOR WELLS READINGS

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

KING ROAD MINE
TARMAC AMERICA, LLC
LEVY COUNTY, FLORIDA

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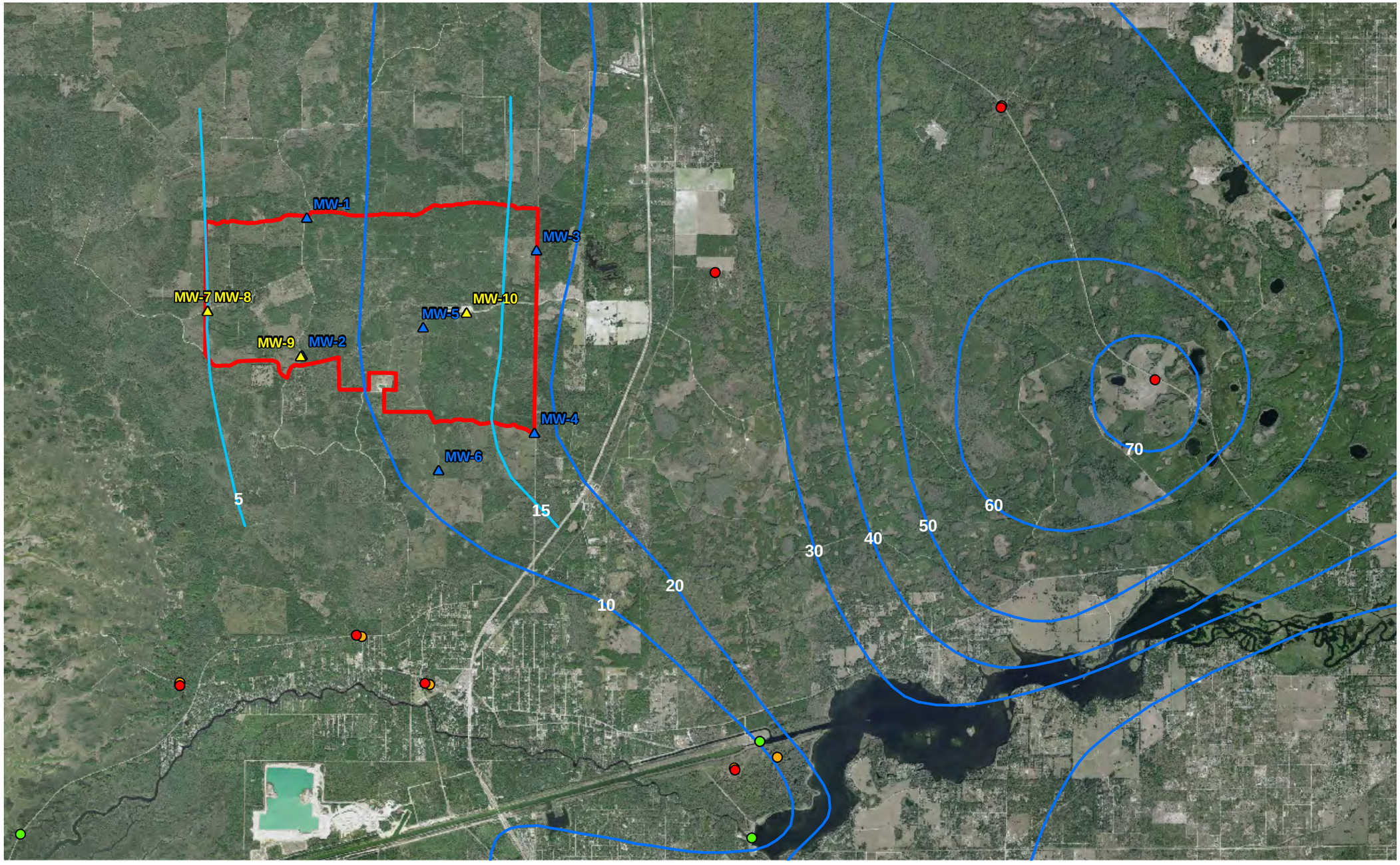
FILE NO. 05-086	APPROVED BY:	FIGURE: 14

T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 14 Wells Readings.dwg 6/07/2010 12:12:56 PM, reinaldo.rolo



N
W E
S

Scale: 1" = 6,000'

Feet
0 2,000 4,000 6,000

- USGS Wells
- SWFWMD Wells
- SWFWMD Rain Gage

TARMAC America Monitor Wells

- Shallow Wells
- Deep Wells (≥150')
- Property Boundary
- Sept 2005 Pot Surface
- Estimated Pot Surfaces From Site Wells

FIGURE 15

Disclaimer
Ardaman & Associates used the following data "as is" and makes no representation as to the accuracy of the data:

Imagery	SWFWMD	2008
Pot Surface Contours	USGS/SWFWMD	2007

Project: 05-086	Projection: State Plane Florida West	
Prepared: 06-22-09	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by:	Modified:

File: _ArcLayouts\20100602 - Compiled Report Figures\Figure15 Wet Season Pot Surface Map.mxd

WET SEASON POTENTIOMETRIC SURFACE

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

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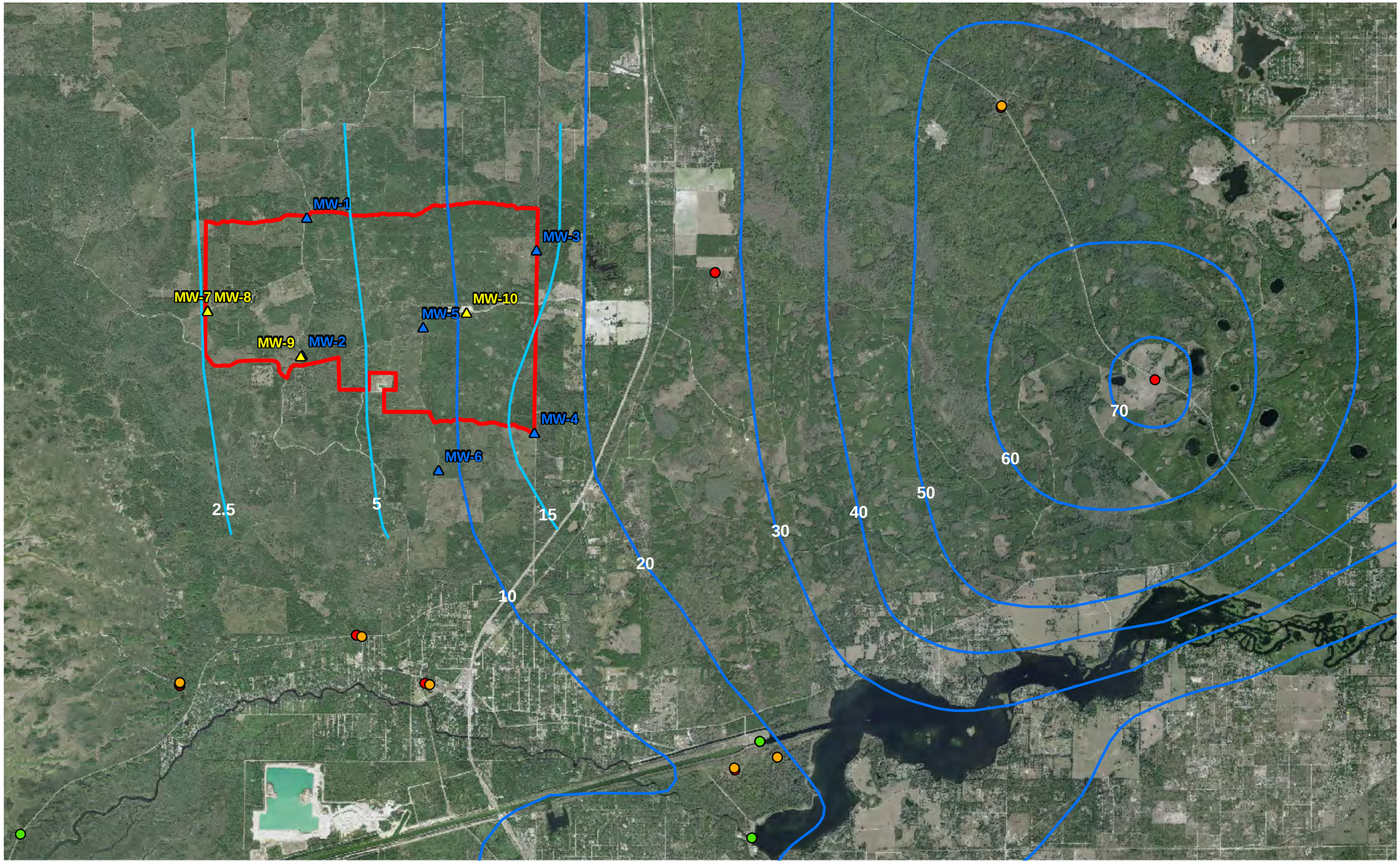
Orlando, Florida 32809



N
W E
S

Scale: 1" = 6,000'

Feet
0 3,000 6,000

- SWFWMD Wells
- USGS Wells
- SWFWMD Rain Gage

TARMAC America Monitor Wells

- Shallow Wells
- Deep Wells (≥150')
- Property Boundary
- May 2005 Pot Surface
- Estimated Pot Surfaces From Site Wells

FIGURE 16

Disclaimer
Ardaman & Associates used the following data "as is" and makes no representation as to the accuracy of the data:

Imagery	SWFWMD	2008
Pot Surface Contours	USGS/SWFWMD	2007

Project: 05-086	Projection: State Plane Florida West	
Prepared: 06-22-09	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by:	Modified:

File: _ArcLayouts\20100602 - Compiled Report Figures\Figure16 Dry Season Pot Surface Map.mxd

DRY SEASON POTENTIOMETRIC SURFACE

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

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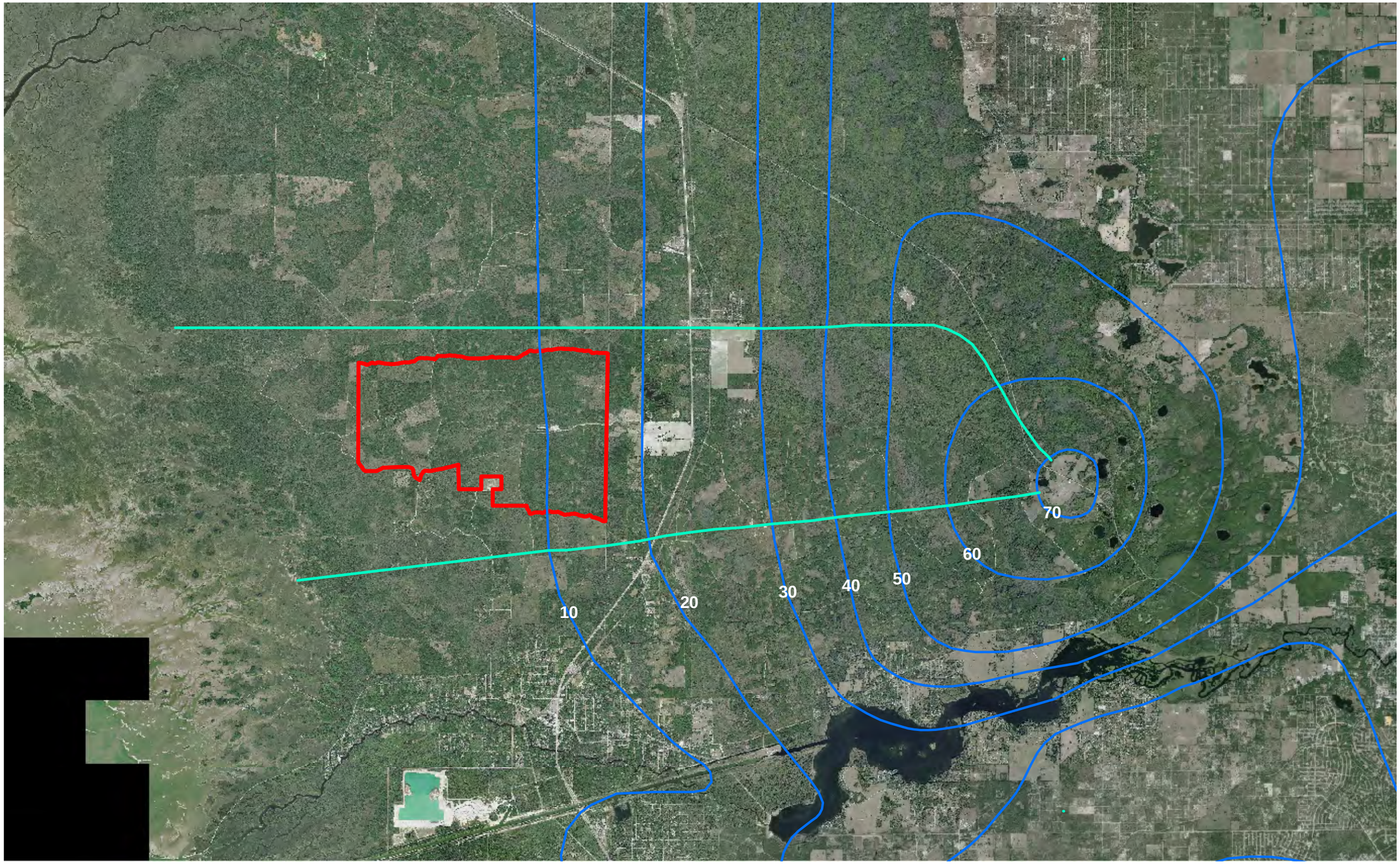
Orlando, Florida 32809



N
W E
S

Scale: 1" = 8,000'
0 4,000 8,000
Feet

Limits of Groundwater Basin
May 2005 Pot Surface
Property Boundary

FIGURE 17

GROUNDWATER BASIN

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

Project: 05-086	Projection: Florida West Stateplane	
Prepared: 08-07-08	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by:	Modified:
File: \\ArcGIS_ArcLayouts\20100602 - Compiled Report Figures\Figure17 Groundwater Basins.mxd		

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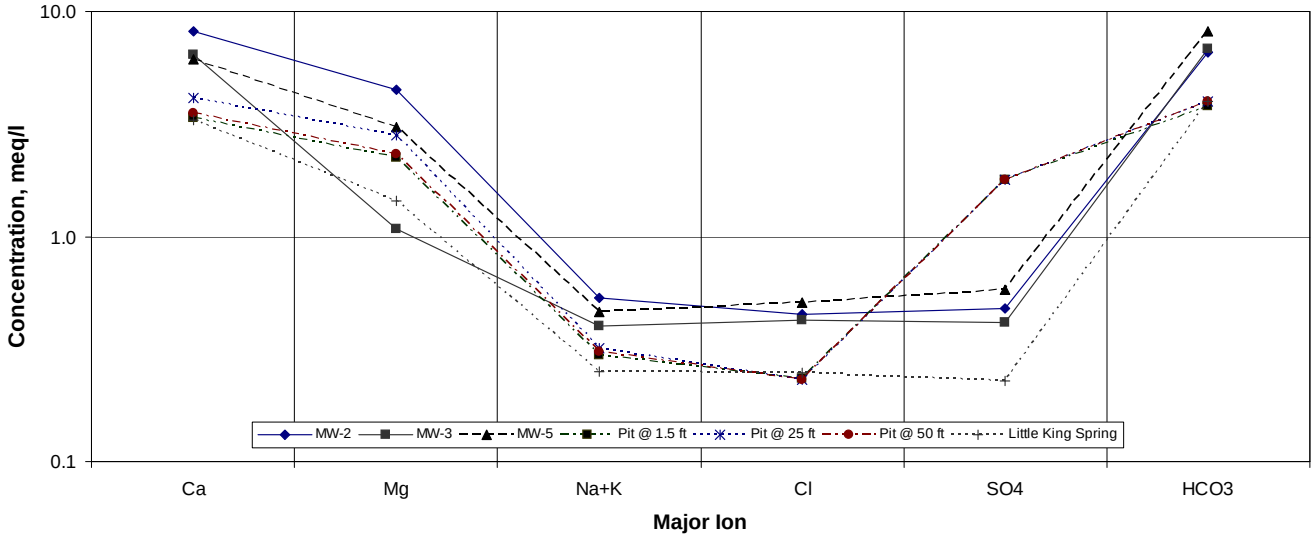

T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 18 Schoeller Diagram.dwg 6/07/2010 12:17:59 PM, reinaldo.rolo

SCHOELLER DIAGRAM

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TARMAC AMERICA, LLC
LEVY COUNTY, FLORIDA

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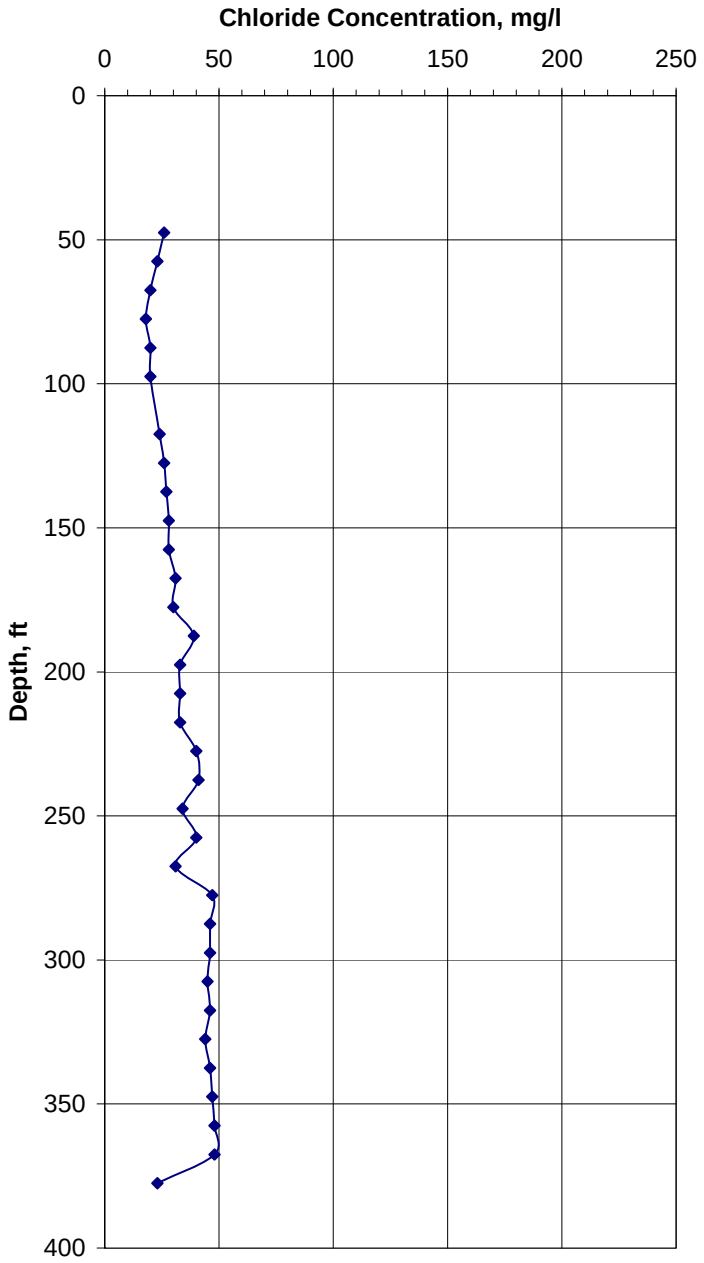
FILE NO. 05-086	APPROVED BY:	FIGURE: 18



CHLORIDE CONCENTRATION PROFILE

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

KING ROAD MINE
TARMAC AMERICA, LLC
LEVY COUNTY, FLORIDA

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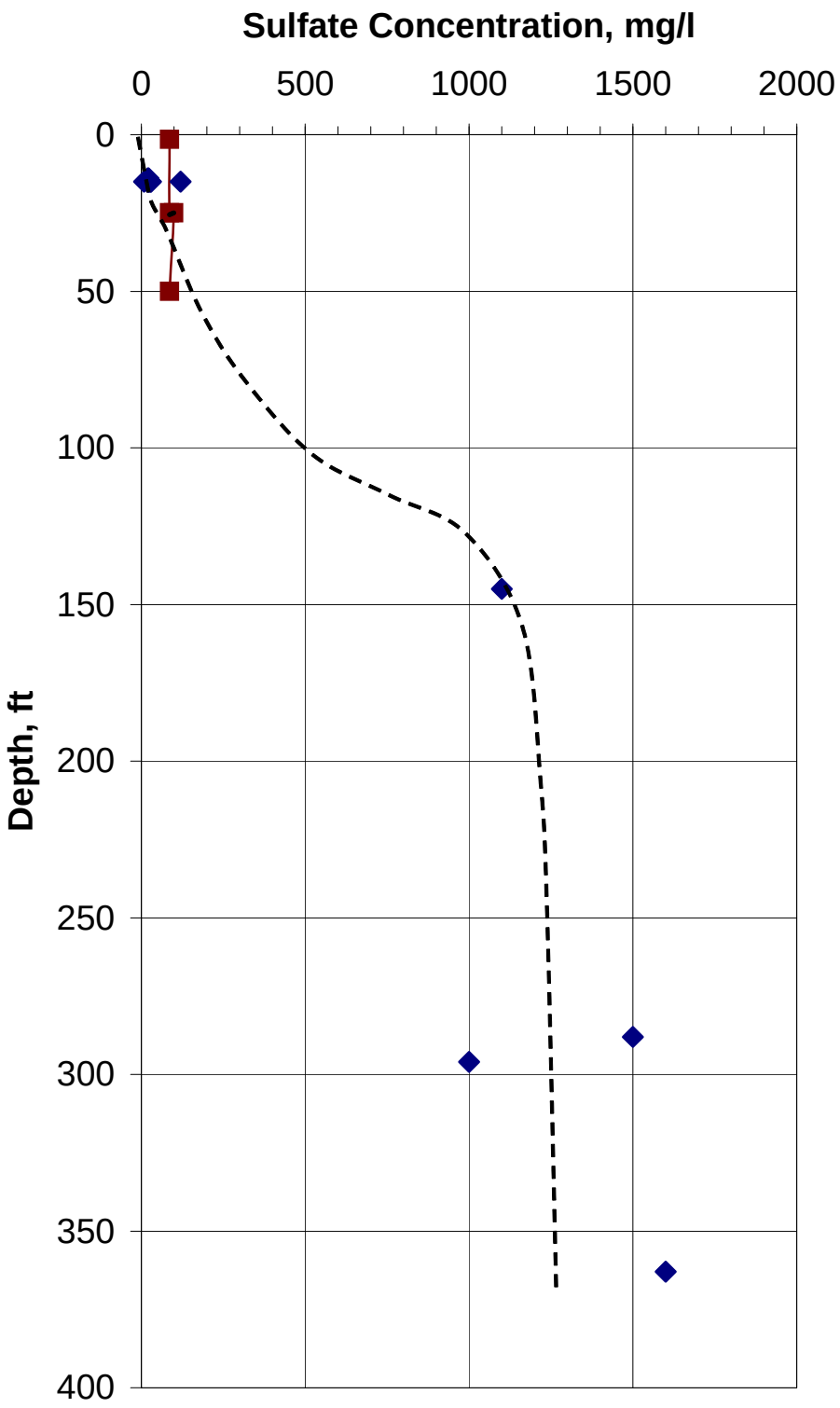
FILE NO. 05-086	APPROVED BY:	FIGURE: 19

T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 19 Chloride.dwg 6/07/2010 12:19:35 PM, reinaldo.rolo



SULFATE CONCENTRATE VS. DEPTH

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Geotechnical, Environmental and Materials Consultants

KING ROAD MINE
TARMAC AMERICA, LLC
LEVY COUNTY, FLORIDA

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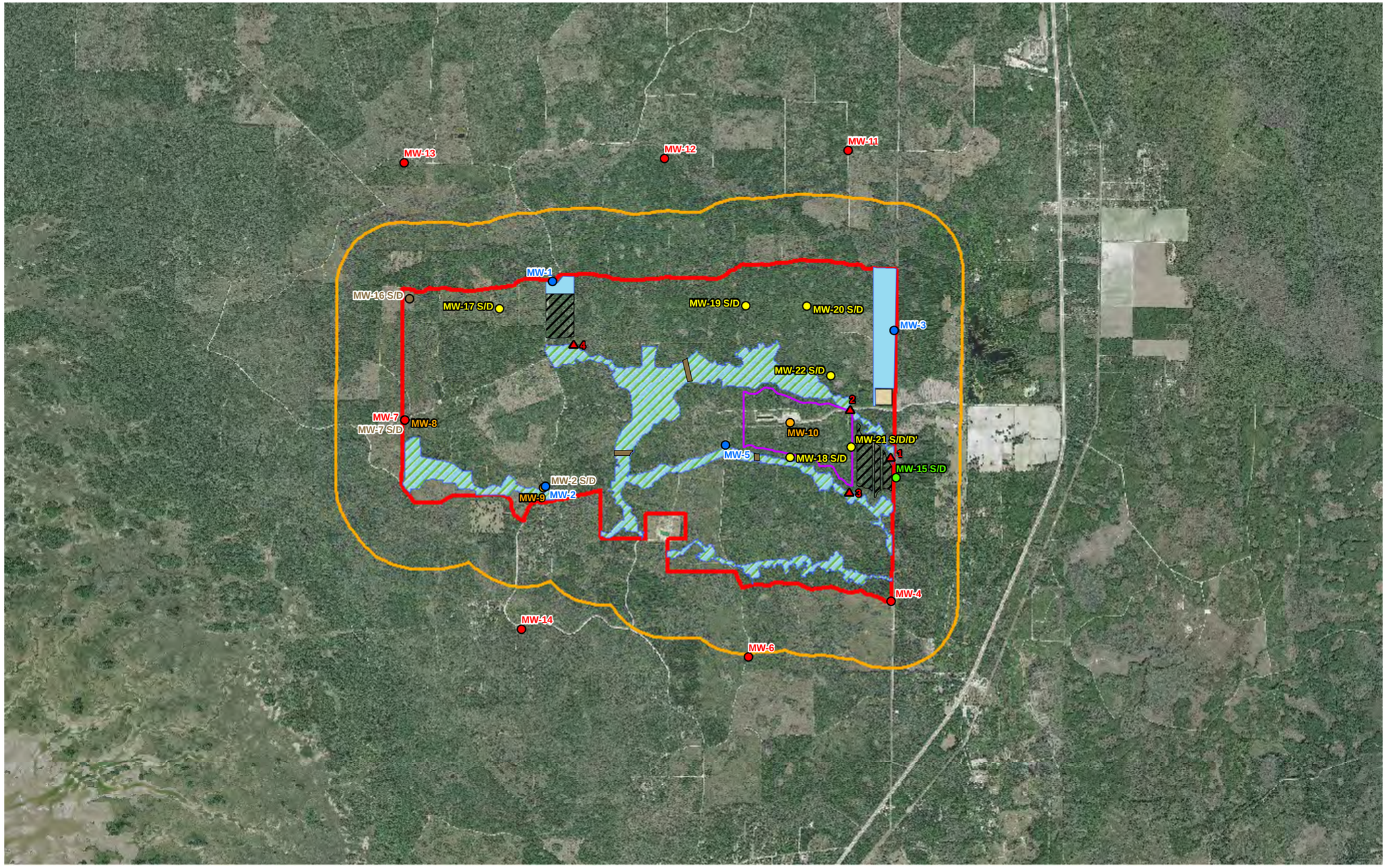
FILE NO. 05-086	APPROVED BY:	FIGURE: 20

T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 20 Sulfate.dwg 6/07/2010 12:22:03 PM, reinaldo.rolo



N
W E
S

Scale: 1" = 4,000'

0 1,000 2,000 4,000
Feet

- Wetland Gauges
- Existing Monitor Wells
- Regional Wells
- Compliance Wells
- Background_Wells
- Intermediate_Wells
- Existing Salt Water Monitors
- Lake
- Reclaimed
- Temp Impacts
- Processing_Plant
- Preserve No Mine
- 10 Acre Square
- 1/2 Mile Buffer
- Property Boundary

FIGURE 21

GROUNDWATER MONITORING PLAN

KING ROAD MINE
TARMAC AMERICA LLC
LEVY COUNTY, FLORIDA

Project: 05-086	Projection: State Plane Florida West	
Prepared: 05-07-09	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by: RMC	Modified: 12-02-09
File: \\20100602 - Compiled Report Figures\Figure21 MW NetworkMap.mxd		

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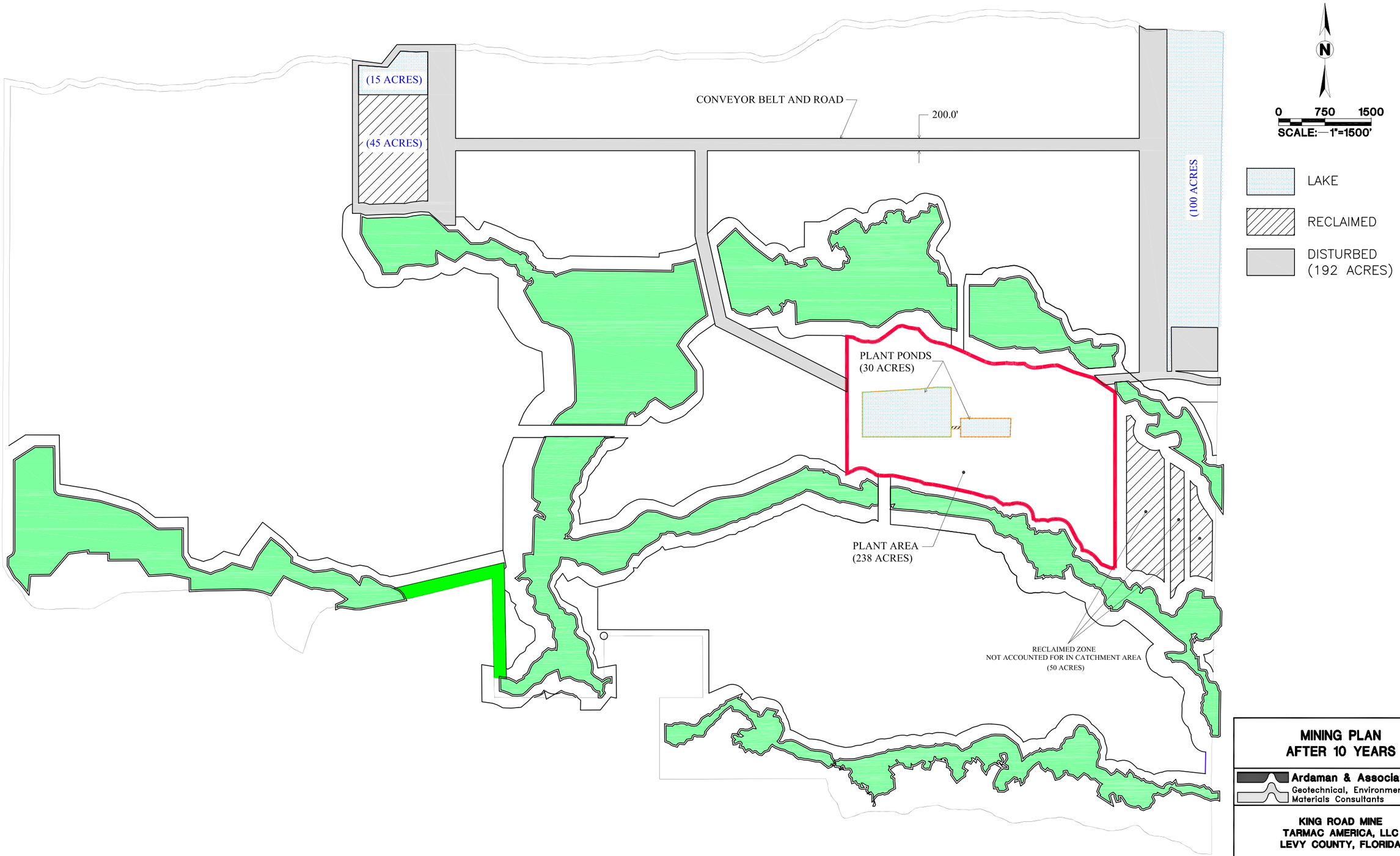

MINING PLAN
AFTER 10 YEARS

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

KING ROAD MINE
TARMAC AMERICA, LLC
LEVY COUNTY, FLORIDA

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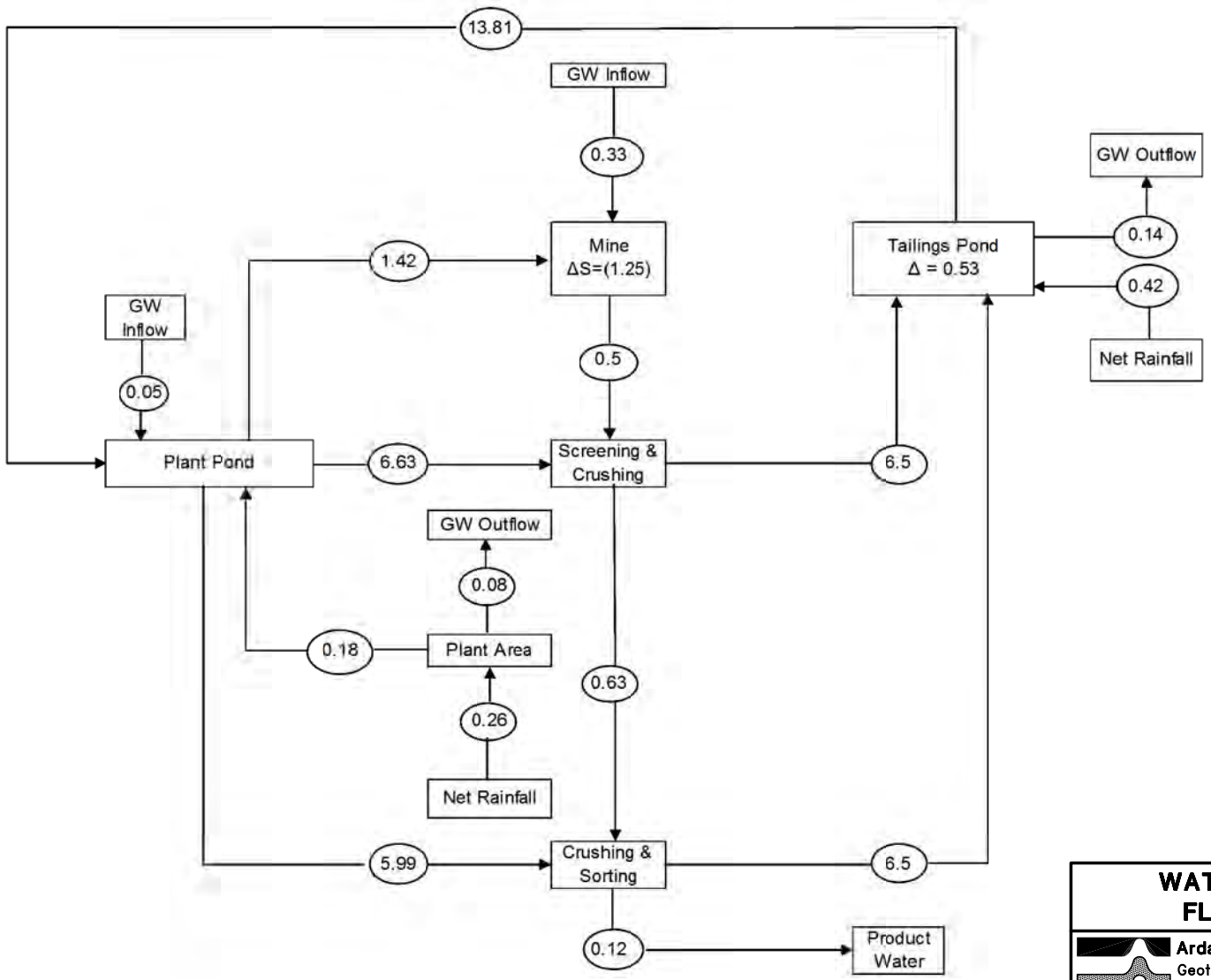
FILE NO. 05-086	APPROVED BY:	FIGURE: 22

T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 22 – 10 yrs Mine Plan.dwg 6/07/2010 12:32:00 PM, reinaldo.rolo

T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 23 Flow Chart.DWG 6/09/2010 12:25:31 PM, reinaldo.rolo

Flow Chart for King Road Mine
All Flows in Million Gallons per Day



WATER BALANCE FLOW CHART

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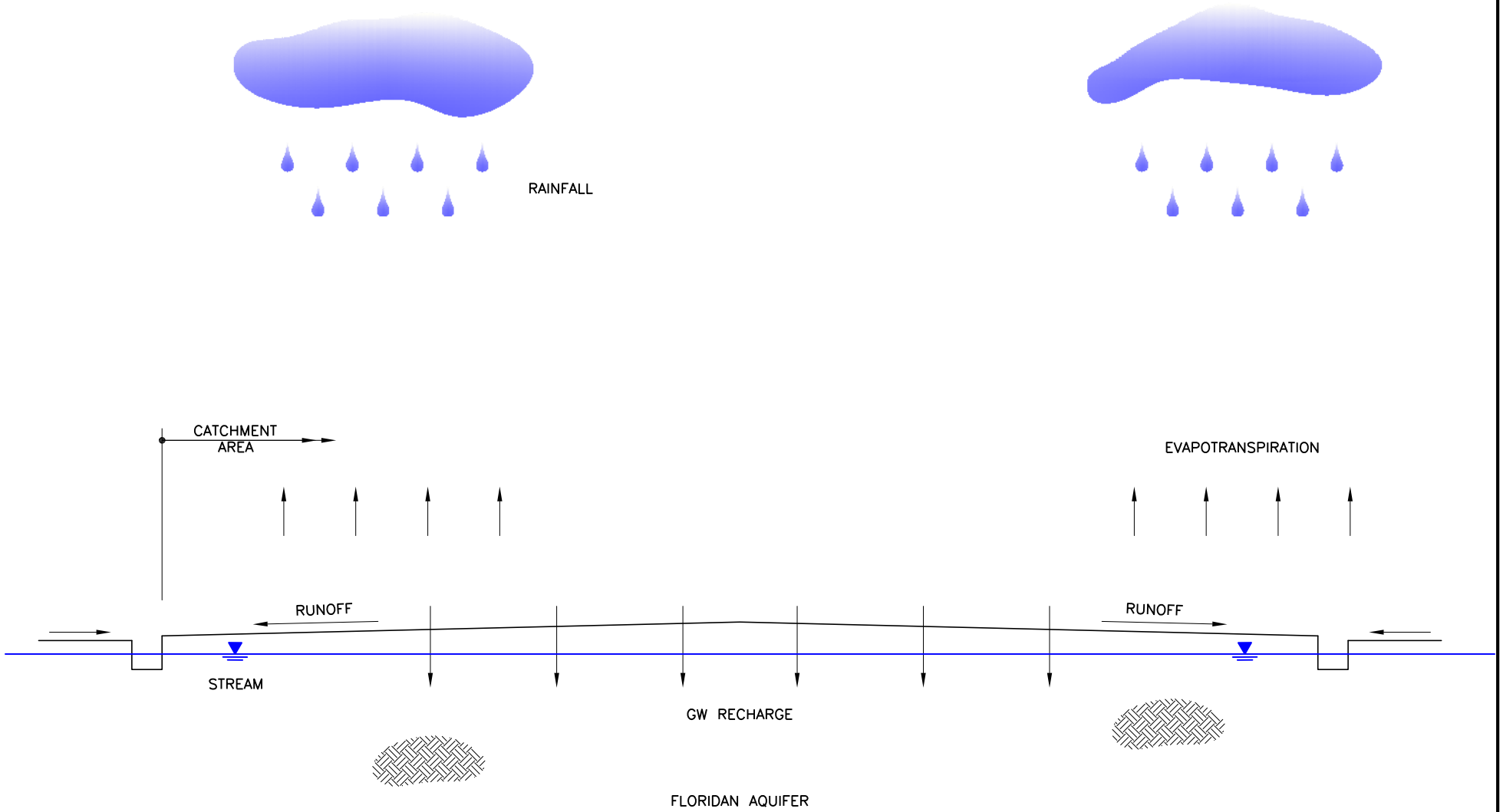
FILE NO. 05-086		FIGURE: 23

T:\Corporate\05\05-086\Report\Compiled Report\Figures 24 and 25 - Water Budget.dwg 6/09/2010 12:28:46 PM, reinaldo.rolo



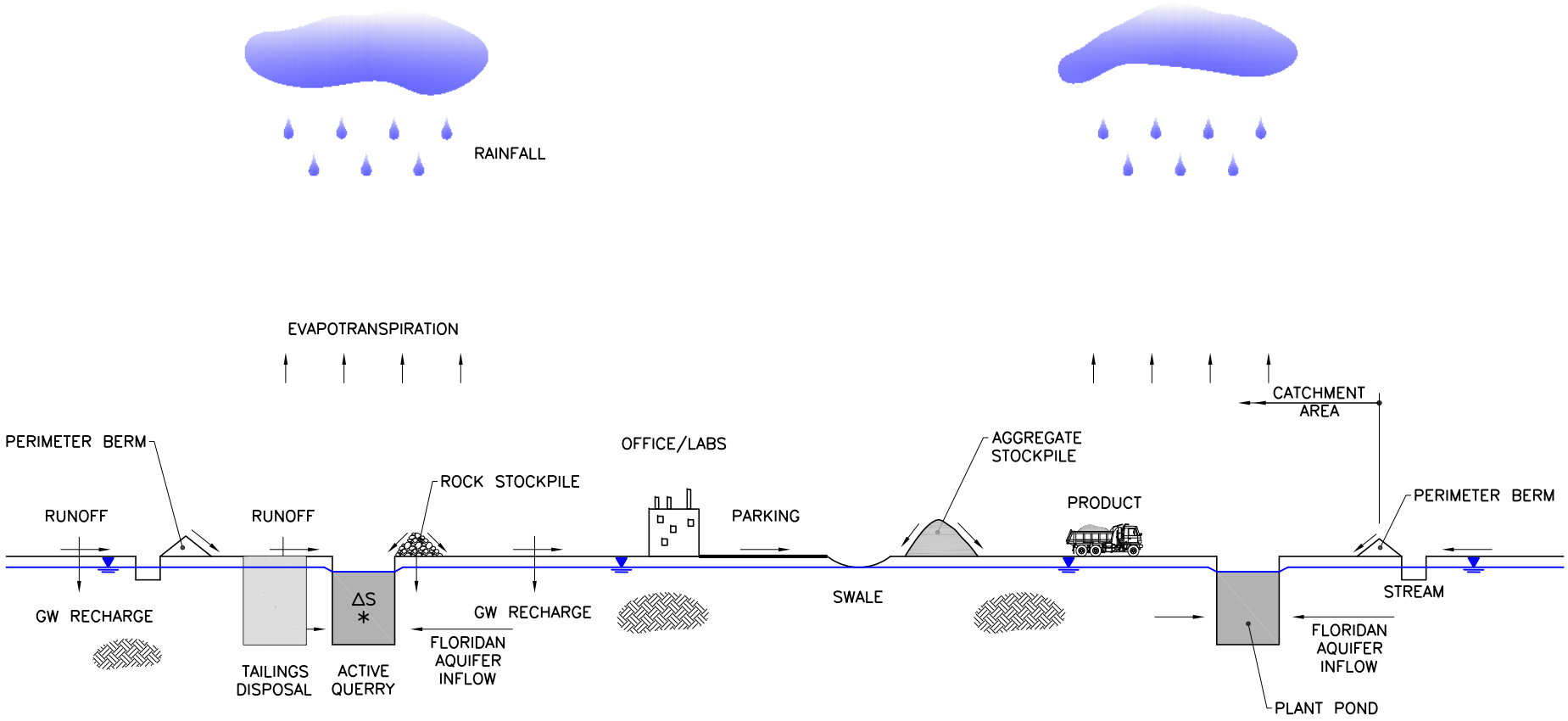
RAINFALL = EVAPOTRANSPIRATION + GW RECHARGE + RUNOFF
2.37mgd = 2.37mgd

PRE-MINING WATER BUDGET

PRE-MINING WATER BUDGET

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

DRAWN BY: BTW	CHECKED BY:	DATE: 03/16/09
FILE NO. 05-086		FIGURE: 24



* (PRODUCT REPLACEMENT)

RAINFALL + FLORIDAN AQUIFER INFLOW = EVAPOTRANSPIRATION + GW RECHARGE + ΔSTORAGE + PRODUCT MOISTURE
2.71mgd = 2.71mgd

DURING-MINING WATER BUDGET

DURING MINING WATER BUDGET

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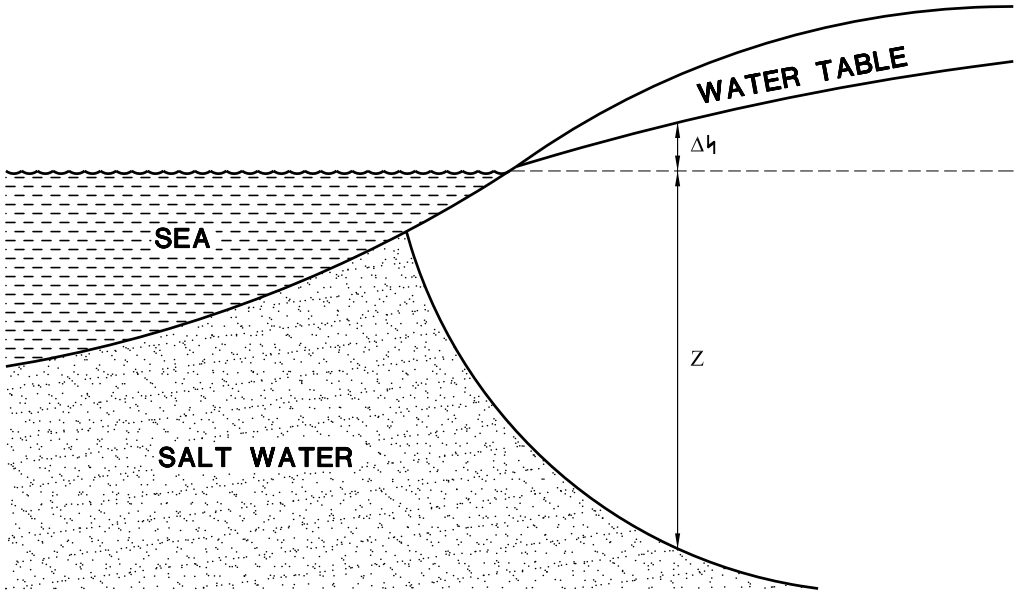
FILE NO. 05-086		FIGURE: 25



SALT WATER INTERFACE

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TITAN AMERICA, LLC
LEVY COUNTY, FLORIDA

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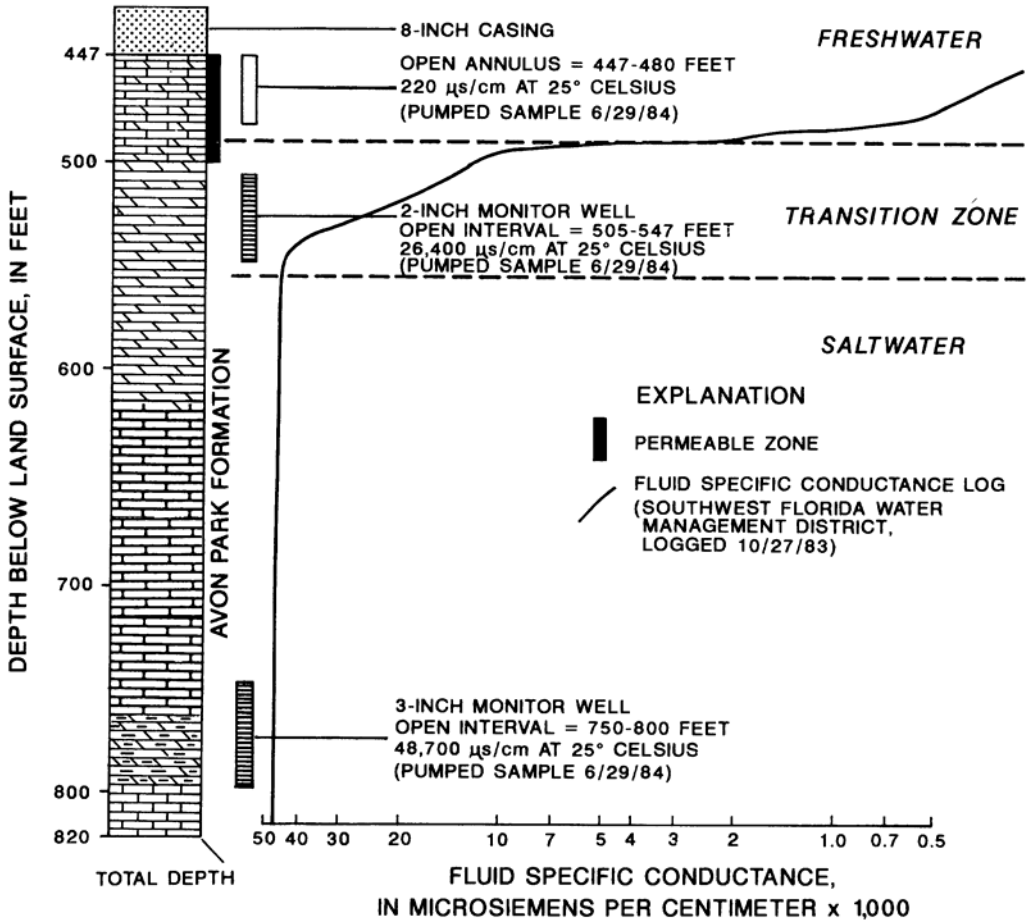
FILE NO. 05-086	APPROVED BY:	FIGURE: 26

T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 26.dwg 6/09/2010 12:31:51 PM, reinaldo.rolo



(AFTER MAHON, 1989)

CONDUCTIVITY LOG
USGS WELL 18-2

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TITAN AMERICA, LLC
LEVY COUNTY, FLORIDA

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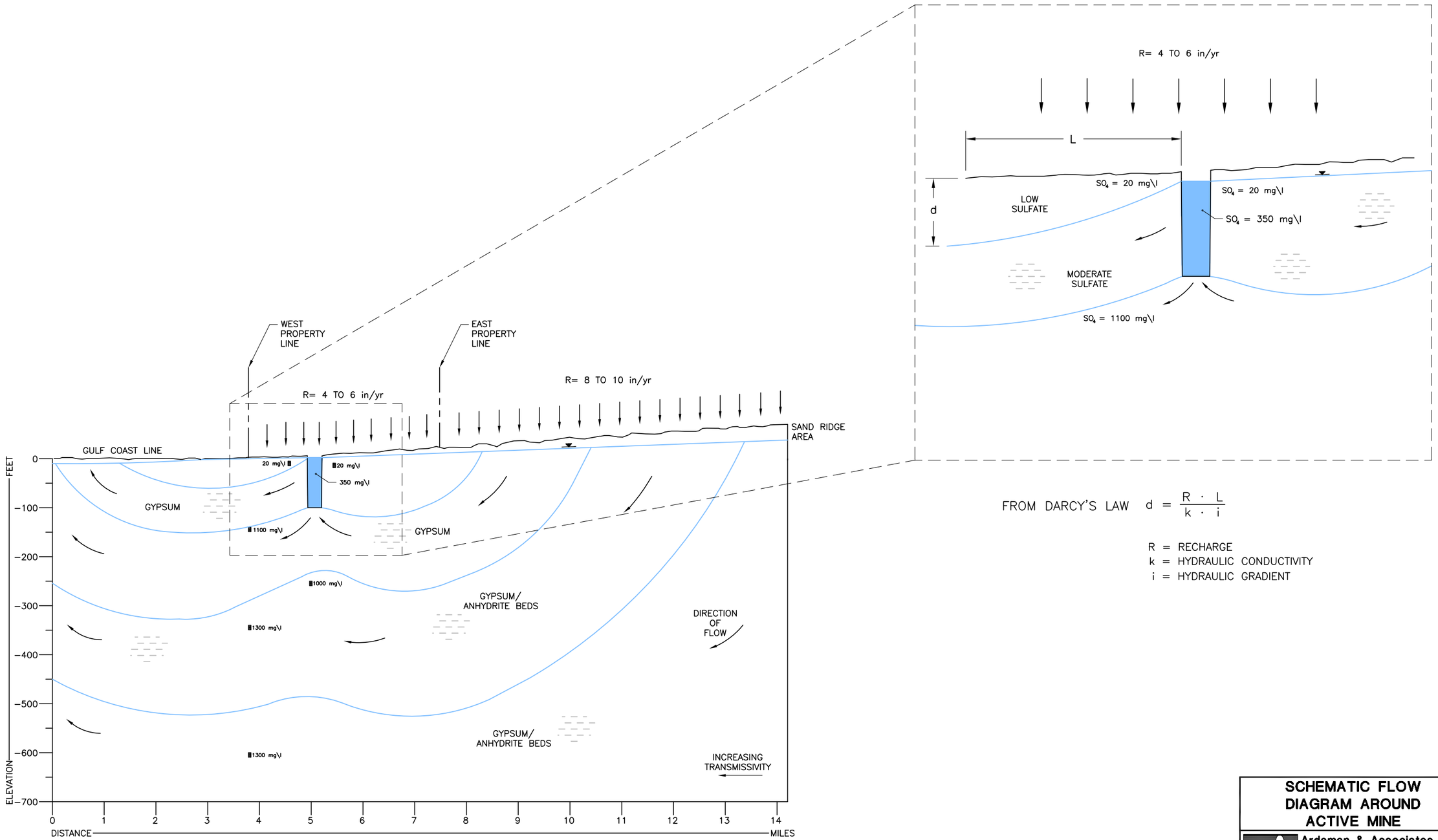
FILE NO. 05-086	APPROVED BY:	FIGURE: 27

T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 27.dwg 6/09/2010 12:32:46 PM, reinaldo.rolo



FROM DARCY'S LAW $d = \frac{R \cdot L}{k \cdot i}$

R = RECHARGE
k = HYDRAULIC CONDUCTIVITY
i = HYDRAULIC GRADIENT

NOTE: FLOW LINES NOT TO SCALE

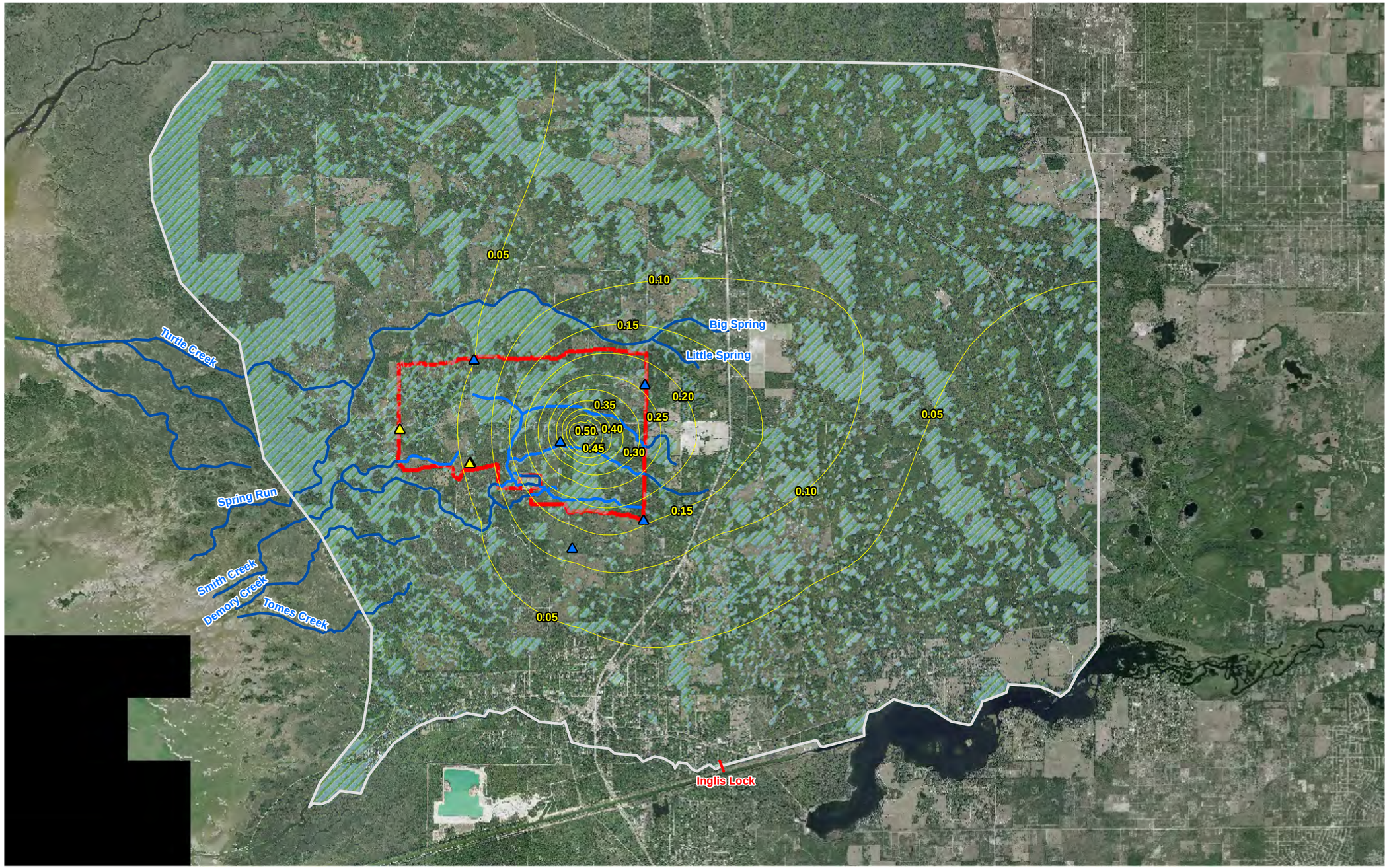
SCHEMATIC FLOW DIAGRAM AROUND ACTIVE MINE

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

KING ROAD MINE
TARMAC AMERICA, LLC
LEVY COUNTY, FL

DRAWN BY: SDS	CHECKED BY:	DATE: 05/18/09
FILE NO. 05-086	APPROVED BY:	FIGURE: 28

T:\Corporate\05\05-086\Report\Compiled Report\Figure 28 Sulfate Flow.dwg 6/09/2010 12:34:24 PM, reinaldo.rolo



N
W E
S

Scale: 1" = 8,000'

0 4,000 8,000
Feet

TARMAC America Monitor Wells

- Shallow Wells
- Deep Wells (>150')
- Contours (ft)
- Inner Arterial Streams
- Arterial Streams
- Property Boundary
- Wetlands*

* U.S. Fish and Wildlife Service National Wetlands Inventory (Published 2002)

FIGURE 29

INCREMENTAL DRAWDOWN CONTOURS WITH 0.38 MGD WITHDRAWAL FROM PLANT POND - STEADY STATE

KING ROAD MINE, TARMAC AMERICA LLC, LEVY COUNTY, FLORIDA

Project: 05-086	Projection: State Plane Florida West	
Prepared: 01-20-09	Horizontal Datum: NAD83	Vertical Datum: N/A
Prepared by: RMC	Modified by:	Modified:
File: \\ArcGIS_ArcLayouts\20100602 - Compiled Report Figures\Figure29.mxd		

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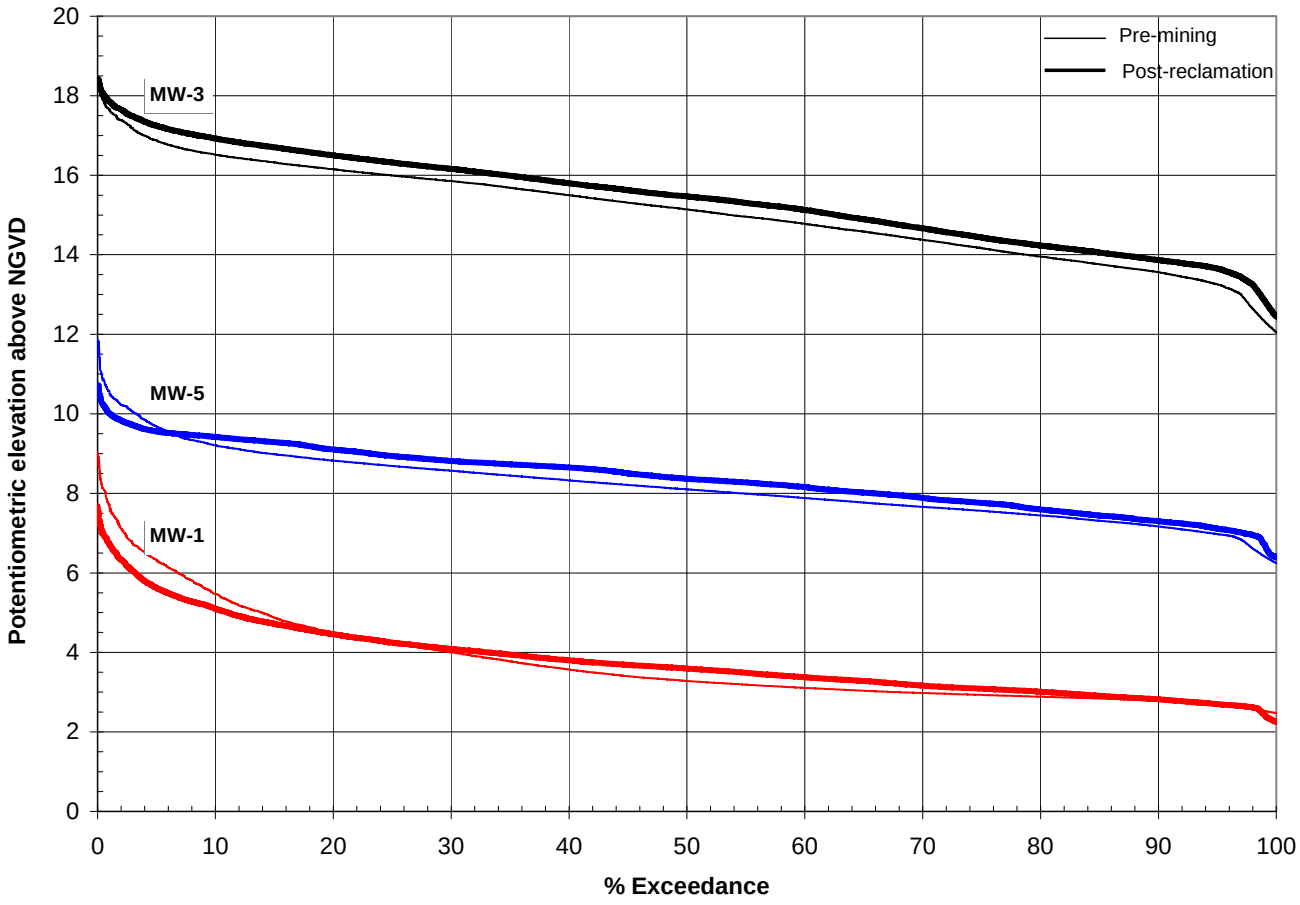


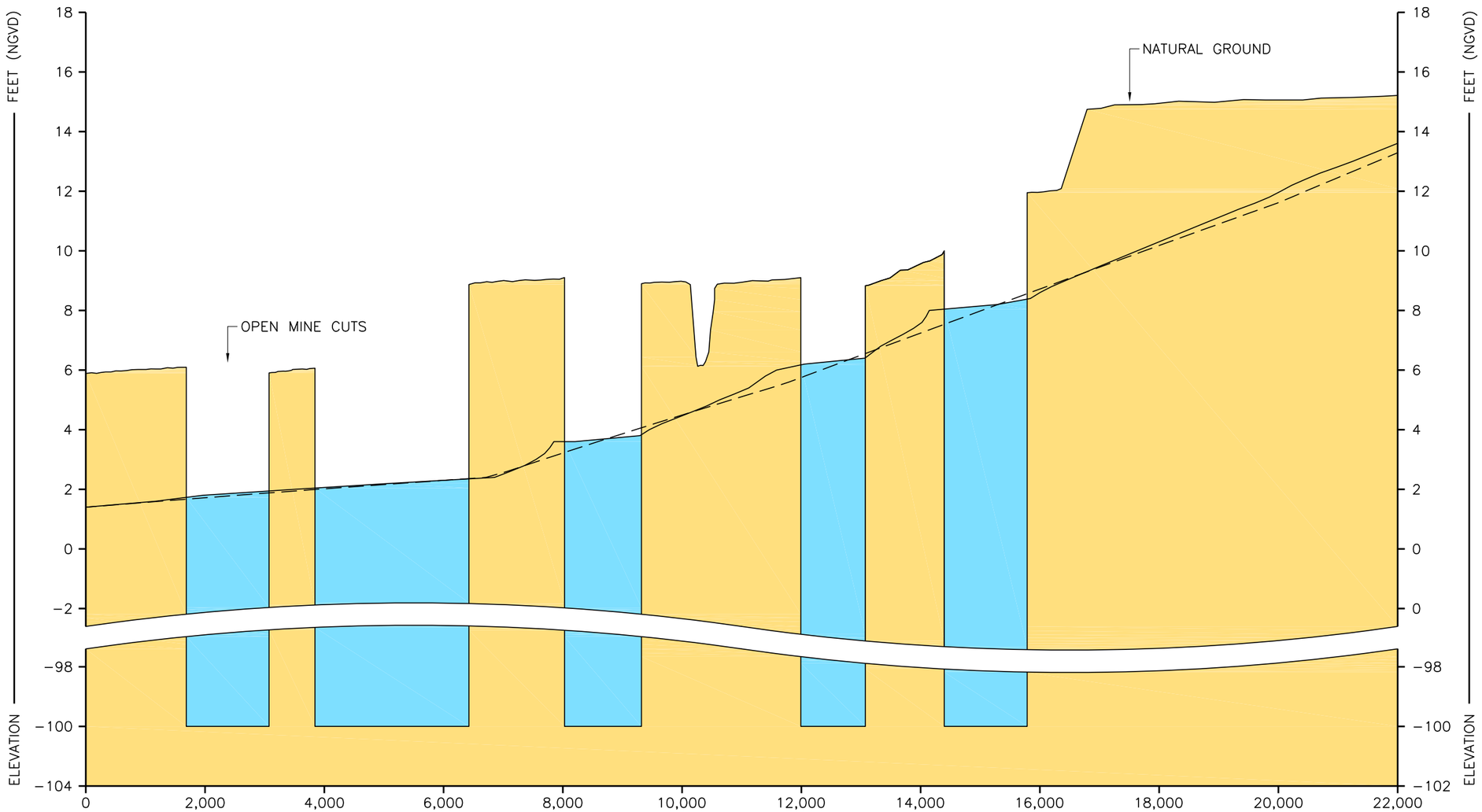
PREDICTED
STAGE DURATION CURVES
PRE-MINING & POST-RECLAMATION

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

KING ROAD MINE
TARMAC AMERICA, LLC
LEVY COUNTY, FLORIDA

DRAWN BY: RRG	CHECKED BY:	DATE: 08/05/08	
FILE NO. 05-086	APPROVED BY:		FIGURE: 30

T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 30.dwg 6/09/2010 12:38:17 PM, reinaldo.rolo



CROSS SECTION

HORIZONTAL SCALE: 1" = 2000'
VERTICAL SCALE: 1" = 4'

LEGEND

— — — — POTENTIOMETRIC SURFACE BEFORE MINING

———— POTENTIOMETRIC SURFACE POST–RECLAMATION

POTENTIOMETRIC SURFACES ACCROSS MINE WITH LATE JUNE 2000 RAIN

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

KING ROAD MINE
TARMAC AMERICA, LLC
LEVY COUNTY, FLORIDA

DRAWN BY: AAD	CHECKED BY:	DATE: 08/28/08
FILE NO. 05-086	APPROVED BY:	FIGURE: 31

T:\Corporate\05\05-086\Report\Compiled Report\FIGURE 31.dwg 6/09/2010 12:39:48 PM, reinaldo.rolo

Table 1
Average Monthly Rainfall, inches

Month	Levy	Citrus
January	3.13	2.75
February	3.35	2.97
March	3.95	3.98
April	3.04	2.69
May	3.21	3.51
June	6.77	7.76
July	8.10	8.47
August	8.19	8.19
September	6.07	6.23
October	3.02	2.91
November	2.11	1.92
December	2.95	2.62
Total	53.94	54.12

Table 2
Average Monthly Lake Evaporation, inches

Month	Gainesville	Lisbon
January	3.32	1.86
February	4.01	2.14
March	5.10	3.61
April	5.29	4.92
May	5.35	5.77
June	4.77	5.42
July	4.40	5.32
August	3.98	5.27
September	3.31	4.13
October	2.78	2.92
November	2.41	1.99
December	2.70	1.61
Total	47.42	44.95

Table 3
Average Annual Evapotranspiration, inches

Landform	Central Florida	North-Central Florid
Class A Pan	74 - 76	66 - 68
Irrigated Golf Course	58 - 62	53 - 56
Lakes & Ponds	50 - 52	45 - 47
Riparian Wetlands	47 - 49	42 - 44
Upland Wetlands	42 - 44	38 - 40
Flatwood	37 - 39	34 - 36
Xeric Uplands	34 - 36	31 - 33
Paved or Roofed Areas	8 - 10	7 - 9

Table 4
Summary of Soil Properties

Soil Name	Depth, in	USDA Texture	% Passing 200 Sieve	% Clay	Permeability, in/hr	Available Water Capacity, in/in	% Organic	Dry density, g/cc	Water Content, %		
									1/10 bar	1/3 bar	15 bar
Wekiva	0-4	Fine sand	6-18	2-6	6.0-20.0	0.05-0.15	2-5	1.43	16.3	8.7	5.8
	4-9	Fine sand, loamy fine sand	6-18	1-6	6.0-20.0	0.05-0.10		1.60	6.6	3.3	3.0
	9-18	Fine sandy loam, sandy clay loam	25-45	12-35	0.2-0.6	0.10-0.15		1.59	25.2	20.5	1.5
	>18	Limestone bedrock	--								
Waccasassa	0-2	Sandy clay loam	25-50	12-35	0.2-0.6	0.12-0.18	2-10	1.07	44.2	42.0	10.6
	2-12	Fine sandy loam, sandy clay loam	25-50	12-35	0.2-0.6	0.10-0.15		1.25	29.1	29.1	8.6
	>12	Limestone bedrock	--								
Demory	0-6	Sandy clay loam	13-35	8-25	0.2-2.0	0.08-0.15	6-18				
	6-11	Fine sandy loam, sandy clay loam	25-50	12-35	0.2-0.6	0.10-0.15					
	>11	Limestone bedrock	--								
Smyrna	0-19	Fine sand	2-12	1-6	6.0-20.0	0.03-0.07	1-5	1.47	7.2	4.1	1.5
	19-23	Fine sand, loamy fine sand	5-20	6-8	0.6-6.0	0.10-0.20		1.33	24.9	17.6	4.2
	23-80	Sand, fine sand	2-10	<6	6.0-20.0	0.03-0.07		1.58	8.60	5.30	1.50
	>80	Limestone bedrock	--								

Table 5
Dry Density Data*

Statistic	Specific Gravity Oven-dried	Dry density (lbs/ft^3)
Average	2.0	125
Minimum	1.5	94
Maximum	2.6	162
Median	2.0	125

(*) From 136 rock cores extracted from the King Road Mine site.

Table 6

Water Level Measurement (ft, NGVD)

			Date													
WELL id	Ground Elevation (ft, NGVD)	Screen Depth (ft)	09/04/05	11/15/05	12/01/05	03/07/06	04/10/06	05/09/06	10/15/07	11/28/07	02/26/08	03/24/08	04/08/08	10/23/08	12/02/08	03/09/09
MW-1	9.4	10 – 20	5.7	3.8	5.6	8.1	5.7	3.6	5.6	3.7	7.4	7.7	8.1	5.3	Abandoned	Abandoned
MW-2	8.2	10 – 20	4.0	2.1	3.6	6.8	4.2	2.6	4.2	2.3	5.7	7.1	7.7	3.0	1.4	2.2
MW-3	17.6	9 -19	14.4	12.5	14.9	16.3	14.0	13.2	14.3	12.7	15.6	16.9	16.6	14.2	11.7	12.8
MW-4	21.6	10 – 20	18.2	16.9	17.9	19.6	18.2	16.5	18.4	16.9	20.3	20.5	21.2	17.3	15.3	15.7
MW-5	12.5	10 – 20	9.0	7.1	8.1	11.1	8.9	7.3	9.5	7.0	9.9	11.8	11.5	8.8	7.5	7.6
MW-6	13.7	7.6 – 17.6	9.4	7.7	9.1	13.7	10.9	8.9	11.5	7.4	12	13.7	13.8	8.8	7.6	7.0
MW-9	8.2*	277.5 – 297.5	-	-	-	-	-	-	-	-	5.9	6.5	5.9	4.1	3.9	3.2

* Approximate elevation

Table 7
Summary of Water Quality Analyses

Parameter	Units	MCL	Sample I.D.														
			MW-1		MW-2			MW-3			MW-4		MW-5			MW-6	
			10'-20'		10'-20'			9'-19'			10'-20'		10'-20'			10'-20'	
			3/24/2008	11/4/2008	3/22/2007	3/24/2008	11/4/2008	3/22/2007	3/24/2008	11/3/2008	3/24/2008	11/3/2008	3/22/2007	3/24/2008	11/3/2008	3/24/2008	11/3/2008
pH (field)	s.u.	--	6.96	6.60	7.05	6.90	6.90	7.18	6.73	6.50	6.76	6.50	7.06	6.80	6.60	6.72	6.50
pH (lab)	s.u.	--	7.40	--	--	7.20	--	--	7.00	--	--	--	--	7.10	--	7.10	--
Conductivity (field)	μmhos/cm	--	991	980	732	796	618	748	814	778	1025	880	886	923	727	1013	1043
Temperature	°C	--	20.3	22	18.5	20.5	22	18.8	21	23.1	20.2	23.4	18.7	20.3	22.6	20.4	21.9
Turbidity	NTU	--	1.0	1.5	24.0	0.0	2.2	6.8	0.4	1.8	6.5	4.1	7.0	0.2	0.9	0.3	0.6
Calcium	mg/l	--	126	132	164	93	85	128	123	130	97	97	122	119	93	103	105
Magnesium	mg/l	--	38	41	55	23	21	13	12	13	31	32	37	37	28	58	58
Sodium	mg/l	160	11	12	12	11	9	9	9	10	10	10	11	11	7	20	20
Potassium	mg/l	--	0.5	0.7	0.5	0.2	0.5	0.1	0.1	*0.3*	0.1	*0.3*	0.2	0.2	0.5	0.2	*0.3*
Iron	mg/l	0.3	0.05	0.04	1.97	0.99	0.78	1.15	0.86	1.62	2.19	2.45	0.83	0.95	1.05	0.60	0.64
Alkalinity as $CaCO_3$	mg/l	--	360	340	330	350	280	340	360	340	370	340	410	420	310	480	460
Chloride	mg/l	250	20	21	16	21	16	15	19	19	23	32	18	22	12	42	42
Sulfate	mg/l	250	120	150	23	22	16	20	24	27	8.3	12	28	29	33	19	18
Fluoride	mg/l	4	0.4	0.4	0.1	0.3	0.2	0.1	0.2	0.2	0.4	0.3	0.3	0.6	0.6	0.8	0.7
Total Nitrogen	mg/l	10	0.7	0.7	0.7	0.0	0.9	0.8	0.4	0.4	0.3	0.3	0.7	0.3	0.3	0.0	0.3
Total Phosphorous	mg/l	--	0.02	0.02	0.19	0.02	0.04	0.05	0.03	0.04	0.05	0.05	0.02	0.03	0.04	0.02	*0.01*
Silica	mg/l	--	5.2	--	10.0	5.3	--	6.0	6.1	--	3.9	--	10.0	11.0	--	5.8	--
TDS	mg/l	500	610	630	--	400	370	--	460	460	400	430	--	470	410	500	570
Arsenic	μg/l	10	10.3	*4.0*	--	11.6	*4.0*	--	8.5	*4.0*	8.0	*4.0*	--	16.0	7.2	14.9	7.7
Barium	μg/l	2000	15.9	16.6	--	9.7	*11.0*	--	40.7	51.1	17.9	20.0	--	14.9	14.8	22.0	25.0
Cadmium	μg/l	5	*<0.2*	*1.1*	--	*<0.2*	*1.1*	--	*<0.2*	*1.1*	*<0.2*	*1.1*	--	*<0.2*	*1.1*	*<0.2*	*1.1*
Chromium	μg/l	100	*<1.2*	*4.5*	--	*<1.2*	*4.5*	--	*<1.2*	*4.5*	*<1.2*	*4.5*	--	*<1.2*	*4.5*	*<1.2*	*4.5*
Copper	μg/l	1000	--	*2.2*	--	--	*2.2*	--	--	*2.2*	--	*2.2*	--	--	*2.2*		*2.2*
Lead	μg/l	15	*<2.2*	*1.2*	--	*<2.2*	*1.2*	--	*<2.2*	*1.2*	*<2.2*	*1.2*	--	*<2.2*	*1.2*	*<2.2*	*1.2*
Mercury	μg/l	2	*<0.01*	*0.02*	--	*<0.01*	*0.02*	--	*<0.01*	*0.02*	*<0.01*	*0.02*	--	*<0.01*	*0.02*	*<0.01*	*0.02*
Selenium	μg/l	50	3.5	*5.2*	--	4.5	*5.2*	--	3.5	*5.2*	3.5	*5.2*	--	3.5	*5.2*	6.4	*5.2*
Silver	μg/l	100	*<0.4*	*0.2*	--	*<0.4*	*0.2*	--	*<0.4*	*0.2*	*<0.4*	*0.2*	--	*<0.4*	*0.2*	*<0.4*	*0.2*
Zinc	μg/l	5000	*16.0*	*16.0*	--	--	*16.0*	--	--	24.5	--	35.9	--	--	*16.0*	--	*16.0*
Gross Alpha	pCi/l	15	--	4.4	--	*1.9*	2.0	--	2.8	3.3	--	2.8	--	5.3	2.9	--	4.1
Radium 226	pCi/l	5	--	1.3	--	1.8	1.4	--	1.8	1.9	--	1.7	--	1.6	1.4	--	1.7
Radium 228	pCi/l		--	*0.8*	--	*1.0*	*0.7*	--	*1.0*	*0.9*	--	*0.9*	--	*1.0*	*0.9*	--	*0.8*

Table 7
Summary of Water Quality Analyses

Parameter	Units	MCL	Sample ID												
			MW-7		MW-8		MW-9		MW-10		Test Pit	Test Pit		Test Pit	Little King Spring
			140'-150'		353'-373'		278'-298'		286'-306'		1.5'	25'		50'	Surface
			3/24/2008	11/4/2008	3/24/2008	11/4/2008	3/24/2008	11/4/2008	3/24/2008	11/3/2008	3/22/2007	3/22/2007	3/24/2008	3/22/2007	3/22/2007
pH (field)	s.u.	--	6.72	6.90	7.07	6.80	7.00	6.90	7.29	6.90	7.95	7.48	6.83	7.49	7.35
pH (lab)	s.u.	--	7.40	--	7.30	--	7.30	--	7.10	--	--	--	8.00	--	--
Conductivity (field)	µmhos/cm	--	2180	2280	2720	2940	2550	2816	2030	2034	568	585	783	578	479
Temperature	°C	--	21.5	21.1	21.6	21.4	21.7	21.5	21.6	22	--	--	20.2	--	--
Turbidity	NTU	--	1.1	1.2	0.2	1.3	2.3	1.1	0.6	0.3	0.9	21.5	0.0	1.6	0.5
Calcium	mg/l	--	388	414	497	554	419	531	386	392	68	83	71	70	66
Magnesium	mg/l	--	92	96	127	141	90	115	69	66	27	34	24	28	18
Sodium	mg/l	160	20	20	30	30	27	25	10	10	7	7	6	7	6
Potassium	mg/l	--	2.6	2.6	6.1	6.7	2.3	2.7	1.9	1.8	0.6	0.8	0.6	0.7	0.4
Iron	mg/l	0.3	--	0.57	--	0.18	--	0.04	--	0.07	0.04	0.14	0.01	0.04	0.09
Alkalinity as $CaCO_3$	mg/l	--	170	170	150	140	170	160	190	180	190	200	220	200	200
Chloride	mg/l	250	34	35	51	53	40	41	15	13	8	8	10	8	9
Sulfate	mg/l	250	1100	1200	1600	1800	1500	1700	1000	1100	86	86	99	86	11
Fluoride	mg/l	4	--	0.8	--	1.6	--	1.0	--	0.7	0.1	0.1	0.3	0.1	0.1
Total Nitrogen	mg/l	10	--	0.3	--	0.8	--	0.5	--	0.4	0.8	1.1	0.0	1.0	1.4
Total Phosphorous	mg/l	--	--	0.04	--	*0.01*	--	*0.01*	--	0.01	0.02	0.04	0.02	0.02	0.05
Silica	mg/l	--	--	--	--	--	--	--	--	--	3.4	5.0	2.4	4.5	4.0
TDS	mg/l	500	2000	2000	2500	2800	2500	2600	1800	1800	--	--	380	--	--
Arsenic	µg/l	10	--	*4.0*	--	*4.0*	--	*4.0*	--	*4.0*	--	--	4.2	--	--
Barium	µg/l	2000	--	*11.0*	--	*11.0*	--	12.8	--	24.5	--	--	8.0	--	--
Cadmium	µg/l	5	--	*1.1*	--	*1.1*	--	*1.1*	--	*1.1*	--	--	*<0.2*	--	--
Chromium	µg/l	100	--	*4.5*	--	*4.5*	--	*4.5*	--	*4.5*	--	--	*<1.2*	--	--
Copper	µg/l	1000	--	2.3	--	3.3	--	2.8	--	*2.2*	--	--	--	--	--
Lead	µg/l	15	--	*1.2*	--	*1.2*	--	*1.2*	--	*1.2*	--	--	*<2.2*	--	--
Mercury	µg/l	2	--	*0.02*	--	*0.02*	--	*0.02*	--	*0.02*	--	--	*<0.01*	--	--
Selenium	µg/l	50	--	*5.2*	--	*5.2*	--	*5.2*	--	*5.2*	--	--	5.4	--	--
Silver	µg/l	100	--	*0.2*	--	*0.2*	--	*0.2*	--	*0.2*	--	--	*<0.4*	--	--
Zinc	µg/l	5000	--	*16.0*	--	20.2	--	*16.0*	--	21.4	--	--	--	--	--
Gross Alpha	pCi/l	15	--	7.7	--	*5.0*	--	*5.4*	--	*4.3*	--	--	3.5	--	--
Radium 226	pCi/l	5	--	1.2	--	0.5	--	2.0	--	1.7	--	--	0.4	--	--
Radium 228	pCi/l		--	*0.8*	--	*0.8*	--	*0.8*	--	*0.8*	--	--	*0.9*	--	--

Table 8

Annual Water Budget for King Road Mine

Average Rainfall Year

Annual Rainfall	54	in/yr
Natural ET	38	in/yr
Lake Evaporation	48	in/yr
Stockpile ET	40	in/yr
Paved Area ET	10	in/yr
Other Disturbed Area ET	34	in/yr
Average Mining Rate	25	ac/yr
Average Mining Depth	100	ft
Rock Production	3	mty
Product Moisture Content	6	Percent
Catchment Area	590	acres
Open Mine Areas	145	acres
Reclaimed Areas	30	acres
Other Areas	393	acres
Paved & Roofed Areas	5.0	acres
Stockpile Areas	17	acres
Unit Weight of Rock	2,750	lbs/yd^3
Specific Gravity of Aggregate	2.75	
Groundwater Outflow	5	in/yr

AVERAGE ANNUAL WATER BUDGET UNDER NATURAL CONDITIONS

SOURCES	ACRE-FT	MGD	USERS	ACRE-FT	MGD
Rainfall	2,655	2.37	ET	1,868	1.67
			Groundwater Recharge	246	0.22
			Contribution to Streamflow	541	0.48
			Change in Storage	0	0.00
TOTAL	2,655	2.37		2,655	2.37

ANNUAL WATER BUDGET WITH MINING

SOURCES	ACRE-FT	MGD	USERS	ACRE-FT	MGD
Rainfall	2,655	2.37	ET	1,849	1.65
Floridan Aquifer	375	0.34	Change in Storage*	803	0.72
Recycle Water	14,563	13.00	Tailings water return	14,563	13.00
			Product Moisture	132	0.12
			Groundwater Recharge	246	0.22
			Contribution to Streamflow	0	0.00
TOTAL	17,593	15.71		17,593	15.71

Uses	MGD	Gal/ton	Source	MGD	Gal/ton
Change in ET	-0.02	-2	Captured GW Recharge	0.00	0
Product	0.12	14	Floridan Aquifer	0.34	41
Change in Storage	0.72	87	Captured SW	0.48	59
Total	0.82	100		0.82	100

* Change in Storage = Volume of Rock (Aggregate) Removed from Site

** Visher & Hughes (1975)

APPENDIX C
APPLICANT'S ALTERNATIVE ANALYSIS

TARMAC KING ROAD LIMESTONE MINE
LEVY COUNTY, FLORIDA
REPORT IN SUPPORT OF THE ANALYSIS OF PRACTICABLE ALTERNATIVES
PURSUANT TO 40 C.F.R. § 230.10

TABLE OF CONTENTS

Page

I. Introduction 1
II. Tarmac's Proposed Mine at King Road 3
  A. The King Road Limestone Mine Site 4
  B. Tarmac's Initial Analysis of the King Road Mine Site 6
III. The Project Purpose 7
  A. Tarmac's Need for a Local Source of Limestone to Serve the West-Central Florida Market 7
  B. Tarmac's Need for A Long-Term Supply of High-Quality Limestone 9
  C. Public Need for A Long-Term Supply of Construction Aggregate Within the West-Central Florida Market 13
IV. Factors Affecting the Practicability of Alternatives 13
  A. Quality of Limestone Reserves 14
  B. Availability of Property for Acquisition and Use 17
  C. Ability to Supply the Entire West-Central Florida Market from a Single Source 19
  D. Transportation Logistics 20
  E. Transportation Costs 20
  F. Need to Avoid Multiple Handling of Limestone to Minimize Product Losses 22
  G. Electric Power Infrastructure 23
VI. Evaluation of Potential Alternative Mining Locations 23
  A. Potential Sites Inside the Market Area of West-Central Florida 24
    i. Sites Inside Levy County 25
    ii. Citrus County 29
    iii. Hernando County 31
    iv. Pasco County, Northern Hillsborough County and Northwest Polk County 32
    v. Lake County 36
    vi. Southern Taylor County 37
    vii. Counties Inside the West-Central Florida Market Not Underlain with Avon Park or Suwannee Formations 39

1. Marion/Sumter Counties 39
2. Alachua County 41
3. Clay County 42
B. Shipping Limestone Aggregate In Through Ports 42
C. Shipping Limestone Aggregate In Through Rail Terminals 45
D. Other Distant Florida Sites 46
VII. Conclusion 46

FIGURES

1. Population Density
2. Market Area
3. Avon Park and Suwannee Formation Outcroppings
4. Parcels
5. Suitable Land Use – Levy County, Florida
6. NWI (National Wetlands Inventory)
7. Streams Suitability
8. Plantable vs. Non-Plantable Plum Creek Land
9. USACE Alternative Boundary 8 – UMAM Evaluation
10. Storm Surge Suitability
11. Suitable Land Uses – Citrus County, Florida
12. Property Owners Map – Citrus County, Florida
13. Suitable Land Use – Hernando County, Florida
14. Property Owners and Suitable Lands – Hernando County, Florida
15. Suitable Land Use – Pasco County, Florida
16. Suitable Land Use – SE Pasco, NE Hillsborough & NW Polk Counties, Florida
17. Property Owners and Suitable Land Use – Pasco County, Florida
18. Property Owners and Suitable Land Use – Hillsborough County, Florida
19. SWFWMD & Suitable Land Use Two Rivers Ranch
20. Stream Locations Two Rivers Ranch
21. Property Owners and Suitable Land Use – Polk County, Florida
22. Property Owners and Suitable Land Use – Taylor County, Florida
23. NWI Wetlands – Taylor County, Florida

APPENDIX

1. Urban Economics Aggregate Demand Analysis
2. Seminole Electric Cooperative Letter
3. Florida Geology: An Introduction to the Florida Platforms Geology
4. Entrix Environmental Evaluation
5. McLean Engineering Cost Estimate

REPORT IN SUPPORT OF THE ANALYSIS OF PRACTICABLE ALTERNATIVES PURSUANT TO 40 C.F.R. § 230.10

TARMAC AMERICA, LLC
KING ROAD LIMESTONE MINE

I. INTRODUCTION

This report provides information as to whether there are less environmentally damaging practicable alternative locations for Tarmac America LLC, a Titan America Business ("Tarmac"), to excavate limestone at its proposed King Road Mine in Levy County, Florida. This report's purpose is to assist the U.S. Army Corps of Engineers (the "Corps") in its alternatives analysis pursuant to 40 C.F.R. § 230.10.

Tarmac proposes to open a 4,750.5+/- acre limestone aggregate mine on a 9,277-acre parcel located at the west end of King Road in unincorporated southwestern Levy County. The eastern boundary of the proposed mine is located approximately one mile west of U.S. Highway 19, three miles north of C.R. 40, and two miles north of Inglis, Florida. The purpose of the proposed action is to provide construction-grade limestone aggregate including aggregate that meets Florida Department of Transportation ("FDOT") specifications, for buildings and infrastructure. The proposed mine is to provide a major, long-term, regional source of aggregate for Tarmac's and its customers' use in the west-central area of Florida. In general, the regional market area borders Perry on the north, the I-75 growth corridor on the east, the Gulf of Mexico on the west, and the northern suburbs of Tampa on the south, which are all no more than 80-100 truck driving miles from the King Road Mine site.[1] Section III.A below discusses the west-central Florida market area.

Under Clean Water Act ("CWA") regulations, the Corps may not issue a Section 404 permit to an applicant "if there is a practicable alternative to the proposed discharge which would

[1] The 70-mile radius around the King Road Mine site equates to an 80-100 mile approximate truck driving distance. Both the 70-mile radius and the 80-100 mile truck driving distance are discussed interchangeably throughout this report. As will be discussed below, however, Tarmac does not anticipate that limestone aggregate extracted from the King Road Limestone Mine will be sent more than 60 miles from the King Road site via truck. This report evaluates possible alternatives, however, within the 70-mile radius (80-100 mile truck driving distance) around King Road.

have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences."[2] "Practicable" is defined by the regulations as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purpose."[3]

The Corps must evaluate whether practicable alternatives exist to the proposed activity. There are three steps in this analysis. First, alternatives to the proposed mining location must be identified, *i.e.*, other potential mining locations that would accomplish the overall project purpose. Second, the Corps must determine whether each of those alternative mining locations is practicable within the meaning of the regulations. Finally, for those alternatives that exist and are practicable, the Corps must determine whether each alternative "would have less adverse impact on the aquatic ecosystem," and whether each alternative has "other significant adverse environmental consequences."[4] If there are practicable alternatives that cause the same or greater environmental impacts,[5] guidance indicates that the agency may issue the permit. For purposes of this submittal, Tarmac assumes that it has the burden of clearly demonstrating that its preferred alternative is the least environmentally damaging practicable alternative.

There are two primary controlling factors in the siting of a limestone quarry. First, the nature of limestone aggregate as a product requires that a quarry be located close to construction sites where the limestone aggregate will be used. Aggregate is used to make concrete and other construction products. It has a very low value/weight ratio, *i.e.,* it is very heavy and bulky for its price. This means that the cost of transporting aggregate is high compared to the value of the product itself, and that transportation costs can quickly exceed the value of the aggregate. In a market like west-central Florida, which relies on truck transportation, the cost of transporting aggregate exceeds the value of the aggregate within a very short distance from the quarry – approximately 70 radial miles. This means that a quarry needs to be located in the

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[2] 40 C.F.R. § 230.10(a).

[3] 40 C.F.R. §§ 230.3(q), 230.10(a)(2).

[4] 40 C.F.R. § 230.10(a).

[5] Memorandum to the Field, Appropriate Level of Analysis for Evaluating Compliance with the Section 404(b)(1) Guidelines Alternative Requirements, U.S. EPA & Corps (1993).

market to competitively supply the product.

Second, limestone aggregate must have very specific physical properties in order to make the highest quality concrete that Tarmac seeks to sell. Concrete is formed through a chemical reaction involving aggregate, cement, and other materials. The hardness and strength of concrete depends on the chemical and physical properties of the limestone; use of poor quality limestone can lead to poor quality concrete.[6] In Florida, the physical characteristics of limestone are highly variable, with much of the limestone in the state being too soft or containing excessive amounts of pyrites and chlorides that weaken concrete. In order to meet the most demanding technical specifications for concrete issued by FDOT – which is the biggest consumer of aggregate in Florida – Tarmac needs to find a sizable and accessible source of high quality limestone. The outcropping of the Avon Park limestone formation found at the King Road site is such a source.

There are no practicable alternative locations to the King Road site that would meet the project's overall purpose and have fewer environmental impacts than the proposed project. In west-central Florida, there are limited locations that could have the quality of rock and land use designations necessary for production of construction-grade limestone aggregate. There is no other property available in the area that could supply the needed amount and type of limestone deposits that is also of the requisite size, location, distance from urban areas, proximity to transportation facilities and lack of notable environmental resources.

II. TARMAC'S PROPOSED MINE AT KING ROAD

Tarmac is seeking to open a limestone aggregate mine in the west-central Florida market region, specifically located off of King Road approximately one mine west of U.S. Highway 19 in unincorporated southwestern Levy County (the "King Road

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[6] *See* The Aggregate Handbook, National Stone Association, at § 3.1 (1991) ("Use of nondurable aggregate has caused rapid deterioration of [P]ortland cement concrete under severe weathering conditions including freezing and thawing. Use of improper aggregate in asphalt concrete construction has led to the binder being stripped away from aggregate particles, resulting in rapid pavement deterioration. . . . The actual levels of all needed properties are influenced by how the aggregate is used in the system. Many properties of the aggregate, such as strength, are required at some levels regardless of the aggregate use. Aggregate used in asphalt concrete do[es] not necessarily need to have the same properties as those used in Portland cement concrete.")

Limestone Mine"). The proposed mine would be on property that has been used extensively for silviculture operations since the early 1960s. The King Road site is approximately 9,277 acres, and consists of a 4,750.5+/- acre mine parcel and a 4,526.5+/- acre mitigation tract. The mine and related infrastructure will occupy 3,898+/- acres of the Mine Parcel and the remaining 852+/- acres will be placed under a perpetual conservation easement.[7]

A. **The King Road Limestone Mine Site**

The proposed mine site is underlain by the Avon Park Formation, a dolomitic limestone that occurs at the surface in most of southern Levy County. The formation is overlain by an average of less than two feet of overburden throughout the proposed King Road site. FDOT test data indicates that the Avon Park Formation at this location is highly suitable for making high quality limestone aggregate, which would meet market needs for aggregate, an essential component of concrete. Core sampling data for the King Road Mine site indicates that limestone there is of significantly high quality.

The King Road Mine site is located away from major residential/urban developments. The closest residential developments/towns to the site are Inglis, Florida and Yankeetown, Florida, both of which are approximately 2 to 3 miles from the southern edge of the King Road Limestone Mine. According to the U.S. Census Bureau, these two towns had a total population of approximately 2,298 people in July 2009.[8] The next closest residential area, Otter Creek, is approximately 22 miles north of the King Road Limestone Mine and had a population of 127 in July 2009.[9] These towns, and the residents that live there, are far enough away from the mine site that daily mining activities at King Road, including blasting, will not affect

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[7] The need for a mine site of this size is discussed in other submittals by Tarmac to the Corps. In the interest of brevity, this Report will not repeat these reasons here.

[8] U.S. Census Bureau, Annual Estimates of the Resident Population for Incorporated Places in Florida, *at:* http://www.census.gov/popest/cities/tables/SUB-EST2009-04-12.xls.

[9] U.S. Census Bureau, Annual Estimates of the Resident Population for Incorporated Places in Florida, *at:* http://www.census.gov/popest/cities/tables/SUB-EST2009-04-12.xls.

them. *See* **Figure 1**.[10]

The King Road Mine site is located approximately one mile from U.S. Highway 19, making transportation efficient. In fact, the only public access to Plum Creek Timberlands, LP's ("Plum Creek") property west of U.S. 19 in this general area is King Road (right-of-way owned by Levy County). Thus, as discussed in Section IV.E below, the site also avoids the added cost and logistical difficulties of trucking limestone aggregate from a mine site over rural country roads to a major road, and then to its final destination. Although the market area is a 70-mile radius around the King Road site (*i.e.*, approximately 80-100 mile truck driving distance from the site), almost all truck trips would be expected to be less than 60 miles from mine to jobsite.

The eastern boundary of the proposed King Road Mine site is the existing Progress Energy Florida 230 kV transmission line. This boundary was established because the dragline used for mining would need to be disassembled and reassembled to mine any area east of the transmission line, which would result in exorbitant cost and down time (approximately two years). As discussed below, proximity to the transmission line is also essential to ensure that Tarmac can obtain electrical power to conduct operations at the site.

The King Road Limestone Mine site is consistent with Tarmac's long-term business plan. Tarmac is a vertically-integrated business in that its concrete plants rely on limestone aggregate produced by Tarmac to operate. To ensure the efficiency of its business, Tarmac must have steady sources of limestone aggregate that ideally are geographically close to Tarmac's concrete ready-mix and block plants. Tarmac has ready-mix and block plants on the central-west coast of Florida and its future plans include expanding into north and west-central Florida, including into Gainesville and Ocala. Limestone aggregate from the King Road Limestone Mine will supply Tarmac's already-existing plants in the area and will provide a long-term source of supply for Tarmac's planned growth throughout west-central Florida. Because Tarmac is a vertically-integrated business, it is also consistent with Tarmac's business model that limestone aggregate supplied to its ready-mix and concrete block plants be obtained from Tarmac's mines, and not from an outside source.

[10] All of the figures referenced in this Report are attached to the back of this Report.

B. Tarmac's Initial Analysis of the King Road Mine Site

When Tarmac initially evaluated the parcel, it determined that the King Road site had the right combination of various key factors, including the availability of a large parcel with a single, willing land owner, isolation from significant residential development, and proximity to a quality transportation infrastructure.

After Tarmac entered the contract with the land owner of the King Road Mine site, Plum Creek, but before deciding to move forward with permitting the site, Tarmac further evaluated the suitability of the site for a limestone mine. To test the quality of the rock and determine whether it was capable of producing FDOT construction-grade aggregate, Tarmac drilled and analyzed over 100 borings. Tarmac also received approval from the Levy County Commission to open a test pit on the property. Tarmac extracted approximately 15 truck loads of material from the test pit to a depth of roughly 55 feet and sent them to various processing plants for further processing and analysis. Testing results confirmed that the aggregate from this location is capable of producing FDOT construction-grade aggregate.

Environmental features of the site were also analyzed, first to identify and delineate on-site wetlands, and second to configure the specific mine site to avoid intermittent flow ways and significant wetland resources. Tarmac also conducted a wildlife survey to identify any endangered and threatened species. An evaluation of the various environmental considerations conducted on the King Road Mine Site can be found in the Environmental Impact Statement.

Although the King Road Limestone Mine project involves unavoidable impacts to jurisdictional wetlands, the King Road site has environmental advantages over other sites in the west-central Florida area. The King Road site is being actively used for silviculture, with large areas of pine plantation periodically clear cut on a 20 to 25 year rotation. The wetlands that do exist on the site are of the same or lower quality than other sites nearby. In fact, whereas many of the wetlands on the King Road Mine site have been converted to hydric pine plantation, intact hydric hammock with a significant cypress component is common to the north. The site also avoids Class I Springs, such as Fanning Springs and Manatee Springs, in the northwestern corner of Levy County. Finally, of the 9,277-acre King Road site, 4,526.5+/- acres will be available for Tarmac to purchase and convey to the State of Florida as

mitigation.[11]

III. THE PROJECT PURPOSE

Under the Section 404(b)(1) Guidelines ("Guidelines"), the Corps must evaluate whether an alternative is practicable in light of the project's "overall purpose." The overall project purpose is not the basic nature of the activity involved, but identifies the specific needs of the project in question. When defining the overall purpose, the Corps is required to consider the applicant's needs "in the context of the desired geographic area of the development and the type of project being proposed."[12]

Tarmac's basic purpose for undertaking the proposed project is to extract construction-grade limestone aggregate. The overall project purpose is to excavate and provide primarily two types of limestone aggregate - limestone aggregate that meets FDOT specifications and commercial-grade limestone aggregate to be used in buildings and infrastructure. The proposed mine is to provide a major, long-term, regional source of these types of limestone aggregate for Tarmac's and its customers' use in the west-central area of Florida.

Tarmac's statement of overall project purpose is based on well-documented facts and historical market demand for Tarmac's product.

A. Tarmac's Need for a Local Source of Limestone to Serve the West-Central Florida Market

Central to Tarmac's overall project purpose is that the site is located in the market that Tarmac intends to serve – west-central Florida. This market generally consists of the area north of Tampa's suburbs, west of the I-75 growth corridor, and south of Perry. The west-central Florida market area lacks an adequate rail transportation network, which means that all limestone aggregate must be transported primarily via truck within the market, placing a premium on proximity between the

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[11] The remaining 4,750.5+/- acres will be the mine parcel. There are approximately 2,900+/- acres of wetlands and 1850+/- acres of uplands within the 4,750.5+/- acre mine parcel. Of those 2,900+/- acres of wetlands, 2,283+/- acres are proposed for impact and 617+/- acres of wetlands will be avoided.

[12] U.S. Army Corps of Engineers' Standard Operation Procedures for the Regulatory Program, at 7 (Oct. 15, 1999).

supply and demand for the aggregate. Because of the low value per weight of limestone aggregate, the cost of transporting aggregate can easily exceed the cost of extracting the aggregate. As such, quarries typically are located near an area where large volumes of aggregate are needed. Because of the high cost of transporting rock from the quarry to the rock's final destination, the market area is generally viewed as an area that constitutes an 80 to 100-mile truck haul from the mine to the consumers.[13] Thus, an alternative location does not meet the project's overall purpose unless the alternative is located within the west-central Florida market – i.e., within an 80 to 100-mile truck haul from the King Road Limestone Mine site in west-central Florida.[14] The west-central Florida market is shown on **Figure 2**.

Federal agencies have repeatedly recognized the economic importance of siting mines in the market sought to be served. In court filings discussing the aggregate business, the U.S. Department of Justice has recognized that different areas of Florida constitute distinct geographical markets for the sale of aggregate, and that because of high transportation costs and long delivery times, "producers of aggregate . . . not located in or near [a particular geographic market] do not sell a significant amount of aggregate" for use in that distinct geographic market.[15] For example, when specifically discussing the Southwest Florida market, the Justice Department told a court that "[t]o be cost competitive in Southwest Florida, an aggregate production facility must be able to produce large amounts of consistent quality aggregate in close proximity to . . . where the aggregate will be used."[16]

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[13] *See* Florida Department of Transportation ("FDOT"), *Strategic Aggregates Study: Sources, Constraints & Economic Value of Limestone and Sand in Florida: Part I, Evaluation of Aggregate Materials In Florida's Future* ("FDOT Study, Part I") at, 19 (2007).

[14] Figure 2 also highlights areas in the Avon Park Formation (Areas A, B, C and D) that this Report evaluates in determining whether a practicable alternative to mining the King Road Mine site exists inside the Avon Park Formation.

[15] Competitive Impact Statement, *United States v. Fla. Rock Indus., Inc.*, Civil No. 99-516-CIV-J-20A, at 3 (M.D. Fla. May 26, 1999); *see also United States v. Vulcan Materials Comp.*, Civil No. 1:07-cv-02044 (D.D.C. Nov. 13, 2007) ("because of transportation costs, a small but significant . . . increase in the price of coarse aggregate would not cause customers to procure coarse aggregate from quarries farther away").

[16] Complaint for Injunctive Relief, *United States v. Fla. Rock Indus., Inc.*, Civil No. 99-516-CIV-J-20A, at 5 (M.D. Fla. May 26, 1999).

For purposes of this analysis, Tarmac has defined its market based on two independent governmental analyses. First, the definition of the market is based on the 2007 FDOT Strategic Aggregates Study, which explains that the market area for this type of mine is generally viewed as an area that constitutes an 80 to 100-mile truck haul from the mine to the consumers. Second, the U.S. Department of Justice, in defining relevant markets for purposes of antitrust review of mergers in the aggregate industry, has recognized that aggregate markets are defined primarily on the basis of proximity to the source of the aggregate, especially when they rely on truck transportation. Tarmac believes that the most reasonable approach to defining the market for purposes of this analysis is to follow this logic and focus on the 80-100 mile truck hauling distance. As a practical matter, that area necessarily includes the customers which Tarmac seeks to serve with the King Road Mine.

B. Tarmac's Need for A Long-Term Supply of High-Quality Limestone

The overall project purpose also reflects the type, quality, and quantity of aggregate and other limestone products needed for Tarmac's business. Tarmac seeks to produce limestone aggregate that meets FDOT-specifications for quality. Aggregates are crushed stone particles that are used as a structural filler for Portland cement concrete, asphaltic concrete, fill for drain fields or rip rap, and a myriad of other products. Construction aggregates are divided into two categories – those certified by FDOT ("FDOT-quality aggregates") and Commercial-Grade aggregate, *i.e.*, "crushed stone materials that are produced and sold to non-[F]DOT projects or other projects which do not require [F]DOT certification."[17] The properties of both kinds of aggregates are described and graded according to standardized tests that measure hardness and chemical stability.

In Florida, most aggregate suppliers participate in a statistical quality control program developed by FDOT. FDOT "is the quality control and standards setting organization in the State of Florida for construction aggregates. Mining companies must meet the engineering tests prescribed by FDOT for materials used on state projects so aggregate producers selling materials

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This further highlights the need for producers of aggregate to locate quarries within the local market to be served.

[17] *See* FDOT *Strategic Aggregates Study: Sources, Constraints & Economic Value of Limestone and Sand in Florida,* at v (March 2007).

for state projects must participate with the FDOT State Materials Office to verify the quality and consistency of mined materials."[18] The main purpose of this frequent testing is to alert the producer of possible fluctuations in aggregate quality so prompt adjustments can be made. FDOT sets the standards for materials used in the Florida transportation system. "FDOT-quality aggregates" require the most durable materials.[19] "The ideal aggregate particles are hard, rough textured, angular and blocky in shape."[20] FDOT-quality aggregates are used for public road and bridge projects, and for other public or private projects that involve structural applications where strength, chemical stability, and resistance to abrasion are needed and specified by the project engineer.[21] Commercial-grade aggregate, on the other hand, is used when the project engineer specifies lesser quality or untested materials.[22] Tarmac's primary products are FDOT-quality and commercial-grade aggregates.

Most locations in Florida with geological formations cannot produce coarse crushed stone that meets FDOT-quality specifications. In some areas, Florida's crushed stone materials are too soft or the deposits yield materials that are unsuitable for FDOT projects.[23] The harder and more consolidated limestone formations underneath Florida are the source of crushed stone materials used for road building and construction. Significant deposits of this crushed stone may be found in six

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[18] FDOT Study, Part I, at 4.

[19] *See generally* FDOT Standard Specifications for Road & Bridge Construction – 2007, §§ 901-902, 921, *available at*: http://www2.dot.state.fl.us/SpecificationsEstimates/implemented/CurrentBK/Default.aspx. FDOT Study, Part I, at 5, 8 (stating that, "[a]ggregate materials need to be inherently durable because the rock particles become the framework that is held together by Portland cement or asphalt to form concrete," and "[r]ock that is suitable for the production of aggregates must be hard and durable[.]")

[20] FDOT Study, Part I at 5.

[21] *See FDOT Strategic Aggregates Study: Sources, Constraints & Economic Value of Limestone and Sand in Florida, Part II: Potential Impacts to the Economy of Florida from the Curtailment of Crushed Stone Production* ("FDOT Study, Part II"), at 1 (March 2007).

[22] *See* FDOT *Strategic Aggregates Study: Sources, Constraints & Economic Value of Limestone and Sand in Florida,* at v (March 2007) (defining "commercial grade crushed stone" as "materials that are produced and sold to non-DOT projects or other projects which do not require DOT certification").

[23] FDOT Study, Part I, at 4.

geographical regions in Florida.[24] Although limestone mines are operated in 22 counties in Florida, most of these mines produce limestone base (which cannot be used to make concrete) rather than high quality limestone aggregate.[25]

The King Road Limestone Mine is located on a large outcropping of Avon Park Limestone, which is reasonably durable, and usually better suited for coarse limestone aggregate production than other geological formations.[26] The FDOT test data indicates that the Avon Park Formation is suitable for producing high-quality aggregates.

In order to be a major long-term source of limestone aggregate, a site must have a large footprint of mineable land. Tarmac's mining plan calls for the production of a minimum of 3 million tons of aggregate per year. Tarmac arrived at this target of 3 million tons per year after evaluating current and future demand in the market area, in conjunction with limits on capacity and operations at any mine it would site. Michael McElveen, a State Certified General Real Estate Appraiser with Urban Economics, Inc. has provided Tarmac with an evaluation of current and projected demand for aggregate in the west-central Florida market. Mr. McElveen's conclusions are attached to this Report as **Appendix 1**.

According to Mr. McElveen, aggregate demand is directly linked to construction activity and population growth in the market. From a demand perspective, the potential sales market – west-central Florida – encompasses all or part of 23 of Florida's 62 counties and currently includes a population of just under 7 million people. According to the North Carolina Geological Survey, a national rule of thumb is that approximately 10 tons of aggregate are needed per resident each year.[27] Thus, the current 2010 demand for aggregate in the area is approximately 70 million tons. Population projections from the University of Florida Bureau of Economic and Business

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[24] FDOT Study, Part I, at 41. The FDOT characterized these resource areas as being geographically located in Southeast Florida, Southwest Florida, West-Central Florida, and the Panhandle.

[25] FDOT Study, Part I, at 41.

[26] FDOT Study, Part I, at 57.

[27] North Carolina Geological Survey web site, at: http://www.geology.enr.stat.nc.us/nae%20aggregates%20internet%20nrc%20with%20usgs%20sheet/aggregate%20overview%20new.htm.

Research predict that the population in the area will continue to grow, reaching more than 9.3 million people by 2030.[28] To keep up with this growth, it is expected that the area will need more than 90 million tons of aggregate per year by 2030. Because Tarmac wants to be a long-term major supplier of limestone aggregate to the west-central Florida market, this current and projected demand were considered when evaluating goals relating to production at King Road.

One operational limitation on the amount of aggregate Tarmac could produce per year is time, *i.e.*, the hours that an aggregate plant and quarry would operate once up and running. Tarmac's anticipated Levy County Special Exemption Permit for a Major Mining Project is expected to limit Tarmac's operating hours at the mine to 12 hours per day, 6 days per week, excluding production on major holidays. Because of this restriction, *i.e.*, that the work week is maxed out at 72 hours, Tarmac's theoretical maximum capacity could be 3.7 million tons per year. But, because of the intensive amount of maintenance required in an aggregate plant, a 60-hour per week production schedule is more realistic and likely. Thus, no matter what restrictions a particular county imposes, Tarmac anticipates it will operate its aggregate plant for 60 hours per week, thereby further limiting the maximum tonnage per year Tarmac could produce to approximately 3.1 million tons.

Recognizing that economic conditions fluctuate, that projections as to population growth and aggregate demand may change, and that Tarmac's operational capacity could fluctuate if equipment breaks or if for whatever reason Tarmac is unable to operate 60-hour work weeks every week of the year, Tarmac has set its target production rate at 3 million tons per year.

Because Tarmac's mining plan calls for production of a minimum of 3 million tons per year, producing this volume of aggregate over a long period of time will require a substantial footprint. Tarmac has identified a 2,700-acre footprint as appropriate to meet its long-term goals.[29]

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[28] *See* Appendix 1(April 7, 2010 Letter from Michael McElveen to Cindy Burns).

[29] The size of the footprint needed could change, however, depending on the yield per acre at a particular site. Yield per acre is discussed further below in Part IV.A.

C. Public Need for A Long-Term Supply of Construction Aggregate Within the West-Central Florida Market

The proposed King Road Limestone Mine would serve the public by providing a necessary construction material. Construction aggregate demand for the west-central Florida market area is projected to come from both regional and local population growth and transportation and infrastructure projects. Examples of projects being considered within Levy County include Progress Energy's Nuclear Plant, the Chiefland Hospital, and the Chiefland Community College.

One of the factors to be considered on the issue of practicability is the production cost of the aggregate.[30] Aggregate that is too expensive is not practicable because it is economically infeasible for Tarmac to sell, it raises the cost of construction projects for customers, reduces the amount and type of construction that can be afforded, and raises public budgets for infrastructure such as roads, bridges, and public buildings. Assuming higher aggregate costs, local and state governments will either be forced to use inferior materials to improve roadways, or not improve important roadways at all, both of which could lead to public safety concerns. If local and state governments "bite the bullet" and pay more for aggregate, this will take away money from other projects. It is not practicable for Tarmac to produce, or for the public to purchase, aggregate that is too expensive to excavate and/or process, and that has high transportation costs.

IV. FACTORS AFFECTING THE PRACTICABILITY OF ALTERNATIVES

The CWA's regulations concerning practicability explain that an alternative is practicable if it is "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes."[31] An alternative that does not fulfill the project's overall purpose is not an alternative to the proposed project, and can be eliminated before any factors of practicability are considered.[32] Even if an alternative is practicable, an alternative that has a greater adverse impact on the aquatic

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[30] 40 C.F.R. §§ 230.3(q), 230.10(a)(2).

[31] 40 C.F.R. § 230.10(a)(2); 40 C.F.R. § 230.3(q).

[32] 40 C.F.R. § 230.10(a)(2).

ecosystem than the proposed King Road Limestone Mine, or other significant adverse environmental consequences, cannot be chosen in place of the proposed project.[33] As explained by the Corps and EPA in their 1993 Memorandum to the Field, "[w]hen it is determined that there is no identifiable difference in adverse impact on the environment between the applicant's proposed alternative and all other practicable alternatives, then the applicant's alternative is considered as satisfying the requirements of Section 230.10(a)."[34]

A. Quality of Limestone Reserves

Because Tarmac seeks to produce construction-grade limestone aggregate, including aggregate that meets FDOT specifications, any alternative site must be able to produce aggregate that would meet FDOT specifications for it to be practicable. As discussed by Dr. Thomas Scott in his Report,[35] there are only three formations containing some amount of minable high-quality construction-grade aggregate in the market area: the Avon Park, the Suwannee, and the Ocala Formations. Of the three, only the Avon Park and the Suwannee are capable of producing large quantities of construction-grade aggregate. Most of the Ocala Limestone Formation, on the other hand, does not meet FDOT aggregate specifications. There is a hard recrystallized zone near the top of the Ocala Limestone that may have FDOT-quality aggregate. These areas are generally only a maximum of 15 to 20 feet thick and are of limited areal extent. As discussed below, the thinner the reserve, the lower the yield per acre of aggregate. In other words, because the areas of hard potentially high-quality Ocala Limestone are thin, one would have to mine a greater amount of acreage to obtain the same amount of limestone aggregate one could obtain from an area with thicker reserves. For example, if a mineable deposit were 100 feet thick, Tarmac would need to excavate 24.3 acres per year to be able to produce 3 million tons of aggregate per year. On the other hand, if the mineable deposit were only 20 feet thick, like most of the Ocala Limestone's hard zone, Tarmac would need to mine 121.5 acres per year, or five times more acreage than a 100 feet thick mine site. Mining a much greater

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[33] *See* 40 C.F.R. § 230.10(a).

[34] Memorandum to the Field, Appropriate Level of Analysis for Evaluating Compliance with the Section 404(b)(1) Guidelines Alternative Requirements, U.S. EPA & Corps (1993).

[35] *See* Appendix 3.

acreage not only increases the cost to the permittee, but also increases the amount and extent of environmental impacts.

Moreover, because hard zones of Ocala Limestone are limited in areal extent, these areas lack the amount of high-quality reserves needed to fulfill the project's overall purpose of supplying the entire west-central Florida market with a major long-term source of aggregate. Tarmac's own investigation of various sites within the market area also concluded that there are no potential long-term sources of high-quality construction-grade aggregates in the Ocala Formation. Another indicator that the Ocala Formation is insufficient to produce high-quality aggregate meeting FDOT specifications is the fact that the 2010 FDOT list for approved aggregate mines does not include a single mine found in the Ocala Formation.[36] Rather, the mines in the list are exclusively found in either the Avon Park or the Suwannee Formations.

Thus, because the Ocala Formation does not produce large quantities of construction-grade limestone aggregate that would meet FDOT's specifications, any potential site in the west-central Florida market containing only the Ocala Formation is an impracticable alternative.

Although Avon Park or Suwannee Formation has the potential to produce high-quality construction-grade limestone aggregate meeting FDOT specifications, core samples must still be taken to assess the physical properties of limestone at a particular site. FDOT-quality aggregate requires the most durable materials. FDOT performs a series of tests on aggregate to determine whether limestone meets FDOT's specifications for roadway use. The physical characteristics of limestone in Florida are variable with much of the limestone being too soft or containing excessive amounts of pyrite and chloride that weaken concrete. The King Road Limestone Mine site sits atop the Avon Park Formation, a dolomatic limestone. Tarmac's internal testing has indicated that this location of Avon Park Formation is capable of producing high-quality limestone aggregates. Thus, actual test data indicates that this site would fulfill the quality aspect of Tarmac's purpose.

Quality, however, is not only concerned with the type of

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[36] *See* Approved Aggregate Products from Mines or Terminals, FDOT State Materials Office (last updated August 11, 2010), *available at*http://www.dot.state.fl.us/statematerialsoffice/quality/programs/qualitycontrol/materialslistings/sources/aggregate/allproducts.pdf.

limestone that is under the ground at a particular site. The amount of "overburden," *i.e.,* unconsolidated loose sand and clay that sits on top of the aggregate that needs to be removed to reach the rock beneath,[37] can also have an impact on both the quality and quantity of the rock. Overburden has to be removed to prevent comingling of rock or sand resources and degradation of the quality of the limestone.[38] The less overburden, the less costly it is to remove.[39] After overburden is removed, it has to be handled, stored and ultimately disposed. All of these costs will increase depending on the thickness of the overburden. The cost of removing, handling, storing and disposing of overburden cannot be directly recouped and must be factored into any consideration of the cost of obtaining rock from a particular site. "[T]he economic viability of a mine is determined in part by the thickness of the overburden that must be removed to reach the mineable limestone."[40] Often, a company will make a business decision not to mine a particular site, because the thickness of the overburden will result in mining at the site being impracticable from a cost perspective. Indeed, in some places, limestone suitable for aggregate is too far below the surface to be removed by normal methods.[41]

One of the reasons Tarmac made the decision to move forward with permitting the King Road Limestone Mine site was the thinness of overburden that exists there. The average overburden thickness across the site is less than 2 feet. The FDOT *Strategic Aggregates Study* found that other areas in central and northern Florida have a much thicker level of overburden.[42] When evaluating an alternative site's practicability, the thickness of the overburden must be considered.

For an alternative site to be practicable, it must also have the ability to produce the amount of limestone needed to sustain a major, long-term, regional source of supply for Tarmac's and its customers' use in the west-central Florida

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[37] FDOT Study, Part I, at 8.

[38] FDOT Study, Part I, at 11.

[39] FDOT Study, Part I at 11.

[40] FDOT Study, Part I, at 8.

[41] FDOT Study, Part I, at 8.

[42] FDOT Study Part I, at 8.

market area. The amount of reserves is one element of limestone aggregate quantity. The yield per acre of a particular site can also impact how much limestone aggregate can be extracted. The term "yield per acre," or "recovery ratio," refers to the percentage of stone removed from the quarry that is actually produced and sold. Thus, a higher yield per acre means that more stone being extracted is being sold to the end-user. If a particular alternative site results in a lower yield per acre, not only will the site have less quantity of useable limestone aggregate, but also, extracting limestone there will result in more environmental damage, as more acres will have to be impacted to obtain the same amount of limestone as at a site with a higher yield per acre.

The thickness of the limestone can also have an impact on the amount of reserves per acre. Thicker deposits of limestone yield more limestone per acre of land than thinner or shallower limestone. Because the Avon Park Formation at the King Road Mine site is over 120 feet thick, Tarmac estimates it will yield up to 148,000 tons of limestone aggregate per acre. Moreover, the King Road Limestone Mine can produce 3 million tons net from 5.2 million gross tons per year, meaning that the yield per acre of the proposed project is approximately 57% by weight, an average recovery for active deposits in the region.[43] When evaluating an alternative's reserve capacity, these numbers must be taken into consideration.[44]

B. Availability of Property for Acquisition and Use

If an alternative is otherwise practicable, "an area not presently owned by the applicant which could reasonably be obtained, utilized, expanded or managed in order to fulfill the basic purpose of the proposed activity may be considered."[45] If

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[43] Comparatively, if this mine site were located in the hard zone of the Ocala Formation, where the depth is a maximum of 20 feet, the recovery would drop down to approximately 46%. In other words, Tarmac would need to mine 153.1 acres per year to produce 3 million tons net. At that point, Tarmac would have to reduce the scope of its sales significantly to continue operations.

[44] Impurities in the aggregate, like clay, can also reduce the yield. The Aggregate Handbook, National Stone Association, at 4-5 (1991). For example, Cemex/Rinker's Ft. Myers and Brooksville quarries only yield between 20,000 to 30,000 tons per acre. *See* Transcript from *Sierra Club v. Flowers*, Evidentiary Hearing in the Southern District of Florida (2006) (hereinafter referred to as *Sierra Club* Tr. at___) at 5761-62.

[45] 40 C.F.R. § 230.10(a)(2).

a particular site is owned by an individual, who is unwilling to sell the land or to allow Tarmac to lease the land, however, that site is impracticable from a property availability standpoint. Moreover, property that is already being mined by a competitor company, who is unwilling to sell or lease the property to Tarmac, because they wish to continue to mine there, is unavailable. Sites that are owned by the government and maintained for environmental or restoration purposes are also unavailable. Sites that are owned by multiple owners can also be rendered unavailable due to the logistics and cost associated with assembling so much land into one contiguous piece of property for mining. Single owners may hold out for more money or may be unwilling to sell, rendering other sites around the hold-out land unusable for mining purposes. Thus, the difficulty of assembling a tract of the necessary size can also render a site impracticable. Finally, mine sites that may have available limestone reserves surrounding the site oftentimes are rendered unavailable because developments exist on top of the reserves, precluding expansion of the particular mine site once the mine is exhausted.[46]

Land use restrictions[47] put in place to prevent or to slow-down the ability of an alternative site to provide limestone aggregate can also render an alternative site unavailable. If a particular site is not zoned for mining, or zoning in the area needs to be modified for a mine to be built or expanded in a particular location, additional barriers exist to mining that site. Permitting a facility is time consuming and can take five years or more.[48] As such, "[t]he regulatory process requires that the mining activity must meet the local land use designations (zoning category)."[49] As discussed below, most areas in west-central Florida which potentially have high quality limestone are unusable from a land use perspective.

Siting a mine near an urbanized area is not only a problem from a land use/regulatory outlook. A collection of other issues are likely to surface whenever a mining company seeks to site a mine anywhere near a population center, generally

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[46] FDOT Study, Part I, at 19.

[47] This term is used throughout the document in the general sense to include both land use restrictions imposed by future land use maps of a County's comprehensive plan and those imposed generally by County ordinances within specific zoning districts.

[48] FDOT Study, Part I, at 14.

[49] FDOT Study, Part I, at 14.

involving opposition to opening the facility.[50] It is preferable to site mines away from population centers.

One of the great advantages of the King Road Limestone Mine is that it is located far from heavily populated areas. The closest residential developments/towns to the King Road Mine site are Inglis, Florida and Yankeetown, Florida, both of which are approximately 2 to 3 miles from the southern edge of the King Road Limestone Mine. According to the U.S. Census Bureau, these two towns had a total population of 2,298 people in July 2009.[51] The next closest residential area, Otter Creek, is approximately 22 miles north of the site and had a population of 127 in July 2009.[52] These towns, and the residents that live there, are far enough away from the mine site so that daily activity at the site will not disturb them. Moreover, because of its distance from population centers, the site is free from many of the land use restrictions mentioned in the prior section.

C. Ability to Supply the Entire West-Central Florida Market From A Single Source

Part of Tarmac's purpose is to provide a long-term source of supply for the west-central Florida market region. Specifically, because of current and projected demand and operational capacity, Tarmac seeks to produce approximately 3 million tons of limestone aggregate per year. It is not practicable from a business perspective, or from a costs and logistics perspective to attempt to provide this amount of limestone aggregate from multiple sources. It is very difficult to obtain permits to open a quarry and there is a significant cost to installing infrastructure there. From a business perspective, it is not practicable to attempt to do this at multiple locations. Moreover, all of the logistical issues that arise whenever a company tries to mine a site will be amplified by an attempt to site multiple mines in multiple locations at the same time. Logistically, Tarmac will also potentially have

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[50] FDOT Report, Part I, at 33-34.

[51] U.S. Census Bureau, Annual Estimates of the Resident Population for Incorporated Places in Florida, *at:* http://www.census.gov/popest/cities/tables/SUB-EST2009-04-12.xls.

[52] U.S. Census Bureau, Annual Estimates of the Resident Population for Incorporated Places in Florida, *at:* http://www.census.gov/popest/cities/tables/SUB-EST2009-04-12.xls.

to overcome land use restrictions from varying local governments, depending on the location – and the amount – of the mine sites. From an environmental standpoint, environmental impacts would also be multiplied if there are multiple quarries in multiple locations.

D. Transportation Logistics

Essential to Tarmac's purpose is its ability to transport limestone aggregate efficiently from the mine site to the end user. Rail transportation plays a key role in the movement of aggregate materials in other parts of Florida. Figure 2 highlights the lack of existing rail in and around the west-central Florida market. Indeed, there is insufficient rail throughout the west-central Florida market to transport aggregate primarily via rail from an alternative mine site to the end-user. *See* Figure 2. There also is only one port within the market area (Port of Tampa), but it is on the very southern edge. This means that limestone will have to be transported within and to the market by truck. Due to cost and logistics, however, trucks normally can only be used to transport aggregate short distances. Transporting rock via truck more than 80 to 100 miles would also cause increased stress on highways, thereby, worsening already-major traffic and air congestion issues throughout the state.[53] Another consideration that must be factored into whether using trucks to transport aggregate long distances is practicable is the ability for trucks to avoid or limit transport through urban areas. The type of roadway infrastructure from a particular alternative mine site can be important in determining whether, or the extent to which, truckloads of limestone aggregate coming from that mine site will have to travel through urbanized areas to get to their ultimate jobsite. Another component of an efficient, practicable transportation infrastructure is proximity or access to major roadways. Reserves that are far away from major roadways or rail oftentimes create insurmountable costs and logistics.

E. Transportation Costs

The cost of transporting limestone aggregate from a particular alternative site to its end user could also render a particular site impracticable. Transportation costs vary depending on the mode of transportation being used to move

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[53] FDOT Study, Part I, at 38.

aggregate from the mine site to its end-use destination. Costs can also vary depending on the number of modes of transportation being used to move aggregate. "The cost of crushed stone materials at the construction jobsite is most influenced by the haul distance and the corresponding fuel costs."[54]

To transport limestone aggregate in the west-central Florida market, trucks necessarily will be used, as there is no other practicable alternative for transportation there. Trucks hauling aggregate generally hold about 25 tons of material.[55] Trucking costs are based on several factors, including total distance traveled, fuel costs, and whether the truck will have back hauls or will have to return empty.[56] The cost per ton hauled generally trends lineally upward the farther away the source is from the end user. Because aggregate is a low cost commodity, the weight-to-value ratio makes it impracticable from a cost perspective to truck limestone distances further than 80 to 100 miles, and sometimes even less, from its source.[57]

To the limited extent limestone aggregate could be transported into the market via rail – a cheaper transportation alternative to trucking – the cost of trucking the limestone aggregate from the rail station to its ultimate jobsite in the market must also be factored in, as aggregate rail does not exist throughout the market area. The cost of rail transport itself, however, can also impact the cost of the aggregate. For every additional 200-300 miles a rail car travels, the cost of the aggregate to the purchaser will typically double.[58] The cost of additional rail cars, locomotives, and rail lines to handle the increased limestone aggregate on the line also must be factored in to the analysis. This cost will vary depending on

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[54] FDOT Study, Part I, at 23.

[55] FDOT Study, Part I, at 23 ("The maximum weight of materials that can be legally carried by trucks is in the range of 18-24 tons depending upon the truck design and number of axles . . . . A tandem axle dump truck is limited to approximately 18 tons and can be increased to 22 tons with a third axle. Trucks configured as tractor trailer combinations can carry up to approximately 25 tons depending upon the number of axles and the empty weight of the truck.").

[56] FDOT Study, Part I, at 23.

[57] *See* FDOT Study, Part I, at 19.

[58] *Sierra Club* Tr. at 5945. This determination was based on 2006 fuel prices. Fuel prices vary on a daily basis, meaning tomorrow the cost of railing in aggregate an additional 200-300 miles could result in a tripling of the cost of the aggregate to the end user.

the location of the alternative site, with more distant sites costing more, because of the wear and tear on the equipment, and the need for additional rail cars and locomotives due to increased turnaround time caused by the greater distance.

The cost associated with transporting aggregate from the mine site to its end user varies greatly depending on numerous factors, including but not limited to fuel costs, total distance hauled, labor and capital costs, among other things. Specific examples of applying these cost factors to a specific site, however, are included in the discussions of the Port of Tampa and Taylor County.

F. Need to Avoid Multiple Handling of Limestone to Minimize Product Losses

If rock is handled multiple times during transport from the mine site to the processing plant, the aggregate will break off and start to degrade, creating dust, which is not suitable for most construction-grade aggregates, and certainly not suitable for FDOT-quality limestone aggregate.[59] Loading and reloading the rock between various modes of transportation also can result in this degradation, an increase in the "fines" or dust, and a decrease in the amount of coarser aggregate in the sample, *i.e.*, a multiple handling problem. For example, if a quarry location requires that aggregate first be loaded onto a truck and then driven to a railroad station where the aggregate is offloaded from the truck onto the railcar and then transported via railcar to another rail station where the aggregate is offloaded from the rail car and then loaded on a truck, which drives the material to its ultimate jobsite, by the time that rock gets to its job site, much of it may have degraded and broken off, rendering a portion of the rock useless. At a minimum, this degradation results in an increase in the cost of aggregate to the end user, as the cost of the lost and unusable product will be passed on indirectly to the customer.

Because this degradation impacts the gradation of the aggregate – a factor evaluated by FDOT when they evaluate aggregates – oftentimes multiple handling not only impacts the quality of the end product, but also results in rejection by FDOT. Because of problems and cost associated with the multiple handling of aggregate, such multiple handling should be limited

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[59] The Aggregate Handbook, National Stone Association, at § S15.5 (1991).

or avoided entirely, if at all possible.

G. Electric Power Infrastructure

Quarries must be located in areas with adequate and reliable electrical power infrastructure. Mines require large amounts of power to operate, and need that power to be reliably available at all times. Electrical demand from a quarry also can affect the reliability of electrical supply to other customers if power infrastructure is not robust. Any site for a mine therefore needs to be located near high quality electrical transmission lines to supply adequate power to the mine and avoid reliability problems for other users.[60]

As explained in **Appendix 2**, Seminole Electric Cooperative, Inc. evaluated the interconnection with electric facilities in the King Road area to determine whether the surrounding distribution system could support the amount of power needed to operate Tarmac's proposed mine at the King Road site. Seminole Electric determined that the surrounding distribution system is too weak to support the load characteristics or the amount of new mine load. Seminole Electric further eliminated bringing a lower voltage transmission facility into the King Road area, as this would create unacceptable service to other consumers in and around the area. Seminole Electric concluded that the only viable solution to providing power to a mine site in the area would be to interconnect the site with the Progress Energy Florida 230 kV transmission line from Crystal River to Bronson. According to estimates, connecting the Progress Energy transmission line to the King Road Mine site will cost Tarmac approximately $7.1 million. This cost is high, but manageable. Placing a mine site in a location further from the transmission line could cost a great deal more, and be logistically difficult, at best. Thus, the location of Tarmac's proposed mine site is limited by its need to be close to this transmission line, and whether a mine site is close to the transmission line or not is a factor to be considered in the practicability analysis.

V. EVALUATION OF POTENTIAL ALTERNATIVE MINING LOCATIONS

This section evaluates alternative mining locations in the west-central Florida market to determine whether mining at a potential alternative site would fulfill the overall project

[60] For example, Tarmac's Pennsuco quarry is directly served by a Florida Power and Light (FP&L) 230 kv transmission line.

purpose, be practicable based on the above discussed criteria, and result in less impacts to the aquatic ecosystem than mining the King Road Mine site. The evaluation of potential alternative sites is based on four sets of data: (1) a report prepared by Dr. Thomas Scott[61] that analyzed geological rock formations in west-central Florida to determine whether those formations are suitable to produce large quantities of high-quality construction-grade limestone aggregate, attached to this Report as **Appendix 3**; (2) Tarmac's own investigation of other potential sites from 2005 to 2010;[62] (3) County Land Use maps in the market area overlain with Avon Park or Suwannee Formation outcroppings;[63] and (4) an environmental evaluation prepared by Entrix that evaluates the areas where minable construction-grade limestone aggregate is located within suitable land use categories (**Appendix 4**).

These conclusions indicate that the King Road Mine is the least environmentally damaging practicable alternative that meets the project's overall purpose.

A. Potential Sites Inside the Market Area of West-Central Florida

As discussed, the only limestone formations in the west-central Florida market that potentially can produce a sufficient quantity of high-quality aggregate are the Avon Park and Suwannee Formations. The Ocala Formation is not sufficiently hard to produce the large quantities of high quality limestone needed by Tarmac. Counties in west-central Florida underlain with only Ocala Limestone are: Marion and Sumter Counties, Gilchrist and Dixie Counties, and Alachua County. Although those Counties were eliminated from the onset, in the interest of thoroughness, this Report discusses reasons why locations within each of those Counties are impracticable. Accordingly, the analysis begins by evaluating areas within the west-central

[61] Dr. Scott is a retired Assistant State Geologist for Geological Investigations who has over three decades of experience investigating geological formations in Florida.

[62] Tarmac undertook this investigation in addition to the separate evaluation discussed earlier in this Report that Tarmac conducted in 2005 before making the decision to go forward with permitting the site.

[63] Our analysis of these maps shows that counties that have construction-grade aggregate deposits and existing mines are becoming increasingly selective about where they allow an expansion of mining in their county. It is not uncommon for a county to limit allowable land use categories only to areas occupied by existing mines.

Florida market that have outcroppings of Avon Park and Suwannee Formation. *See* **Figure 3.**

i. Sites Inside Levy County

In analyzing potential alternative sites to mining the King Road Mine site inside Levy County, this Report reviews three areas outside of the King Road Mine site that are in the Avon Park Formation. **Figure 4** below shows the ownership scheme of the various parcels of Avon Park Limestone Outcrop. *See also* **Figure 5** (Levy County Suitable Land Use Map). This section reviews two potential alternative locations within that outcrop inside Levy County, which it identifies as Area A and Area B. The King Road Mine Site is located in Area C. This section also reviews why the King Road Mine configuration is the least environmentally damaging practicable alternative for mining within Area C. Figure 4 also identifies Area D as a parcel where the Avon Park Limestone outcrops, but as Area D is located in Citrus County, it will be discussed further below in the section addressing that County.

The only available and economically accessible Avon Park or Suwannee Formation limestone inside Levy County that has not been exploited besides the King Road Limestone Mine is found underneath areas owned by Plum Creek, the same company that owns the land that the proposed King Road Limestone Mine will be sited on. Plum Creek was, and is, unwilling to lease any portion of its property to Tarmac to mine besides the King Road Mine site.[64] Plum Creek is primarily in the timber business, and uses its property for silvicultural operations. Limestone quarrying operations take land out of silvicultural, affecting Plum Creek's business. Thus, from a property availability perspective, Areas A and B, and portions of Area C are impracticable. Even if the property were available, however, Areas A and B, and portions of Area C outside of the King Road Mine site, are not practicable alternatives with fewer environmental impacts than mining the King Road Mine site.

Even if available, Area A is impracticable from a cost and logistics perspective. Area A is located approximately twenty-seven (27) truck miles north of the King Road Mine site. Except for State Road 24, a two lane road that passes the northwestern edge of Area A, *see* Figure 4, there are no other paved roads anywhere in Area A. There are also no dirt roads maintained by the County in this area. As discussed above in part IV.G, any

[64] December 30, 2009 Letter from Plum Creek Timberlands, LP to the U.S. Army Corps of Engineers, Re: Alternatives Analysis.

alternative site selected would need to be located in an area with a reliable and adequate electrical power infrastructure. When compared to other alternative sites in the area, the King Road Mine site is situated to provide such infrastructure, because it is immediately adjacent to the high power lines necessary for the mine facilities. In fact, Seminole Electric evaluated the interconnection with electric facilities in the area, and determined that the only viable solution to providing adequate power to a mine site in the area was to interconnect the site with the Progress Energy 230 kV transmission line, which lies at the eastern boundary of the King Road Mine site. Other configurations for getting power to the King Road site besides connecting to Progress Energy's line were considered and discarded by Seminole Electric because of concerns that those options would reduce service to other users in the area.

In order to provide any mine site located in Area A with sufficient electrical power needed to operate the mine, Tarmac would need to run a straight power line 12 miles from the Progress Energy 230 kV transmission line to Area A, and site a substation on Area A.[65] The power line would be longer if Tarmac could not acquire property rights for a direct route. This would result in a cost of approximately $14.9 million to Tarmac – approximately ***$7.8 million more*** than it would cost to supply power to the King Road Mine site.[66] Logistically, running power to the site is also impracticable, because in order for Tarmac to run the power line from the Progress Energy 230 kV transmission line to Area A, it would need to obtain rights of way, obtain permission from multiple land owners to place the line on their properties, and obtain permission from the government to cross over U.S. 19. The logistical difficulties and exorbitant cost associated with providing power to Area A render this site an impracticable alternative to mining the King Road site.

Also, because of its location in the market, Area A is less able to serve the same amount of customers as can be served from the King Road site.

Moreover, a major new limestone mine would be unlikely to be permitted in Levy County at Area A, because Tarmac would face even greater opposition from residents and resistance to

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[65] *See* August 2, 2010 Letter from Greg Gladin, McLean Engineering Company, Inc. to Cindy Burns, Tarmac America, LLC, *Re: Central Florida Electric Cooperative, Inc., King Road Substation*, **Appendix 5.**

[66] *See* Appendix 5.

permitting at the County level than it is already facing in its attempt to permit the King Road Mine site. As explained above, Tarmac would transport rock from a site in Area A to end users in part via S.R. 24. S.R. 24 is the only road that provides access to Cedar Key for residents and visitors. Cedar Key is a residential fishing community and a tourist destination. The increased traffic on this road will result in road congestion, and greater annoyance for residents and tourists alike. Thus, because of Area A's proximity to Cedar Key, the County, which must grant a special use permit for Tarmac to mine any area in Levy County, is less likely to approve a permit there. Permitting challenges can render a site impracticable.[67] From an environmental perspective, Area A has the highest density of wetlands of Areas A, B, or C. *See* **Figure 6**. Moreover, Area A has a higher proportion of wetland hardwoods when compared to the King Road mine Site, which has lower quality, planted pine habitat. *See* Appendix 4. Finally, Area A includes intermittent stream channels that intrude and connect to mapped streams. *See id*. Siting a mine in Area A would result in impacts to these intermittent streams. Thus, from a property availability, cost, and logistics standpoint, Area A is not a practicable alternative with fewer environmental impacts than mining the King Road Mine site.

Area B is also an impracticable alternative with fewer environmental impacts than mining the King Road Mine site. Issues relating to aggregate quality and quantity perspective exist in Area B. This area is the site of the Gulf Hammock mine, which recently closed because of lack of high-quality mineable reserves, and the existence of high levels of reactive pyrites on the site, which, when found in large quantities, can contaminate concrete and lower its quality. Although Area B is closer to U.S. 19 than Area A, its proximity to this roadway is actually an impediment, because the northern half of Area B is split by U.S. 19, and operationally, mining on both sides of this major arterial road would be difficult. Moreover, the southern half of Area B is either owned by multiple property owners, making it impracticable to parcel enough land there to site a mine, or is under a conservation easement, and thus unavailable for Tarmac to mine.

As shown below in **Figure 7**, the majority of Area B is also located within half a mile from a mapped stream. In fact Area B has the most streams (including the Waccasassa River and its tributaries) of any of the locations in the Avon Park Formation.

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[67] *See* FDOT *Strategic Aggregates Study: Sources, Constraints & Economic Value of Limestone and Sand in Florida,* at ii.

If Tarmac located a mine of comparable size to the King Road Mine site in Area B, avoidance of impacts to these mapped streams would be impracticable. In addition to mapped streams, Area B also contains many unmapped streams throughout it. *See* Appendix 4. The area north of U.S. 19 also contains high-quality riparian wetlands associated with the large amount of streams there. As explained in Entrix's Environmental Evaluation, the extremely high density of mapped and unmapped streams means that it would be very difficult to obtain FDEP a permit to mine any significant portion of Area B. *See* Appendix 4. Listed species known to occur in Area B include the eastern indigo snake, the one-toed amphiuma, and the Suwannee Cooter. *See id*. Thus, siting and operating a mine in any part of Area B would cause the same or greater impacts to the aquatic ecosystem as the King Road Mine.

Other alternative sites within Levy County that this Report considered were various iterations of the Area C mine site beyond the selected King Road Mine site configuration. In determining the mine configuration, Tarmac evaluated the environmental features and practicability factors of Area C to determine the least environmentally damaging practicable alternative configuration for mining within that area. Portions of Area C are unavailable for mining. *See* Figure 4. Land east of U.S. 19 is either Goethe State Forest or multiple small parcels on which mining is impracticable. Land west of U.S. 19 within Area C is mostly owned by Plum Creek, but is divided by two major perennial streams, Spring Run and Tenmile Creek. *See* Figure 7. Property north of Tenmile Creek that Plum Creek owns is mostly under a conservation easement and not available for mining. Thus, the land available to mine in Area C is limited.

Plum Creek provided Tarmac with timber stand management data for those portions of Avon Park Limestone Formation outcrop Area C that they own. The timber stand metadata was merged into two categories: lands judged "plantable" in pine trees and lands deemed "unplantable" by Plum Creek. *See* **Figure 8**. Unplantable lands are those considered too wet for pine plantations and include mapped wetlands that are assumed to represent the most important aquatic resources in the study area. Using these base maps along with aerial imagery, Tarmac conducted field investigations in Area C to evaluate the extent and quality of wetlands, intermittent or permanent streams, direction and relative magnitude of flow, and the potential for listed species.

Investigations of the land between Spring Run and Tenmile

Creek under Plum Creek ownership indicated a different pattern of drainage and wetland complexes in this region. Both of these streams are perennial with a larger proportion of the wetlands between the streams being connected and contributing directly to base flow. These comparative site evaluations indicated that limestone mining in the Spring Run and Tenmile Creek basins at the scale necessary to meet the overall project purpose would have significantly greater adverse impacts to the aquatic resources than mining the King Road Mine site.

As explained in Section II above, the boundaries of the King Road Mine site within Area C were established to achieve the overall project purpose while simultaneously avoiding impacts to neighboring properties and the aquatic ecosystem. *See* **Figure 9** (Current Mine Plan). The current mine plan is a reduction in size from Tarmac's original mine plan. Tarmac reduced the size of its mine site in order to minimize impacts to the aquatic ecosystem and to ensure that no net loss of functional wetlands will occur from the King Road Mine. The southern border of the mine site was selected to avoid private hunt camps (Figure 1). There is also an intermittent stream that runs along most of the southern border, which provides a natural protected barrier from mine activities. The eastern boundary of the King Road Mine site was set by the existing Progress Energy Florida 230 kV transmission line. The northern boundary of the mine site was set by Pumpkin Road to provide an adequate environmental barrier for Spring Run to the north. The westerly limits of the King Road Mine site were established to ensure that the project could maintain a long-term source of supply for the west-central Florida market, to preserve aquatic resources within the mine boundary, and to limit the potential effects of tropical storm surges on the mine and the aquifer. *See* **Figure 10**.

Thus, mining in Area C outside of the King Road Mine site is not a practicable alternative to mining the King Road Mine.

ii. Citrus County

The Avon Park and Suwannee Formation Outcroppings map (Figure 3) shows that the majority of Citrus County does not have limestone that would meet FDOT-specifications. Furthermore, the land available for mining in Citrus County is limited by the County's Comprehensive Plan which allows mining only in the Extractive land use category. As shown on the Suitable Land Use map of Citrus County below (**Figure 11**), except for small areas that contain existing mines, the Extractive land use category is concentrated in the northwest corner of the

County. **Figure 12**(Citrus County Property Owner Map) also shows that over ninety percent (90%) of this land is owned and operated by other mining companies: Citrus Mining and Timber, HCR Limestone, and Crystal River Quarries.[68]

Crystal River Quarries and HCR Limestone own a small area that is both underlain with Avon Park Formation and within the Extractive land use category. But, none of the mines located in Citrus County produce construction-grade limestone aggregate meeting FDOT-specifications. Crystal River Quarries, for example, is approved to produce limestone base, which is not equivalent or comparable with high-quality limestone aggregate. Moreover, Cemex has a mine in northern Citrus County in Inglis, but this mine does not produce construction-grade limestone aggregate meeting FDOT specifications.[69]

As discussed above in the Levy County section, this Report also considered an area of Avon Park Formation called Area D. This area is the most populated of any of the areas of Avon Park Formation considered by Tarmac. Moreover, it contains many thousands of parcels in separate ownership (*see* Figure 4), and is thus unavailable for mining.

Although there is a small area of Suwannee Formation outcropping within the Extractive land use category in the south eastern portion of the County, this area is much too small for Tarmac to develop a long-term source of supply. Moreover, this area is in close proximity to Withlacoochee State Forest and thus faces the same or greater environmental impacts than mining the King Road site. Thus, there is no land available to Tarmac in Citrus County in either the Avon Park or Suwannee Formations which would meet Tarmac's purpose. Because none of the land in Citrus County could potentially meet Tarmac's purpose of providing a major long-term source of supply of construction-grade aggregate meeting FDOT specifications to the west-central Florida market, Tarmac did not evaluate any possible specific locations in Citrus County beyond Area D.

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[68] *See* Approved Aggregate Products from Mines or Terminals, FDOT State Materials Office (last updated August 11, 2010), *available at*: http://www.dot.state.fl.us/statematerialsoffice/quality/programs/qualitycontrol/materialslistings/sources/aggregate/allproducts.pdf.

[69] None of the mines located in Citrus County produce construction-grade limestone aggregate meeting FDOT-specifications. Approved Aggregate Products from Mines or Terminals, FDOT State Materials Office (last updated August 11, 2010), *available at*: http://www.dot.state.fl.us/statematerialsoffice/quality/programs/qualitycontrol/materialslistings/sources/aggregate/allproducts.pdf.

iii. Hernando County

There is no site in Hernando County that is a practicable alternative for Tarmac. Suwannee Limestone underlies much of Hernando County, and is at or near the surface in north-central Hernando County, and along the coast as shown on the Avon Park and Suwannee Formation Outcroppings map (Figure 3). The Hernando County Comprehensive Plan allows for mining only in the Mining Category on the Future Land Use Map. (*See* **Figure 13** – Hernando County Suitable Land Use Map) Neither the Suwannee Limestone found along the coast nor about half of the Limestone found underneath north-central Hernando County is within the Mining Category on Hernando County's Future Land Use Map. Thus, the only available land for mining that potentially has high quality limestone reserves underneath it is in the north central area of the County near Brooksville.

But, most of that area is already owned by other mining companies. As shown on the Hernando County Property Owner map (**Figure 14**), the majority of the property available for mining in Hernando County is unavailable as it is owned by two of Tarmac's major competitors: Florida Crushed Stone and Florida Mining and Materials (both currently owned and operated by Cemex), and Brooksville Quarry, LLC (currently owned and operated by Vulcan Materials Company). In summary, there is not a sufficient amount of property available in Hernando County's Mining Land Use category that would allow Tarmac to obtain a long-term source of construction-grade aggregate.

Even if land were available there, reserves of high quality limestone there are dwindling.[70] In 2005, Florida Rock stated that its Brooksville quarry would only have reserves there until 2010 or 2015 based on then-existing conditions.[71] Recently, this and other companies have reported that reserves in Hernando County will be depleted within the next couple of years. There is also a thicker overburden in Brooksville than in the proposed King Road Limestone Mine. Moreover, the yield per acre at these mines is lower than the yield per acre at the King Road Limestone Mine. As such, more contiguous land will be needed to produce the same amount of limestone aggregate as produced at King Road. The impact of these issues on practicability is

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[70] *Sierra Club* Tr. 4974, 5793.

[71] Will Van Sant: *Mining, rock industries carve sizeable roles: The state's continued construction growth allows for a proposed cement plan expansion and a favorable outcome*, ST. PETERSBURG TIMES (Feb. 13, 2005).

discussed above. For all of the foregoing reasons, mining in Hernando County is not a less environmentally damaging practicable alternative to mining the King Road Limestone Mine site.

iv. Pasco County, Northern Hillsborough County and Northwest Polk County

The Suwannee Formation outcrops along the coast and around the southwest corner of Pasco County, the northeastern portion of Hillsborough County and in the northwestern portion of Polk County. Pasco County's Comprehensive Plan allows mining only in its Agricultural, Agricultural-Rural and Industrial-Heavy Land Use categories, which are highlighted in **Figure 15**, Suitable Land Use of Pasco County, Florida. This eliminates all of the deposit located along the coast, and all but two small portions of the deposit in the southwest corner of Pasco County, as mining is not allowed in those areas.

Both of these formations, however, are not practicable alternatives to mining the King Road Mine Site. As seen in **Figure 16** (Suitable Land Use for SE Pasco, NE Hillsborough & NW Polk Counties), the portion of land in the Suwannee Formation and in an acceptable land use category in Southwest Pasco County that is north of U.S. 98 is also Southwest Florida Water Management District ("SWFWMD") conservation land, and thus is unavailable for mining. In addition, most of this land is immediately adjacent to the Green Swamp, an area recognized by the state of Florida for its ecological and hydrological importance. The outcropping in the very southeastern portion of the County has SWFWMD conservation land directly to its north and south.

Moreover, as seen in **Figure 17** (Pasco County Ownership Map), the land in Pasco County within the acceptable land use category that is on the very southeast corner of the County is divided into many parcels with many different owners. Even assuming the land could produce a sufficient amount of aggregate to fulfill Tarmac's overall purpose, it would be logistically impracticable to purchase the land from all the individual owners in Pasco County. None of the areas where Suwannee Limestone outcrops in an acceptable land use category in Pasco County are practicable alternatives with fewer environmental impacts than mining the King Road Mine site.

As shown in **Figure 18**, Hillsborough County allows mining in its Agricultural land use categories of its Comprehensive Plan, including in the sub-categories found within the agricultural

designation of Agricultural-Mining, Agricultural-Rural, and Agricultural. Portions of the Suwannee Formation outcropping in northeastern Hillsborough County are found in the Agricultural land use category. Much of the Suwannee Formation in northeastern Hillsborough County's acceptable land use category is directly adjacent to a state park.

Most of the Suwannee Formation that is within an acceptable land use designation is also owned by multiple owners, and piecing together a parcel of an acceptable size from those owners renders mining there impracticable from a property availability standpoint. *See* Figure 18. There are two large areas of land in Hillsborough County that are within the Suwannee Formation, within an acceptable land use category, *and* owned by single owners: (1) the area east of S.R. 301 that is labeled "1" on Figure 18 and that is owned by Hickory Hills Land Company; and (2) the area east of Paul Buchman Road (S.R. 39) that is labeled "51" on Figure 18 and that is owned by CF Industries, Inc. These two areas initially appear to have enough land for Tarmac to site a mine in either spot. Neither area, however, is a practicable alternative to mining the King Road Limestone Mine.

Hickory Hills Land Company has named the parcel of land it owns in Hillsborough County Two Rivers Ranch. Two Rivers Ranch's land is principally managed for cattle, timber, wildlife, and water resources with a long-term commitment to sustainable development. Thus, Tarmac does not believe that the land is available for Tarmac to mine. Another consideration for mining this area is the huge population center right down the road from Two Rivers Ranch. Just 20 miles from the Ranch lays the City of Tampa, and an estimated 3 million people live within a 50-mile radius of the ranch.[72] The planned development on the property would also greatly increase the proximity to a population center for any mine sited there. The increase in population center will likely result in Hillsborough County placing additional land use restrictions for mining in the area. Therefore, from a property availability and land use perspective, the site is not a practicable alternative for Tarmac to mine.

Even if available, mining this area would result in the same or greater environmental impacts to the aquatic ecosystem

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[72] *See* News Release, *Two Rivers Ranch, Inc.*, Florida Dept. of Agriculture Website, at http://www.florida-agriculture.com/news/tworiversranch.htm.

as mining the King Road Mine site. Two Rivers Ranch was named for the convergence of the Hillsborough River and Blackwater Creek on the property.[73] Mining on the property would result in impacts to these two water bodies, their tributaries, and other intermittent flow-ways throughout the property. *See* **Figure 19** (SWFWMD & Suitable Land Use Two Rivers Ranch). Most of Two Rivers Ranch is also one half mile or less from a stream. *See* **Figure 20** (Streams of Two Rivers Ranch). Two Rivers Ranch also is home to a diverse population of endangered and threatened species, including fox squirrels and gopher tortoises.[74] Moreover, a large part of the flow of the Hillsborough River, which is the primary source of drinking water for the City of Tampa, comes from sources on the Ranch, including Crystal Springs, which yields about 40 million gallons of water a day.[75] Finally, Southwest Florida Water Management District conservation lands are adjacent to the property and could be impacted by any mining there. Thus, the portion of Suwannee Formation that outcrops in an acceptable land use category in Hillsborough County is not a practicable alternative with fewer environmental impacts than the King Road Mine site.

CF Industries owns a phosphate fertilizer manufacturing plant in Hillsborough County in Plant City off of Paul Buchman Highway (S.R. 39). As shown on Figure 18, a portion of this land is underlain with Suwannee Formation. According to CF Industries website, the facility in Plant City is "one of the largest integrated ammonium phosphate fertilizer complexes in the U.S." and "is ideally sized to the company's mining and beneficiation operations."[76] Thus, CF Industries' business plan for this facility appears to be tied to the exact size of its

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[73] *See* News Release, *Two Rivers Ranch, Inc.*, Florida Dept. of Agriculture Website, at http://www.florida-agriculture.com/news/tworiversranch.htm.

[74] *See* News Release, *Two Rivers Ranch, Inc.*, Florida Dept. of Agriculture Website, at http://www.florida-agriculture.com/news/tworiversranch.htm.

[75] *See* News Release, *Two Rivers Ranch, Inc.*, Florida Dept. of Agriculture Website, at http://www.florida-agriculture.com/news/tworiversranch.htm. *See also* Mary Kelley Hoppe, "Where Two Rivers Converge: Robert Thomas," Bay Soundings, Tampa Bay's Science & Nature News Journal, *at*: http://baysoundings.com/spring09/Stories/profile.asp.

[76] *See Plants: Phosphate Fertilizer Manufacturing Plant*, CF Industries Holdings, Inc. Website *at*: http://www.cfindustries.com/plants_plant-city-phosphate-complex.html.

operations, meaning that land here is unlikely to be available for mining. To the extent there is additional land around CF Industries' gypsum plant that could potentially be available to Tarmac, a great deal of that land is unavailable as it is under a conservation easement. More specifically, in accordance with a 1996 DRI Development Order, Hillsborough County agreed to allow CF Industries, Inc. to conduct restoration activities on 650+/- acres of land there, and to allow a conservation easement to be placed on the land, called Cone Ranch.[77] Thus, because most of the land either has CF Industries' operations on it or is under a conservation easement, there is not sufficient land available on parcel "51" for Tarmac to site and operate a limestone mine that could supply a major long-term source of aggregate for the west-central Florida market. Finally, even if enough land were available from CF Industries, mining this parcel would cause the same or greater environmental impacts than mining the King Road Mine site. CF Industries, Inc.'s land is surrounded by SWFWMD conservation lands, *see* Figure 18, and has a conservation easement on a portion of it. Thus, mining CF Industries' land in Hillsborough County is not a practicable alternative with fewer environmental impacts than mining the King Road Limestone Mine site.

The Suwannee Formation outcrops in only the northwest corner of Polk County near the Pasco/Hillsborough County lines. This is the only area in Polk County with any potential to produce high-quality limestone aggregate. Polk County allows mining throughout the County in all land use categories, subject to County approval. As seen in **Figure 21**, Property Owners and Suitable Land Use in Polk County, Florida, the area where the Suwannee Formation outcrops is divided into many parcels with many different owners. In addition, portions of the land along US 98 are densely populated, making it impracticable for Tarmac to acquire enough land and obtain County approval to site a limestone mine in this area. More importantly, however, the great majority of Polk County underlain with Suwannee Formation – including the areas with the largest pieces of property owned by single owners – is SWFWMD conservation lands. *See* Figure 21. This land is thus not available for Tarmac to mine.

Moreover, the only existing mine in Pasco, northern Hillsborough or northwestern Polk Counties that has been

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[77] Board of County Commissioner, Hillsborough County, Agenda Item Cover Sheet, Approving Agreement and Resolution between CF Industries, Inc. and Hillsborough County (Nov. 6, 1996), *available at*: http://www.hillsboroughcounty.org/coneranch/resources/publications/info/11696 boarditemconsesmt.pdf.

approved by FDOT is Central State Aggregates, LLC in Pasco County, and this mine produces only limestone base, and not FDOT-quality limestone aggregate.[78] This suggests that there is a not sufficient quantity of FDOT-quality limestone aggregate in Pasco, northern Hillsborough or northwestern Polk Counties.

The lack of good alternative sites in this region is confirmed by Tarmac's own investigation. Tarmac inspected one potential alternative location in Pasco County: an existing mine site located within the Suwannee formation in Zephyrhills. Tarmac visited and toured the site in 2006. This existing mine produces almost entirely base rock, with only very small amounts of coarse aggregate. Although the site initially was identified as having approximately 765 acres, Tarmac concluded that only 170-200 acres of the site were available to mine. The site is simply too small to fulfill the overall project purpose. Moreover, Tarmac's analysis concluded that the yield per acre at the site is significantly lower than the yield per acre of limestone aggregate from the King Road Mine. Thus, the Zephyrhills site is not a practicable alternative to mining the King Road Mine.

v. Lake County

Part of Lake County is within the west-central Florida market area (70-mile radius around the King Road site). As seen on Figure 3 (Avon Park and Suwannee Formation Outcroppings Map), however, neither the Avon Park nor the Suwannee Formation outcrop in Lake County. Lake County is home to several regional sand mines used for aggregates in the manufacture of block, pipe, pre-stressed concrete, and bituminous concrete pavement.[79] There is currently no limestone mines in Lake County because there is a lack of geological formations with limestone material underlying the County. Neither sand nor Ocala Limestone produces material that consistently meets FDOT specifications for construction-grade aggregate, rendering the sites in Lake County impracticable from an aggregate quality perspective.

In evaluating potential alternative sites in Lake County, Tarmac investigated two possible locations: (1) a site near Mascotte, Florida ("Lake County Site #1"), and (2) a site

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[78] *See* Approved Aggregate Products from Mines or Terminals, FDOT State Materials Office (last updated August 11, 2010), *available at*: http://www.dot.state.fl.us/statematerialsoffice/quality/programs/qualitycontrol/materialslistings/sources/aggregate/allproducts.pdf.

[79] FDOT Study, Part I, at 47.

neighboring Lake County Site #1 ("Lake County Site #2"). Both of these sites were impracticable alternatives to mining the King Road Mine site because, among other reasons, analysis of stone from this area shows very high levels of chert that exceed FDOT specifications, making stone from these sites unusable for the high quality aggregates Tarmac seeks to produce. Confirming these quality concerns was the fact that the Mazak site supported a mine that was producing road base rock, and not high quality limestone aggregate.

Thus, from an aggregate quality and property availability perspective, there is no site in Lake County that is a practicable alternative with fewer environmental impacts than mining the King Road site.

vi. Southern Taylor County

The Suwannee Formation outcrops in Southern Taylor County, west of Perry, and along the southwestern boarder of Southern Taylor County. Taylor County's Future Land Use Map of its Comprehensive Plan allows mining only in its Agricultural land use categories. *See* **Figure 22** (Property Owners and Suitable Land Use, Taylor County). The great majority of Suwannee Formation in Southern Taylor County along the coast is not in an acceptable land use category for mining.[80] The small portion of Suwannee Formation along the coast that is in an acceptable land use category is not large enough to fulfill Tarmac's overall project purpose. There is an outcropping of Suwannee Formation within an allowable land use for mining east of the coast. *See* Figure 22. This outcropping is divided up into multiple parcels with numerous owners. It would be impracticable to obtain a large enough parcel from these various land owners in order to site a mine that fulfills Tarmac's project purpose there. There is, however, one piece of land that could be large enough for Tarmac to site a mine within that particular outcropping. This part of the outcropping, however, has a high density of wetlands. *See* **Figure 23** (NWI Wetlands, Taylor County). Mining that parcel would result in the same or greater environmental impacts as mining the King Road Limestone Mine site.

Even if a large enough piece of land were available in the Suwannee Formation in Taylor County in an appropriate land use category, Southern Taylor County's distance from the center of the west-central Florida market renders this area impracticable from a cost and logistics standpoint. Southern Taylor County is on the very extreme edge of the west-central Florida market, and

[80] *See* Figure 22.

is approximately 100 miles from the proposed King Road Limestone Mine site via truck, with portions of the County, including areas in and around Salem and Carbur, located approximately 80-85 miles from the proposed King Road Limestone Mine site. Perry is approximately ninety-five (95) miles from the King Road Mine site. A large part of Taylor County, including where the E.R. Jahna pit is located approximately 101 truck miles from the King Road site, and is outside of the west-central Florida market.

Because Southern Taylor is on the edge of the market, however, and no rail exists in this area,[81] the logistics and cost associated with transporting limestone aggregate from this area to the entire west-central Florida market render this site impracticable. Trucks would have to be used to transport limestone aggregate from Southern Taylor County to the market, greatly increasing the price of the limestone aggregate to the end user, and rendering this site impracticable. For instance, assuming a mine was sited in Carbur, Florida, which is approximately 83 miles from the King Road Mine site via truck and 88 miles via truck from Progress Energy's site for its new nuclear plant, it would cost approximately $22.60 per ton just to transport limestone aggregate from that mine site to Progress Energy's Nuclear plant.[82] Depending on the cost of providing the aggregate itself, the shipping costs could double the cost of providing the aggregate to Progress Energy. An aggregate mine in Taylor County could not even begin to serve portions of the west-central Florida market that are farther than 80-100 truck miles from a site in Southern Taylor County. A great deal of

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[81] FDOT Study, Part I, at 26. *See also* Figure 2 (showing the rail in the west-central Florida market and the complete lack of rail in Southern Taylor County).

[82] This number was derived by using the figures from the Tampa Port Authority Master Plan (July 17, 2008) at 103. That Plan estimates it costs approximately $2.00 per mile in operating costs for fuel and maintenance to truck aggregate, along with $200 per 8-hour day for labor and capital costs for the truck and driver, and assumes an average loading/unloading time of 40 minutes along with the fact that the truck is unloaded at the receiving station and returns empty, and that each truck carries 20 tons/load. *Id.* The Master Plan further provides that it takes approximately 30 minutes for a 20-mile one-way trip. *Id.* The only figure conservatively left out of the calculations here is the $10 per load fixed cost for paperwork and administration, because this could arguably only apply to loads coming out of the Port. Using these numbers, $22.60 per ton just in truck transportation costs is conservative, as the Progress Energy site is approximately 88 miles from Carbur (176 miles roundtrip), resulting in $352 per truck load in operating costs for fuel and maintenance, and it would take about 264 minutes for the roundtrip travel (without the 40 minute average loading/unloading time) or a little over 4 hours, resulting in approximately $100 in day labor and capital costs for the driver and truck.

the west-central Florida market is more than 80-100 miles from Taylor County.

Finally, the environmental impacts on the aquatic ecosystem will be the same or greater for a mine sited in the Southern Taylor County. As shown in Figure 23, the great majority of the Suwannee outcropping on the western coast of Southern Taylor County within the market area includes extremely dense wetlands. Moreover, a great deal of the other Suwannee outcropping formation found in the southeastern part of Taylor County also includes extremely dense wetlands. Siting a mine in Southern Taylor County is thus not a less environmentally damaging practicable alternative than mining the King Road Mine site.

vii. Counties Inside the West-Central Florida Market Not Underlain With Avon Park or Suwannee Formations

As discussed above, several counties inside the west-central Florida market are impracticable because they are only underlain with Ocala Formation. To be thorough, this section of the Report reviews counties inside the west-central Florida area underlain only with accessible Ocala Limestone to determine whether any alternative sites there are practicable. This review confirms that mining each of these sites is not a practicable alternative location with less environmental impacts than mining the King Road Mine site.

1. Marion/Sumter Counties

Marion and Sumter Counties lie directly east and southeast of Levy County, respectively. As explained above and further discussed by Dr. Scott in his report, neither the Suwannee nor the Avon Park Formations outcrop in Marion or Sumter Counties. The majority of accessible rock found in Marion and Sumter Counties is from the Ocala Formation, which is suitable for some production of commercial-grade aggregate but is too soft to make FDOT-quality materials. Most mines in Marion and Sumter Counties simply do not produce FDOT-quality construction-grade limestone aggregate. Rather, most of the mines produce limestone base only, or a combination of limestone base with other products, such as rip rap.[83] For this reason alone, sites

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[83] Approved Aggregate Products from Mines or Terminals, FDOT State Materials Office (last updated August 11, 2010), *available at*: http://www.dot.state.fl.us/statematerialsoffice/quality/programs/qualitycontrol/materialslistings/sources/aggregate/allproducts.pdf.

in Marion and Sumter Counties would not meet the overall project purpose and would be impracticable.

To the extent there are mines approved by FDOT in Marion and Sumter Counties, these mine sites are unavailable to Tarmac, as they are owned by Tarmac's competitors like M and S Limerock, Summerfield Mine or Statewide Materials. Moreover, M and S Limerock Mine's Marion County site has completely exhausted its reserve, and prior to such exhaustion was producing only limestone base, which is not FDOT-quality or construction-grade aggregate. Both Steven Counts, Inc.'s Marion County site and Statewide Materials' Sumter County site are located on much smaller areas of land (77 acres and 1,052 acres respectively) than King Road, and thus, even if producing high-quality limestone aggregate, have insufficient reserves to supply the entire west-central Florida market.

Even assuming accessible high-quality construction-grade aggregate exists in Marion and Sumter Counties, these areas are still not practicable alternatives to mining the King Road Mine.

In evaluating possible locations to a site a mine, Tarmac evaluated two possible sites in Marion County: one 720 acre site located about fifteen miles north of Ocala ("Marion County Site #1"); and one 482-acre site near Flemington, about ten (10) miles northwest of Marion County Site #1 ("Marion County Site #2"). Tarmac further evaluated a 412-acre site located in central Sumter County near Centerhill, Florida approximately sixty-three (63) miles from the King Road Mine site ("Sumter County Site"). None of these sites meets the project's overall purpose or are practicable alternatives to mining the King Road Mine site.

Tarmac visited Marion County Site #1 in 2007. At that time, the site was being mined for base rock as well as a clay material used in the making of kitty litter. Only the Ocala Formation is accessible at this site. As discussed previously, Ocala Formation will not produce any meaningful quantity of high quality construction-grade aggregate. The Ocala Formation at this site is overlain by approximately 50 feet of overburden, which will be onerous to manage and dispose, and require at least a portion of the mine site to be dedicated to storage of this overburden.

Second, Marion County Site #2 also was eliminated as impracticable because the limestone there cannot produce FDOT construction-grade coarse aggregate in any meaningful quantity. Tarmac came to this conclusion after evaluating an August 2009

detailed engineering report provided by the landowner. The report concluded that "[h]ard indurated limestone that is typically identified as suitable aggregate for asphaltic or Portland was not encountered in any substantial amounts within our area of exploration." Thus, this site is an impracticable alternative to the King Road Mine site that does not meet the overall project purpose.

Finally, Tarmac evaluated the Sumter County Site based on a January 2010 engineering report commissioned by the seller. According to the report, the site consists of "open, pasture, forested uplands and wetlands," and approximately 316 of the 412 acres are mineable. The Sumter County Site has similar issues with respect to limestone quality there as the Marion County Sites. The engineering report concluded that, "significant quantities of road base material exist at the site. It is unlikely, however, that a quality of limestone aggregates could be produced from this mining operation." Beyond limestone quality concerns, the site is also too small to produce a long-term source of aggregate for the west-central Florida market. Thus, the Sumter County Site is not a practicable alternative to mining the King Road Mine site.

Possible alternative locations in Marion and Sumter County thus do not meet the overall project purpose to provide a major long-term source of supply of construction-grade limestone aggregate and limestone aggregate that meets FDOT specifications. Thus, sites in these Counties are not "alternatives" to the King Road Mine site. Even if evaluated as "alternatives," however, these sites are impracticable from a logistics standpoint.

2. Alachua County

As seen on Figure 3, neither the Avon Park nor the Suwannee Formations outcrop in Alachua County. In fact, limestone found in Alachua County is not of the same high quality as limestone found in and around the King Road Limestone Mine. Alachua County is underlain by Ocala Limestone, with a very limited percentage to absence of high-quality limestone aggregate. The current absence of high-quality construction-grade limestone aggregate is highlighted by the lack of FDOT-approved limestone aggregate quality sources in the County.[84]

[84] Approved Aggregate Products from Mines or Terminals, FDOT State Materials Office (last updated August 11, 2010), *available at*:

3. *Clay County*

Clay County is in the market area, but there currently exist no limestone mines anywhere in Clay County.[85] Ocala Limestone underlies Clay County, but is too far below the surface and too poor of quality for any mining activity. The only limestone that is near the surface in Clay County is sandy, often phosphatic, clayey, and poorly to moderately indurated limestone that has no aggregate potential. Because there is not high-quality construction-grade limestone aggregate meeting FDOT-specifications in Clay County, this County is not a true alternative to the King Road Limestone Mine as it does not meet the project's overall purpose.

B. Shipping Limestone Aggregate In Through Ports

The Port of Tampa is the only Florida port even partially located within the west-central Florida market, as it is positioned just barely at the southwestern edge of the market, approximately 99 miles from the King Road Limestone Mine. Because the Port of Tampa is located on the edge of – and outside of – the west-central Florida market that Tarmac seeks to serve, the Port will not be able to reach the *entire* market in a cost-effective manner. Because the Port of Tampa cannot fulfill this purpose, it is an impracticable alternative to mining the King Road Limestone Mine site.

To import aggregate, one must have a source for the rock, likely in some other country. Even assuming that Tarmac could find a site in another country that meets FDOT specifications, the logistics of getting 3 million tons a year to the Port of Tampa would be daunting: a mine would have to be permitted; there would need to be transportation from that mine to a foreign port that is deep enough and has the facilities necessary to load aggregate; and then enough ships would have to be obtained to transport 3 million tons a year to Tampa. Logistically, this is impracticable compared to the King Road site, given all the steps necessary to transport the rock. The multiple steps in the transportation chain also would be costly, before the rock even arrived in Tampa. There also is a major

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http://www.dot.state.fl.us/statematerialsoffice/quality/programs/qualitycontrol/materialslistings/sources/aggregate/allproducts.pdf.

[85] Approved Aggregate Products from Mines or Terminals, FDOT State Materials Office (last updated August 11, 2010), *available at*: http://www.dot.state.fl.us/statematerialsoffice/quality/programs/qualitycontrol/materialslistings/sources/aggregate/allproducts.pdf. In fact, no FDOT-approved aggregate mines exist in Clay County at all. *Id.*

"multiple handling" problem (discussed above in Part IV). Also, it is likely that there would be more environmental impacts associated with mining in a less-developed country, which typically has fewer protective environmental regulations in place.

Even assuming that one will affordably deliver the rock to Tampa, it then will have to transport the rock from the Port to customers throughout the west-central Florida market. Since there is not a good rail network serving the west-central Florida market, trucks are the only way limestone aggregate can get from the Port to areas throughout the west-central Florida market. Transporting 3 million tons of limestone aggregate per year via truck would require 500 round-trip truck trips each day six days a week. There are indications in the Tampa Port Authority's Master Plan that there may be some issues with adding this much additional truck traffic a day at the Port. The Master Plan has noted that, "there are a number of rail/highway grade crossings and highway corridors that are currently of concern."[86] Moreover, at least at Hooker's Point (and maybe at other places), "significant increases in truck traffic are likely to require additional truck queuing space and/or more advanced processing technology."[87] Adding an additional 500 round-trip truck trips per day to the Tampa Port and its surrounding area is also bound to impact access for other users of the Port and result in increased congestion and traffic in an area that already faces tremendous traffic issues each day.

Even if the logistics of transporting 3 million tons of limestone aggregate per year from the Port of Tampa were not an issue, the cost of transporting 3 million tons of limestone aggregate from the Port to the end-user in west-central Florida render this option impracticable from a cost perspective. For instance, one potential major customer will be Progress Energy's new nuclear power plant located approximately 99 miles from the Port of Tampa and approximately 10 miles from the King Road Limestone Mine Site. The cost to transport aggregate is best viewed on a per-ton basis.

According to the Port's Master Plan, there is a $10 fixed cost per truckload of aggregate transported from the Port because of paperwork and administration (and this cost can

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[86] Tampa Port Authority Master Plan (July 17, 2008), at 73.

[87] Tampa Port Authority Master Plan (July 17, 2008), at 289.

increase).[88] There is also a $2.00 per mile operating cost for fuel and maintenance, along with $200 per 8-hour day of labor and capital costs for the driver and truck.[89] One truck holds approximately 20 tons of aggregate.[90] The discussion in the Port of Tampa's Master Plan explains that a 20-mile one-way trip takes 30 minutes driving each way.[91] It is estimated that it would take approximately 2½ hours each way to transport a truckload of limestone aggregate from the Port of Tampa to the Progress Energy jobsite (*i.e.*, 5 hours of travel time roundtrip). Thus, transporting limestone aggregate from the Tampa Port to the Progress Energy jobsite would add $125 per truckload in labor and capital costs for the driver and truck. The assumed low operating cost for fuel and maintenance (at $2 per mile) would add $396 per truckload for a roundtrip truck trip from the Port to the jobsite (approximately 99 miles away). These costs ($125 + $396) along with the per load fixed cost for paperwork and administration ($10) would add $531 per truckload to the cost of the aggregate. This adds approximately $26.55 per ton ($531/20 tons per truck) to the market cost of product. This does not reflect potentially higher fuel costs similar to those experienced in 2006 and 2007. Because as of August 2010, in west-central Florida, the cost of construction-grade aggregate in the west-central Florida market is approximately $20/ton and the cost of FDOT aggregate is approximately $25/ton, transporting limestone aggregate from the Port of Tampa to the Progress Energy site will more than double the cost of the aggregate.

Comparatively, transporting aggregate from the King Road Limestone Mine Site to the Progress Energy site will result in vastly less transportation costs. The 20-mile roundtrip delivery would take approximately 30 minutes. The estimated cost to transport limestone aggregate from King Road to the Progress Energy site will be $12.50 per truckload in capital costs for the driver and truck and $40 in operating costs for fuel and maintenance for a total of $52.50 per truckload or a

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[88] Tampa Port Authority Master Plan (July 17, 2008), at 103.

[89] Tampa Port Authority Master Plan (July 17, 2008), at 103.

[90] FDOT Study, Part II, at 9 n. 7.

[91] Tampa Port Authority Master Plan (July 17, 2008), at 103.

maximum of $2.63 per ton.[92] From looking at these simple calculations, one can see that transporting limestone aggregate from the Port of Tampa to the Progress Energy site will cost the end-user approximately ten times more than transporting the limestone aggregate from the King Road Limestone Mine Site. That is impracticable.

C. Shipping Limestone Aggregate In Through Rail Terminals

Another potential alternative would be to ship aggregate through the rail terminals in Gainesville, Ocala, Wildwood, or Tampa served by the CSX Railway. This would be impracticable, for several reasons.

First, these terminals lack capacity to handle 3 million tons per year – they simply are not big enough.

Second, there are significant logistical issues. Tarmac would have to ship the aggregate from a mine served by FEC railroad and interchange with the CSX railroad to make delivery in the western Florida market. The only mine that Tarmac has which meets this condition is its Pennsuco quarry in the Lake Belt served by the FEC Railway. That mine is located more than 200 miles away by air, and because the limestone would start on the FEC Railway and end on the CSX Railway, the aggregate would have to be shipped via a circuitous route through Jacksonville, Florida that exceeds 450 miles. To ship 3 million tons of aggregate per year would require a 120 car unit train leaving the Pennsuco quarry each working day of the year. A rail car on this route typically requires approximately 3-5 days, which means that Tarmac would have to acquire more rail cars than normal and would have a much more difficult time shipping the limestone due to the longer turn-around time. The long transportation times also would make it more difficult for Tarmac to respond quickly to customers' needs, unless inventory levels were increased to offset the extra time required. The increased inventory levels would require more storage capacity at the Wildwood and Ocala rail terminals than they are currently equipped to handle. In addition, the aggregate would be degraded by being loaded and unloaded onto rail cars four times before reaching its final destination, potentially losing its ability to be used as a source of FDOT aggregate.

Third, the cost factors make this option impracticable.

[92] Transporting aggregate from King Road to Progress Energy does not require a per load fixed cost for paperwork and administration of $10, so this cost has been left out of these calculations.

Transportation costs would include not only the truck costs from the rail terminals to customers, but also the rail costs to ship the rock from the Pennsuco quarry to the terminal. Initial estimates indicate that the cost of the rail transportation alone would be approximately $15/ton, and the cost of unloading at the terminals would be approximately $3/ton. The rail terminals therefore are impracticable from a cost perspective, because they would impose a surcharge of at least $18/ton on top of the cost of the product and trucking costs, making the rock cost prohibitive for customers.

Fourth, the rail transportation option has at least the same environmental impacts. Putting aside the environmental efforts of the rail transportation itself, a source like the Pennsuco quarry also is located in wetlands and there is no net environmental benefit to mining there.

D. Other Distant Florida Sites

Sites outside of west-central Florida are not true alternatives to the proposed project, because such alternatives will not meet Tarmac's overall project purpose of excavating construction-grade limestone aggregate *in west-central Florida*. Accordingly, most of the sites discussed in this section do not fulfill the project's overall purpose and need for being located in the market area. Arguably, rail terminals and ports located in the west-central Florida market could meet the project's purpose and need, as these drop-off points are located in the market, and FDOT views rail terminals as de facto mines. As discussed above, however, such rail terminals and ports are impracticable from a logistical perspective, due to lack of capacity, transportation cost and logistics issues, multiple handling problems, and other issues. Sites outside of the market have a range of problems rendering them impracticable beyond simply not meeting the overall project purpose. These problems include cost and logistics associated with transporting the limestone aggregate great distances, various quality of limestone aggregate, local opposition to mining as great, or greater than, exists in Levy County, and similar or greater environmental concerns as there are when mining the King Road site.

VI. CONCLUSION

As detailed above, there are no practicable alternatives to the King Road Limestone Mine that meet the overall project purpose and result in less environmental impacts. Because of a need to be placed inside the west-central Florida market, along

with a need to obtain limestone aggregate that meets FDOT-specifications in a sufficient enough quantity to supply the entire west-central Florida market and transportation logistics and costs, Tarmac's proposed project is the least environmentally damaging practicable alternative to satisfy the project's overall purpose.[93]

[93] Recently, Courts and the Corps have been blurring the line between avoidance analyses and on-site minimization analyses. This document functions as the former, but not the latter, which Tarmac will separately prepare and supply to the Corps.

MICHAEL McELVEEN, MAI
State-Certified General Real Estate Appraiser RZ360

JOHN SABATINI, MAI
State-Certified General Real Estate Appraiser RZ1966

MARK BECKER, MAI
State-Certified General Real Estate Appraiser RZ1763

April 7, 2010

Ms. Cindy Burns
Project Engineer
Tarmac
455 Fairway Drive
Suite 200
Deerfield Beach, FL 33441

Re: Aggregate Demand Within King Road Aggregate Mine Market Area

Dear Ms. Burns:

In our telephone conversation last week you asked that I provide an estimate of aggregate demand within the market area of the proposed King Road Aggregate Mine. Based on conversations I had with representatives of Tarmac, the estimated market area of the proposed King Road Aggregate Mine is a 70-mile radius extending from the King Road Aggregate Mine location. This 70-mile radius is consistent with regional aggregate mine market areas given that the overriding factor constraining the size of the market area is cost of transportation. Aggregate is a low cost item and transportation costs by truck quickly exceed the value of the aggregate itself, thus limiting the size of the market area. Aggregate demand is directly correlated to construction activity and population growth within the defined market area. The 70-mile radius will include all or part of 23 of Florida's 62 counties. Based on population projections from the University of Florida Bureau of Economic and Business Research, I have estimated that the 2010 population within the market area is 6,982,500 persons, and this population is projected to increase 33.72 percent to 9,337,100 persons by 2030.

The North Carolina Geological Survey estimated that about 10 tons of aggregates are required annually for each person.[1] Applying the estimated annual aggregate demand per person to the projected population within the market area provides an estimate of the total aggregate demand within the 70-mile market area of the King Road aggregate mine. Following in Table 1 is Urban Economics' estimate of annual aggregate demand within the King Road Aggregate Mine defined market area.

[1]North Carolina Geological Survey web site:
http://www.geology.enr.stat.nc.us/nae%20aggregates%20internet%20nrc%20with%20usgs%20sheet/aggregate%20overview%20new.htm.

Table 1

King Road Mine Market Area Aggregate Demand

Year	Market Area Population	Annual Aggregate Demand, Tons
2010	6,982,500	69,825,000
2011	7,217,960	72,179,600
2012	7,453,420	74,534,200
2013	7,688,880	76,888,800
2014	7,924,340	79,243,400
2015	8,159,800	81,598,000
2016	8,395,260	83,952,600
2017	8,630,720	86,307,200
2018	8,866,180	88,661,800
2019	9,101,640	91,016,400
2020	9,337,100	93,371,000

Source: Urban Economics, Inc.

I hope the preceding is sufficient for your needs. If you have any questions please do not hesitate to contact me.

Sincerely,

Michael McElveen, MAI

MM/rlg

Seminole Electric
COOPERATIVE, INC.
IN PARTNERSHIP WITH THOSE WE SERVE

September 1, 2009

Michael J. McLean
McLean Engineering Company, Inc.
815 South Main Street
Moultrie, Georgia 31768

RE: Interconnection Requirements for Tarmac's King Road Mine

Dear Mike:

Seminole Electric, the Generation and Transmission Cooperative of which Central Florida Cooperative is a Member/Owner, has been asked to confirm the appropriate transmission interconnection for Tarmac's proposed mining site at King Road. Seminole participated in the evaluation of the interconnection with the electric facilities in the King Road area and along with Central confirmed that the surrounding distribution system is too weak to support the amount of new mine load and cannot adequately support the load characteristics as well. Consideration of bringing a lower voltage transmission facility (69 kV) into the King Road area was also discounted, due to the fact that the various power quality impacts, such as, voltage sag, motor starting transients, and large load swings, that would be imposed on the weak 69 kV system that could potentially feed King Road would create unacceptable service characteristics to other Central Florida consumers in and around the area.

However, the Progress Energy Florida (PEF) 230 kV transmission line from Crystal River to Bronson provides an extremely strong energy source, is close to the site, would not be unduly impacted by the size and type of this mine load, and would provide a very reliable supply of energy to King Road. It is our contention that interconnecting King Road with the PEF 230 kV system in the area is the only viable solution to serve Tarmac. PEF has confirmed this to be the case and Central has been coordinating the details of the 230 kV interconnection with PEF staff.

If you have any further questions, or need any additional information, please give me a call at 813-739-1217.

Sincerely,

Kenneth L. Bachor, P.E.
Manager of Transmission Planning

cc. Ben Dawson, CFEC
J. Frauen

16313 North Dale Mabry Highway P.O. Box 272000 Tampa, Florida 33688-2000
Telephone 813.963.0994 Fax 813.264.7906 www.seminole-electric.com

TARMAC KING ROAD MINE SITE

24 HIGHWAY 40 EAST
INGLIS, FLORIDA

Prepared For:

TITAN AMERICA, LLC
DEERFIELD BEACH, FLORIDA

Prepared By:

SDII GLOBAL CORPORATION
SDII Project Number: **3020178**

AUGUST 2010

Endorsement

This report was submitted to TITAN AMERICA, LLC Deerfield Beach, Florida by SDII GLOBAL CORPORATION. All original work contained in this report was performed under the supervision of the undersigned.

SDII GLOBAL CORPORATION

Thomas M. Scott, Ph.D., P.G.
Senior Principal Geologist
Florida Registration No. 99

Florida Geology
An introduction to the Florida Platforms Geology with emphasis on the occurrence of limestone reserves

by Thomas Scott, Ph.D., P.G.
(Short biographical sketch in Appendix B)

I. Introduction

This paper evaluates the Florida Platform's geology as it relates to available deposits of construction-grade limestone aggregate. It focuses on the geology within a 70-mile radius (80 – 100 mile driving distance) of the proposed King Road Limestone Mine site in Levy County, Florida, which is the market area that Tarmac intends to serve.

Within the 70-mile market radius, there are three geological formations that may contain some mineable FDOT aggregate-quality limestone. These formations are the Middle Eocene Avon Park Formation, the Upper Eocene Ocala Limestone, and the Lower Oligocene Suwannee Limestone. Of these three, only the Avon Park Formation exists in enough quantity and high quality to extract large amounts of construction-grade limestone aggregate from a single mine in the market area. The Avon Park Formation can produce FDOT-quality construction-grade aggregate. For the Avon Park Formation to be economically accessible, it must be at or near the land surface with little to no Ocala Limestone overlying it. This combination occurs only in portions of southern and central Levy County and in northern-most Citrus County. As the Avon Park Formation becomes more deeply buried by younger sediments, it is often softer with limited or no aggregate potential. The Ocala Limestone consists of mainly soft limestone with limited potential to produce FDOT-quality limestone aggregate. In a few places, the Ocala Limestone is mined prior to accessing the higher quality Avon Park Formation. Although there are hard zones of Ocala Limestone that may have FDOT-quality aggregate, the hard zone is generally thin and of limited areal extent. Suwannee Limestone has the potential to produce FDOT-quality construction-grade aggregate. However, within the market area, Suwannee Limestone either exists in limited locations or lies beneath an increasing thickness of overburden.

When evaluating the geology of each county in the 70-mile market radius, a clearer picture emerges of the market area's geology. Portions of the following counties exist in the market radius: Levy County, Citrus County, Hernando County, Alachua County, Marion County, Sumter County, Pasco County, Hillsborough County, Clay County, Lake County and Polk County. The geology of each of these counties is discussed below in detail.

Avon Park Formation underlies the majority of Levy County, but only a limited portion of it is not covered with thick deposits of Ocala Limestone. Where the Ocala Limestone is either missing or thin – like at the King Road mine site – mining for FDOT-quality construction-grade aggregate is ideal. Where Ocala Limestone is present, it is typically too thick for a mining company to economically extract FDOT-quality aggregate from the Avon Park Formation below.

Although a small amount of potentially FDOT-quality construction-grade limestone aggregate exists in parts of Citrus County, there are few FDOT-approved

aggregate producers there. This is likely due to the small amount of FDOT-approved construction-grade aggregate there along with the rapid level of development in Citrus County that makes minable lands economically unavailable.

Suwannee Limestone underlies nearly all of Hernando County, with varying degrees of overburden thickness. FDOT-approved aggregate is produced from the Suwannee Limestone at two mines in Hernando County, northwest of Brooksville along US-98. But, areas that possibly contain accessible FDOT-quality aggregate in Hernando County are rapidly developing, and a large enough land tract with mineable reserves equivalent to the King Road mine site is not likely to be available.

Alachua, Marion and Sumter Counties are underlain by Ocala Limestone, with a very limited occurrence to absence of aggregate-quality limestone found there. The Avon Park Formation underlies Alachua, Marion and Sumter Counties, but it is overlain by Ocala Limestone that varies in thickness from 50-feet to over 100-feet. Thus, the occurrence of FDOT-quality limestone aggregate from the Avon Park Formation in Alachua, Marion and Sumter Counties is limited. Similarly, although Avon Park Formation underlies the entire area of Pasco and Northern Hillsborough Counties, the formation is too deep to be mined. Although Ocala Limestone and Suwannee Limestone are mined in Pasco County, none produces FDOT-approved aggregates.

Clay County is precluded geologically from producing FDOT-approved limestone aggregate, as the limestone underneath it is too deep or too poor quality for any mining activity. Similarly, Lake and Polk Counties have no limestone mines currently operating there. Lake and Polk Counties have Ocala Limestone there, but they do not contain significant amounts of FDOT-quality limestone aggregate.

II. Overview of Florida Geology

The Florida Platform lies on the south-central part of the North American Plate, extending to the southeast from the North American continent separating the Gulf of Mexico from the Atlantic Ocean. The basement rocks of the Florida Platform include igneous, metamorphic, volcanic and sedimentary rocks. Florida's foundation separated from what is now the African Plate when the super-continent Pangea rifted apart in the Triassic (pre-Middle Jurassic?) (about 175 million years ago [ma]) and was sutured to the North American Plate (Arthur, 1988). The modern Florida peninsula is the exposed part of the platform and lies predominantly east of the axis of the platform. Much of the Florida Platform lies under the Gulf of Mexico. Most of the State of Florida lies on the Florida Platform; the western panhandle is part of the Gulf Coastal Plain.

A thick sequence of mid-Jurassic (about 175 ma) to Holocene sediments (the present) lies unconformably upon the eroded surface of the basement rocks. Carbonate sedimentation predominated from mid-Jurassic until at least mid-Oligocene (approximately 25 ma) on most of the Florida Platform producing limestone and dolostone (dolomite). In response to renewed uplift and erosion in the Appalachian highlands to the north and sea-level fluctuations, siliciclastic sediments – sand, silt and clay - began to encroach upon the carbonate-depositing environments of the Florida Platform. Deposition of siliciclastic-bearing carbonates and siliciclastic sediments predominated from mid-Oligocene to the Holocene over much of the platform.

Numerous disconformities that formed in response to nondeposition and erosion resulting from sea-level fluctuations occur within the stratigraphic section (Scott, 2001).

The oldest sediments exposed at the modern land surface are Middle Eocene (approximately 40 ma) carbonates of the Avon Park Formation that crop out on the crest of the Ocala Platform in west-central Florida. The pattern of exposures of younger sediments is obvious on the geologic map. Much of the state is blanketed by Pliocene (5 to 1.8 ma) to Holocene siliciclastic and siliciclastic-bearing sediments that were deposited in response to sea-level fluctuations (Scott, 2001).

The characteristic landscape of Florida is relatively to extremely flat. There are few large, natural exposures and limited smaller exposures that geologists can investigate. The result is that geologists must rely primarily on de-watered or dry pits and quarries for exposures and must make use of subsurface data in studying the geology of Florida. Subsurface data, in the form of well cuttings and cores, were utilized extensively in the development of this map (Scott et al., 2001). Formational tops recognized in the subsurface have been extrapolated to the surface where exposures are limited. Scott et al. (2001) employed the mapping convention of removing up to 20 feet of undifferentiated sediments that overlay a recognized formation.

B. Geologic Structures

The geologic structures (Figure 1) that have affected shallow Tertiary and Quaternary sediments of the Florida Platform have been defined by numerous authors (Puri and Vernon, 1964; Miller, 1986; Scott, 1988; Scott, 1992). The majority of the structures recognized as influencing the deposition, erosion and alteration of the Cenozoic sediments in Florida do not appear to have had a significant effect on the surface expression of the lithostratigraphic units. These geologic structures include the Gulf Basin, Jacksonville Basin, St. Johns Platform, Sanford High, Brevard Platform, Osceola Low and the Okeechobee Basin (Scott, 1992). Those structural features that exerted an influence on the surficial or very near surface distribution of the Cenozoic (last 65 million years) sediments include the Chattahoochee “Anticline” and the Ocala Platform. Eocene and younger sediments crop out on the Chattahoochee Anticline and the Ocala Platform. The King Road mine site is located near the crest of the Ocala Platform. The oldest rocks at or near the surface in Florida occur on the crest of the Ocala Platform in Levy County (Figure 2).

Faulting in Florida’s Cenozoic sediments is limited at best. Miller (1986) recognizes a number of known or suspected Cenozoic faults that affect the Floridan aquifer system. Duncan et al. (1994) identified faulting in the Lower to Middle Eocene Oldsmar Formation. A number of hydrogeologic and geomorphic investigations have proposed the existence of faults (Wyrick, 1960; Leve, 1966; Lichtler et al., 1968; White, 1970; Pirkle, 1970). The faults in the Cenozoic section have very limited

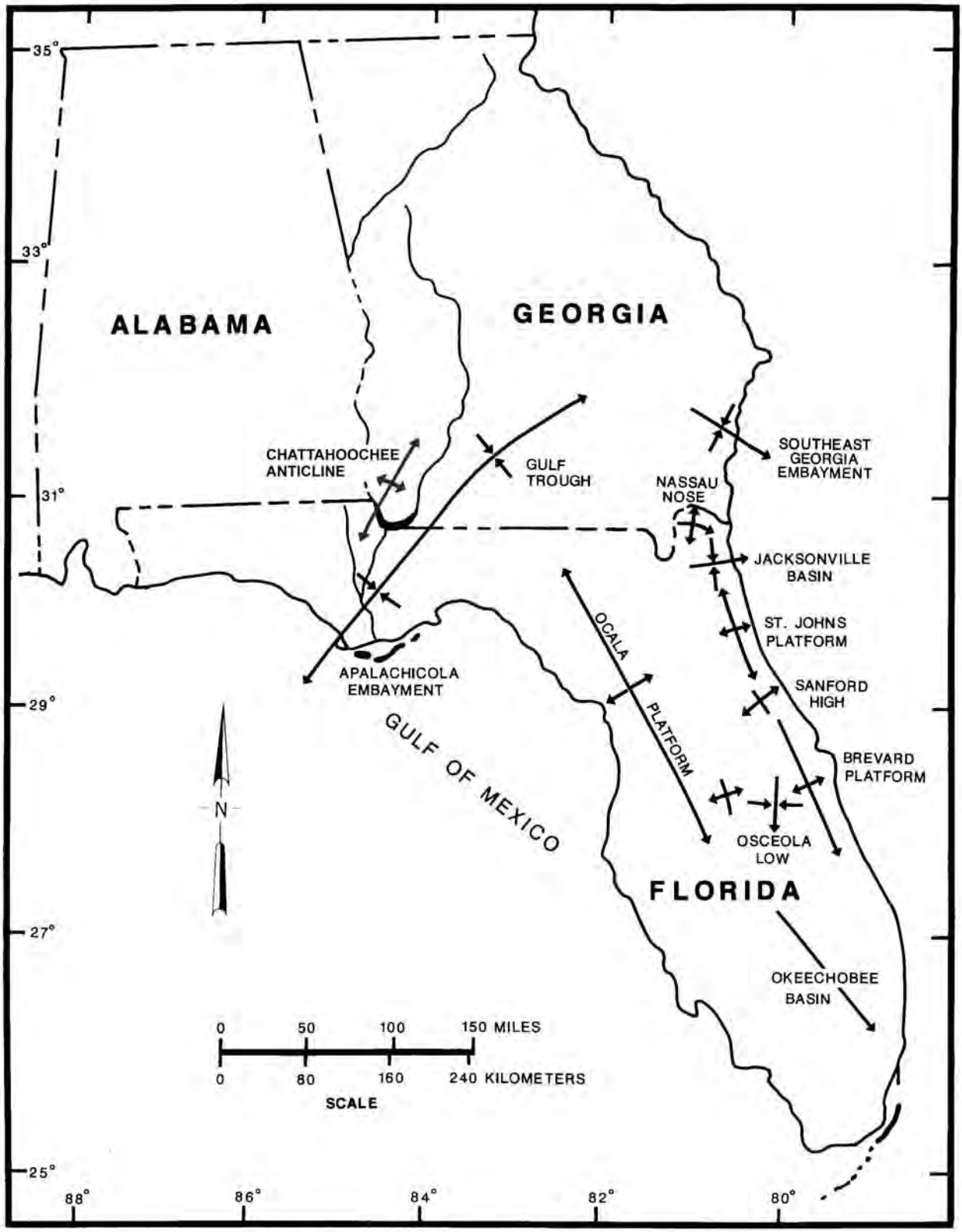

Figure 1 – Geologic structures affecting Florida's Cenozoic sediments (Scott, 1988).

displacement, generally less than 100 feet (30.5 m) and are difficult to identify due to limited displacement, well control, few "marker" beds, erosional disconformities and karstification.

Vernon (1951) proposed a number of faults in his investigation of Citrus and Levy Counties. However, more recent mapping did not recognize the existence the vast majority of the faults (Arthur et al., 2008). One of the biggest issues was that the top of

the Ocala Limestone (first called the Ocala Limestone restricted and the Moodys Branch Formation with the Williston

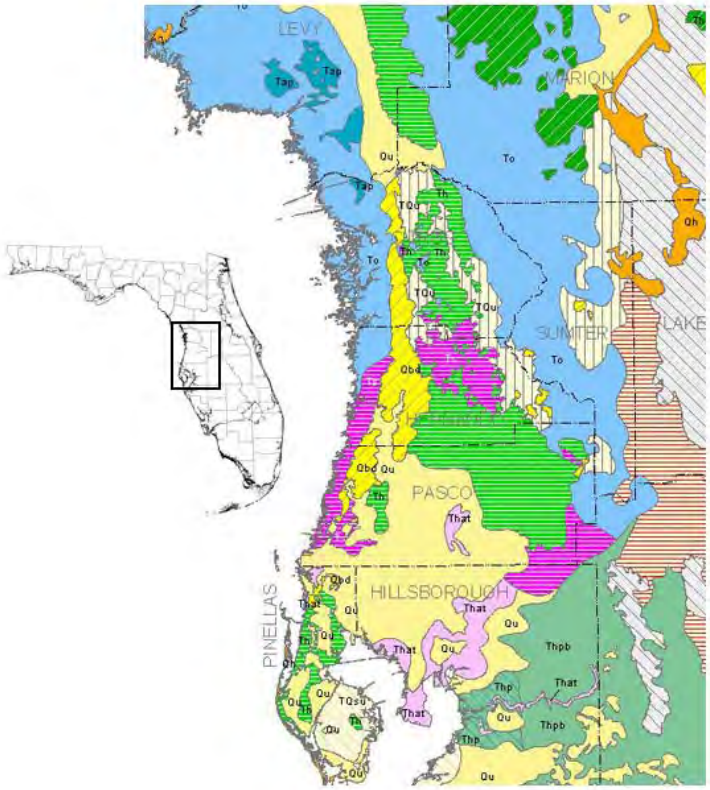

Figure 2 – Geologic Map of Florida (Scott et al, 2001). Dark blue shades in Levy County indicate where the oldest rocks are at or near the surface. See map in Appendix A for legend and abbreviations.

and Inglis members then later called Ocala Group) is an erosional, highly karstified surface. In some areas, as is the case for the King Road mine area, the Ocala Limestone is absent. Where the Ocala Limestone is missing, the surface of the Avon Park Formation is eroded, often has paleo-channels and is somewhat karstic. There are numerous accounts of wells being drilled close (within hundreds of feet) together yet encountering limestone at depths more than 100 feet different. There were problems with formational identification that led to faults being proposed. These factors combined to make Florida Geological Survey (FGS) geologists suspect that many of the faults proposed in Florida do not exist.

Little has been said concerning folding of post mid-Jurassic sediments on the Florida Platform. Missimer and Maliva (2004) believe that folding is more widespread on the Florida Platform than is presently recognized due to the limited amount of detailed subsurface data. They recognize folding with associated fracturing and faulting in the sediments of the Intermediate (Miocene-Pliocene sediments) and Floridan aquifer systems (Eocene-Oligocene sediments) on the southern portion of the platform. They postulate that the interaction of the Caribbean and North American plates in the Late Miocene to Pliocene produced the folds, fractures and faults.

B. **Geomorphology**

The Florida Platform extends southward from the continental United States separating the Gulf of Mexico from the Atlantic Ocean. The exposed portion of the platform, the Florida peninsula, constitutes approximately one-half of the Florida Platform measured between the 600 feet depth contour of the continental shelves. The axis of the platform extends northwest to southeast approximately along the present-day west coast of the peninsula. The Florida peninsula, from the St. Mary's River to Key West, measures nearly 450 miles. From the Alabama-Florida line to the Atlantic coastline is approximately 370 miles.

Florida lies entirely within the Coastal Plain Physiographic Province as defined by Fenneman (1938) and is the only state in the United States that falls completely within the Coastal Plain. Much of the surface of Florida shows the influence of the marine processes that transported and deposited the later Tertiary, Quaternary and Holocene sediments. Fluvial processes, although more important in the panhandle, have helped sculpt the entire state, particularly during the lowstands of sea level, redistributing the marine sediments.

Karst processes have had a dramatic effect on Florida's landscape due to the near surface occurrence of soluble carbonate rocks. Middle Eocene to Pleistocene carbonate sediments are affected by karstification over large areas of the State creating sinkholes, caves and springs. Siliciclastic sediments, ranging in thickness from a few feet to more than 200 feet, overlie the karstified carbonates.

More than 700 springs are recognized in Florida with the major springs occurring within the karstic areas of the State (Scott et al., 2004). The vast majority of the springs are located in the Ocala Karst District, the Central Lake District and the Dougherty Karst Plain District.

The lay of the land in the State of Florida consists of east-west trending highlands in the northern and western portions of the state and north-south trending highlands extending approximately two-thirds the length of the peninsula. Coastal lowlands occur between the highlands and the coastline wrapping around the entire state. The highest point in the state, 345 feet above mean sea level (msl) occurs in the Western Highlands near the Alabama-Florida state line in Walton County. There are several hilltops in the Central Highlands that exceed 300 feet msl in elevation. Cooke (1939) recognized five "natural" subdivisions of the state - the Coastal Lowlands, the Western Highlands, the Marianna Lowlands, the Tallahassee Hills, and the Central Highlands. The Central Highlands essentially separated the coastal lowlands along the east coast from those on the west coast as far south as Lake Okeechobee.

Utilizing better topographic maps of the State, White, Vernon and Puri (1964 in Puri and Vernon, 1964) and White (1970) delineated the geomorphic subdivisions that most geologists working in the state recognize. They continued to recognize the Central Highlands but discussed it as a zone containing a number of north-north west to south-south east trending ridges. There is limited mention of some writers referring to the Central Highlands as the Florida Ridge. However, the source of this name is unknown and its characterization is incorrect.

Scott and Paul (in preparation, 2009) are modifying and updating the geomorphic interpretation of the State. The geomorphic districts recognized by Scott and Paul (in preparation, 2009) are shown in Figure 3. These include: Southern Pine Hills District,

Dougherty Karst Plain District, Apalachicola Delta District, Tifton Upland District, Okefenokee Basin District, Barrier Island Sequence District Ocala Karst District, Central Lake District, Sarasota River District, and the Everglades District (Figure 3). Carbonate rocks – limestone and dolostone (dolomite) – are at or near enough to the surface to be mined predominantly in portions of the Dougherty Karst Plain District, the Ocala Karst District and the Everglades District. Because the 70-mile radius for the market includes areas in the Ocala Karst District and the Central Lake District, these areas are discussed here. A comparison of Figure 3 with Figure 4 reveals the relationship of limestone and sand mining areas to the geomorphology.

1. Ocala Karst District

The Ocala Karst District encompasses a broad area from Wakulla County in the panhandle to Hillsborough and Pinellas Counties in west-central peninsular Florida. Carbonate sediments ranging from the Middle Eocene Avon Park Formation to the Oligocene-Miocene Tampa Member of the Arcadia Formation, Hawthorn Group lie near the land surface (Figure 2). Dissolution of these sediments has created distinct landforms that characterize the district, including numerous springs. The Ocala Karst District lies to the south of the Tifton Uplands, separated by the Cody Scarp. To the east of the Tifton Uplands, the Okeefenokee Basin lies to the north of the district. Throughout most of its eastern boundary, the Ocala Karst District merges with the Central Lake District with which it shares a karstic influence. The southern terminus of the district occurs where the impermeable Hawthorn Group sediments retard the development of karst features in the Sarasota River District and streams and rivers become more common.

Elevations within the district range from sea level along the coast to in excess of 300 feet on the Brooksville Ridge. The topography over much of the district is gently rolling with only minor relief. However, on the Brooksville Ridge, the terrain looks more like that of the Central Lake District and relief may exceed 200 feet.

Sinclair and Stewart (1985) delineated zones of similar karst development in Florida based on the thickness and type of sediment cover and on the sinkhole types. The entire district is covered by a siliciclastic cover of varying thickness ranging from a few feet of sand and clay to as much as 200 feet of sediment. The Ocala Karst District is dominated by "solution sinkholes", shallow, broad bowl-shaped depressions producing a gently rolling topography. This type of dissolution occurs in areas where there is a thin, permeable, siliciclastic cover allowing downward percolating groundwater to dissolve the limestone surface. These sinkholes develop slowly. The area also exhibits collapse features.

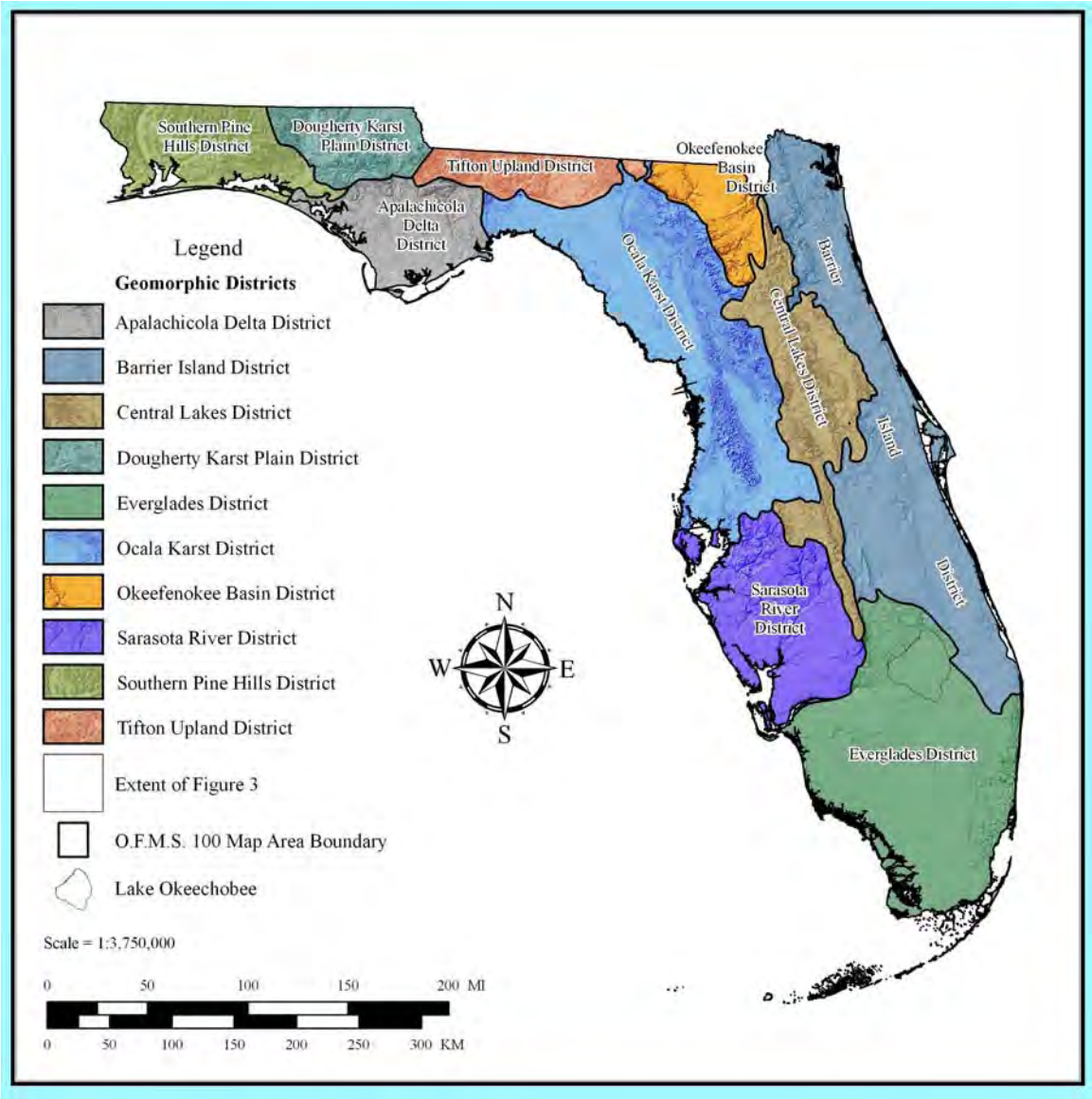

Figure 3 – Geomorphic districts of Florida (Scott and Paul, in Preparation, 2009).
developed from the collapse of cavern roofs. Springs, sinking and resurgent streams and numerous caverns occur within the Ocala Karst District.

2. Central Lakes District

The Central Lake District occupies most of the Central Highlands of Cooke (1939) in peninsular Florida. The district extends from eastern Alachua County, southeastern Bradford County and southern Clay County to southernmost Highlands County. The Central Lake District lies east and south of the Ocala Karst District, and south of the Okeefenokee District in the study area. A thick (up to at least 200 feet) sequence of siliciclastic and carbonate sediments of the Hawthorn Group and siliciclastic sediments of the Cypresshead Formation and undifferentiated sediments overlie the Ocala Limestone in

the district. Dissolution of the limestone and subsequent subsidence or collapse has created the characteristic sinkhole lakes and dry sinks that dominate the landscape.

Sinclair and Stewart (1985) delineated zones of similar karst development in Florida based on the thickness and type of sediment cover and on the sinkhole types. The Central Lake District is delineated as primarily having numerous cover-collapse sinkholes.

Aerial photographic maps and satellite photographs provide an interesting view of the Lake District. The distinctive circular to subcircular shape of the lakes can easily be seen showing individual sinkholes and coalescing sinks. As a result of the numerous sinkholes, the Central Lake District is primarily internally drained through these karst features. Only one of the State's major rivers, the Oklawaha, flows any distance through the district. The largest lakes in the Central Lake District occur at the headwaters of the Oklawaha River in the Central Valley. Lake Apopka, the largest of the lakes lies at the southern terminus of the valley.

The Central Lake District provides some of the most picturesque landscapes in the State with rolling hills interspersed with numerous closed depressions and circular lakes. Elevations in this district range from 50 to 60 feet in depressions and valleys to more than 300 feet on the highest hills. Sugarloaf Mountain, on the southwestern side of Lake Apopka, is one of the highest points in the peninsula with an elevation of 312 feet.

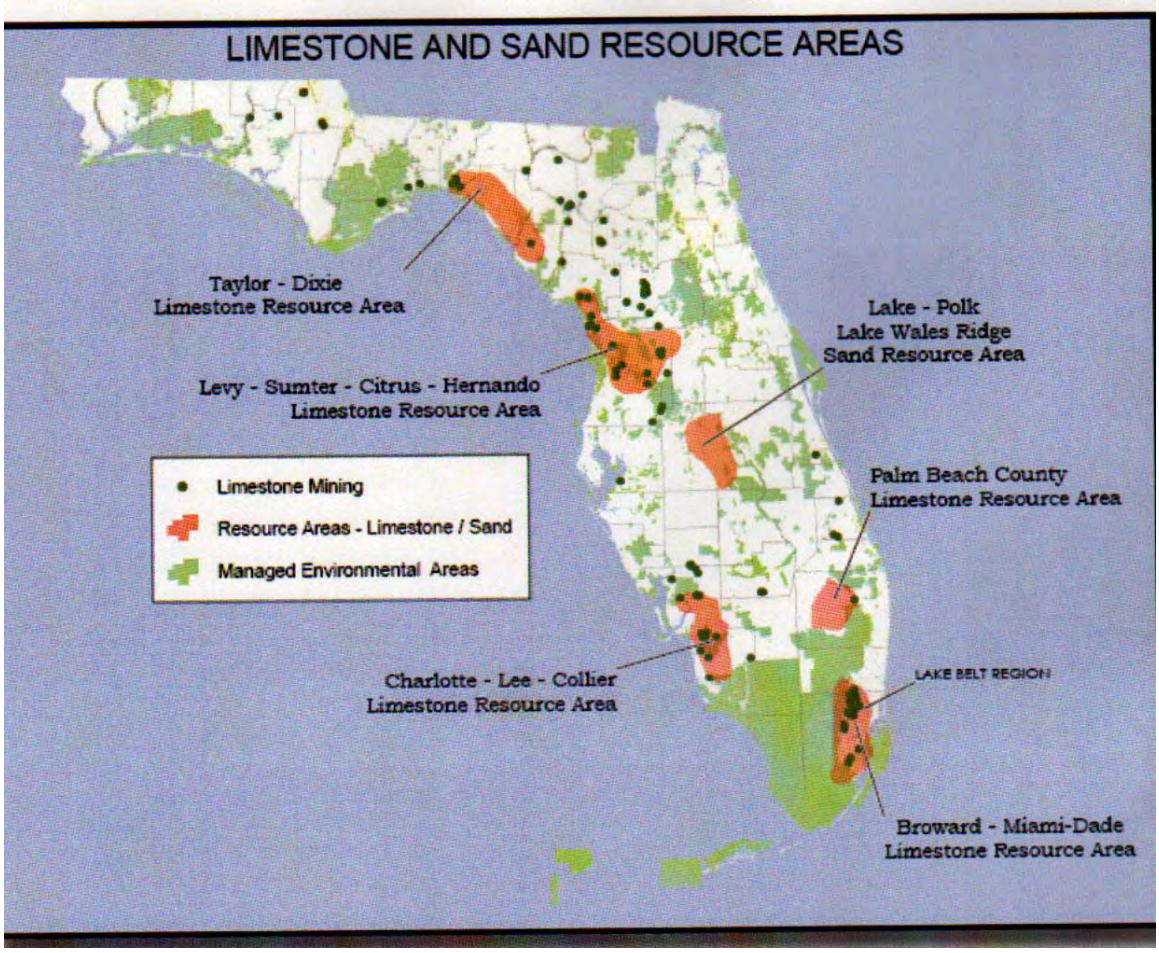

Figure 4 – Limestone and sand mining areas (Florida Department of Transportation (FDOT) Aggregates Study, 2007)

The influence of sea level fluctuations on the development of the Central Lake District is very evident from its coast parallel orientation and the occurrence of relict beach ridges. In some areas, the distribution of karst lakes is controlled by the beach ridges. The district is bounded on the east by erosional scarps with toe elevations ranging from approximately 30 feet to 90 feet. Portions of the western boundary are marked by scarps with elevations ranging from 30 feet to 160 feet.

C. Stratigraphy

A thick sequence of mid-Jurassic (about 175 million years ago [ma]) to Holocene sediments (the present) lies unconformably upon the eroded surface of the basement rocks. Carbonate sedimentation predominated from mid-Jurassic until at least mid-Oligocene (approximately 25 ma) on most of the Florida Platform producing limestone and dolostone (dolomite).[1] In response to renewed uplift and erosion in the Appalachian highlands to the north and sea-level fluctuations, siliciclastic sediments – sand, silt and clay - began to encroach upon the carbonate-depositing environments of the Florida Platform. Deposition of siliciclastic-bearing carbonates and siliciclastic sediments predominated from mid-Oligocene to the Holocene over much of the platform. Numerous disconformities that formed in response to nondeposition and erosion resulting from sea-level fluctuations occur within the stratigraphic section.

The oldest sediments exposed at the modern land surface are Middle Eocene (approximately 40 ma) carbonates of the Avon Park Formation that crop out on the crest of the Ocala Platform in west-central Florida. The oldest sediments exposed on the Chattahoochee "Anticline" in the panhandle belong to the Upper Eocene Ocala Limestone (approximately 36-38 ma). The Lower Oligocene Suwannee Limestone (approximately 32 ma) was deposited widely but subsequently removed from many areas by erosion. The Miocene Hawthorn Group covered the entire Florida Platform. It was eroded from the Ocala Platform and younger sediments were deposited as sea levels fluctuated since the Late Miocene. The pattern of exposures of younger sediments is obvious on the geologic map (Figure 2). Successively younger sediments surround the crest of the Ocala Platform and the Chattahoochee "Anticline." Much of the state is blanketed by Pliocene (5 to 1.8 ma) to Holocene siliciclastic and siliciclastic-bearing sediments that were deposited in response to sea-level fluctuations. For further discussion, see Scott (2001).

III. Limestone Aggregate - King Road Mine Site

The King Road Mine site is situated near the crest of the Ocala Platform (Ocala Uplift of older literature; See Scott, 1988, pp 11-13; Scott, 1992, pp 5-9; Scott, 2001, pp 9-10; and Arthur, et. al., 2008, p. 7). The Avon Park Formation, the oldest rocks at or

[1] Limestone is calcium carbonate. Dolostone is calcium magnesium carbonate with. Although dolostone and limestone are geologically distinct types of rock, the two types of stone commonly are referred to in industry as "limestone."

near the surface in Florida, is exposed here. In the area of the King Road Mine site, the Avon Park Formation consists of dolomitized limestone (dolostone) with very little undolomitized limestone. In large part, the dolomitization of the original limestone caused the occurrence of the aggregate-quality deposit of interest. There is very little overburden overlying the mineable rock. The Avon Park Formation dips deeper into the subsurface away from the crest of the Ocala Platform and becomes less dolomitic with more soft limestone occurring.

It should be noted that FDOT has not conducted aggregate-quality testing on the rock encountered in the Avon Park Formation at the King Road Mine site. Laboratory testing by Titan America concludes that rock meeting the FDOT specifications exists at the mine site. FDOT will test the rock once the processing plant is in operation.

IV. Limestone Formations Within A 70-mile Radius of the King Road Site

Within the 70 mile radius market area, three formations containing mineable aggregate-quality limestone or dolostone occur: Middle Eocene Avon Park Formation (dolostone), the Upper Eocene Ocala Limestone and the Lower Oligocene Suwannee Limestone (Figure 2). Since these stratigraphic units are the only formations that contain at least some mineable aggregate-quality limestone within the market area Tarmac seeks to serve, this section will focus on the existence of, and accessibility to, these formations within the market.

A. Avon Park Formation

The Avon Park Formation can produce FDOT-quality construction-grade limestone aggregate. This formation is at or near the land surface only in portions of central and southern Levy County and northern-most Citrus County (Figure 2). The formation is not exposed or near land surface anywhere else in the State. In the King Road mine area, the Avon Park Formation consists mainly of dolostone (dolomite). The carbonate sediments were originally limestone but were dolomitized over a broad area at the crest of the Ocala Platform in the Late Oligocene. The process of dolomitizing the limestone and recrystallization of the original carbonate sediments created the Avon Park Formation lithologies that contain thick sequences of aggregate-quality dolostone at the site. The aggregate-quality rock is interbedded with softer carbonate sediments primarily poorly-cemented dolostone and dolosilt. The surface of the Avon Park Formation dips away from the crest of the Ocala Platform becoming deeper beneath the land surface. Away from the areas mapped as Avon Park Formation on the State geologic map (Figure 2), the Ocala Limestone overlies the Avon Park Formation. This, in combination with varying thicknesses of post-Ocala Limestone siliciclastics (sand, silt and clay) and younger limestone, bury the Avon Park Formation too deeply to be economically exploited. In addition, as the unit dips deeper into the subsurface, it is often composed of softer limestone and dolostone with no aggregate potential. For a more in-depth discussion, see Vernon (1951), Rupert (1988), Scott (2001) and Arthur et al. (2008). Ideally, mining the Avon Park Formation is best in those areas where the Ocala Limestone has been removed by erosion and dissolution as in the King Road mine site in Levy County.

The Avon Park Formation in the west-central Florida region was deposited in very shallow, tidally affected, near shore marine conditions (ocean water). There were mud flats, shallow-water grass beds and even nearby terrestrial environments. As a result of these depositional environments, a significant amount of organic matter accumulated in the Avon Park carbonate (limestone) sediments. Mines in the Levy and Citrus County area frequently encounter organic-rich beds ranging from dolostone with disseminated organics to discrete organic layers (often referred to as "lignite"). There is an organic-rich clay bed that often occurs at or near the top of the formation in this region. These organic-rich sediments are a diagnostic feature of the Avon Park Formation on the Ocala Platform.

The presence of the organic matter is a precursor to pyrite formation. The reduction of the organic matter as groundwater moves through the sediment and the originally deposited limestone becomes dolomitized allows for the formation of pyrite. As such, pyrite developed in the Avon Park sediments. To geologists, the Avon Park pyrite is a minor mineral accessory. The occurrence of pyrite is not often mentioned in the literature. However, geologists' lithologic descriptions of cores and well cuttings (part of the FGS database) often mention the trace amounts of pyrite. Pyrite is recognized in cores and in rocks on quarry windrows. The pyrite occurs as microscopic crystals in void space and along fractures and bedding planes. In fresh exposures, rock piles and cores, the pyrite is seen as a brassy to purplish sheen on fractures and as small crystals in void space when viewed with a hand lens or microscope. When the rocks are subjected to weathering, pyrite oxidizes and its presence is noted by the occurrence of a rusty yellow stain.

Organic-rich zones and pyrite in the Avon Park dolostone occur to more than 100 feet below land surface in cores. In quarries, it is difficult to determine the depth from which these zones came. However, the quarrying operations were mining 50 to 100 feet below land surface. It would not be unusual to have minor pyrite throughout the upper 100 feet or more of the Avon Park dolostone.

The Florida Geological Survey reports no springs issuing from the Avon Park Formation. The nearest springs occur northeast of the proposed Progress Energy nuclear power plant site east of U.S. 19 in Levy County (Scott et al., 2004).

Only a few operations mine Avon Park dolostone. These include operations that mine a thick sequence Ocala Limestone and recover Avon Park Formation dolostone beneath the Ocala Limestone. Within the market area, the Avon Park Formation is mineable only in portions of Levy County and a small area of Citrus County. Elsewhere within 70 miles of the King Road site, it lies at depths too great to be economically extracted. Several abandoned mines occur in the area. FDOT records show only one approved aggregate mine utilizing the Avon Park Formation. It is now closed.

Levy County, where the Avon Park Formation is usually mined, is a rural county with major silviculture operations. As such, land values will remain lower than in Citrus County where development is occurring at a more rapid pace. In the more developed and developing counties, large tracts of mineable land may not be economically available.

B. Ocala Limestone

The Ocala Limestone is at or near land surface over a large area of west-central Florida including parts of Levy, Marion, Alachua and Sumter Counties (Figure 2). The formation is widely distributed in the King Road mine market area. The Ocala consists of soft to occasionally hard limestone with limited potential for FDOT-approved aggregate production. Where the Avon Park Formation, which may meet FDOT aggregate specifications, is at or near the land surface, the Ocala Limestone is absent due to erosion and dissolution from the crest of the Ocala Platform. The thickness of the Ocala Limestone increases away from the crest of the Ocala Platform and, in some portions of the market area, exceeds 150 feet thick. Because much of the Ocala Limestone does not meet FDOT aggregate specifications, areas where the limestone exists are not suitable for siting a mine seeking to extract large quantities of construction-grade limestone aggregate meeting FDOT specifications. When the Ocala Limestone overlies the Avon Park Formation, the Ocala Limestone must be removed to provide access to the Avon Park dolomitized limestone to produce FDOT-approved aggregates. While the Ocala Limestone is part of the "overburden" overlying the Avon Park Formation, the softer Ocala Limestone can be processed to make other limerock products.

A hard, recrystallized limestone exists at the top of the Ocala Limestone. The hard zone in the Ocala Limestone is generally less than fifteen to twenty feet thick as seen in quarry exposures. In some areas, such as surrounding Lecanto in Citrus County, this limestone may be of FDOT-aggregate quality. Hard zones often occur along fractures in the limestone but are of limited areal extent (Vernon, 1951; Scott, 2001; Arthur et al., 2008). Moreover, those counties where the thin, hard zone of limestone occurs within the Ocala Limestone appear to be developing much more rapidly than Levy County and large tracts of mineable land may not be available.

To the extent there are mines within the market area that extract limerock from the Ocala Limestone, these mines are producing base rock and not significant amounts of FDOT-approved limestone aggregate. Thus, Ocala Limestone does not produce large quantities of construction-grade limestone aggregate that would meet FDOT specifications.

C. Suwannee Limestone

The Suwannee Limestone is at or near land surface in a limited area of west-central Florida (Figure 2). The distribution of the formation is controlled by the Ocala Platform. Erosion and dissolution have removed the formation from a large area of the State. Within the market area, the occurrence of Suwannee Limestone is limited (compare Figures 2). The unit is mapped at or near land surface in a small area of southern Citrus County, an area in northern Hernando County, along the coast in Hernando and Pasco Counties and a limited area at the Pasco, Polk and Hillsborough County intersection (Figure 2). Away from these areas, the Suwannee lies beneath an increasing thickness of overburden. Maps and cross sections reveal the thickness of the overburden (Arthur et al., 2008). Outside the areas mapped as Suwannee Limestone (Scott et al., 2001) overburden consisting of Hawthorn Group sediments and undifferentiated sediments become more than 20 feet thick.

The Suwannee Limestone is composed of hard to soft limestone and may attain thicknesses of more than 150 feet. Suwannee Limestone has the potential to produce construction-grade limestone aggregate that meets FDOT specifications. Hard limestone often dominates the lithology of the formation in some areas. Exposures of more than 75 feet have been measured in Hernando County quarries. Two quarries mining this formation in Hernando County produce FDOT-approved limestone aggregate. (See Yon and Hendry, 1972; Scott, 2001; Arthur et al., 2008).

The ability to access construction-grade aggregate Suwannee Limestone (meets FDOT specifications) is limited in the market area. Within the market area, Hernando and Pasco Counties for example, land with FDOT aggregate-quality Suwannee Limestone is developing quickly. As a result, large land tracts containing mineable reserves are not likely to be available.

III. Evaluation of Limestone Formations by Counties within the Market Area

Because each county in Florida is slightly different, this section discusses the specific formations found within each county in the 70-mile market radius.

A. Levy County

The Avon Park Formation underlies the all of Levy County. It crops out or is near the surface and not overlain by lower-quality limestone from the Ocala Formation in limited portions of central and southern Levy County (Figure 2). The remainder of Levy County is covered with variable thicknesses of Ocala Limestone. Ocala Limestone is generally too soft to produce larger quantities of construction-grade aggregate meeting FDOT specifications. The outcrop pattern on the geologic map is the approximation of where the Avon Park Formation occurs with a thin overburden (< 20 feet) of undifferentiated sands and the Ocala Limestone is absent. The Ocala Limestone is missing due to erosion and dissolution. Where the Ocala Limestone is present, it lies on the Avon Park Formation, and must be removed to provide access to the Avon Park dolomitized limestone to produce FDOT-approved aggregates. While the Ocala Limestone is part of the "overburden" overlying the Avon Park Formation, the softer Ocala Limestone can be processed to make limerock products. In other areas, the Ocala Limestone is too thick – often times reaching 150 feet in thickness – for a mining company to economically extract the Avon Park Formation. Ideally, mining the Avon Park Formation is best in those areas where the Ocala Limestone has been removed by erosion and dissolution as in the King Road mine site.

Identification of the limits of the Ocala Limestone in this area delineates the outcrop pattern of the Avon Park Formation. It is possible that there are limited areas where the Avon Park Formation is at or near the surface but is not recorded in the FGS database. But, these would be areally small and many would fall on Plum Creek's land. To the extent the Avon Park Formation exists in Levy County outside of the King Road Mine site or other Plum Creek lands, residential and commercial development have occurred and much of the aggregate is unavailable. The areas outside of the Plum Creek land where Avon Park Formation exists at or near the surface are either too small to produce 3 million tons of aggregate per year or unavailable due to development.

Mines in the Levy County area frequently encounter organic-rich beds ranging from dolostone with disseminated organics to discrete organic layers (often referred to as "lignite"). These organic-rich sediments are a diagnostic feature of the Avon Park Formation on the Ocala Platform.

B. Citrus County

There is a small area of Avon Park occurrence in northern-most Citrus County. The Ocala Limestone, a small amount of Suwannee Limestone, and undifferentiated sediments also exist in the remainder of Citrus County (Figure 2). Yon and Hendry (1972) report a band of "potential limestone aggregate" extending from the Citrus County line southeast in the eastern half of the county into Pasco County.

Despite these small areas of construction-grade limestone aggregate potentially meeting FDOT specifications, as of July 2009, there was one FDOT-approved aggregate producer in Citrus County (FDOT website). To the extent that mines in this area have the potential to produce construction-grade limestone aggregate meeting specifications, operations there are all relatively small with limited footprints. Moreover, in Citrus County, development is occurring at a more rapid pace than in Levy County. Thus, large tracts of mineable land may not be economically available.

Given the small area of Avon Park occurrence, the thin nature of the aggregate-potential zone in the upper part of the Ocala Limestone, the small area of Suwannee Limestone found in Citrus County, and the nature of development in Citrus County, it is highly unlikely an existing mine in Citrus County could sustain the production of three million tons of limestone aggregate per year. It is also unlikely that a large enough tract could be found to sustain such an operation and be economically feasible due to land values.

C. Hernando County

The Suwannee Limestone underlines nearly all of Hernando County, and is at or near the surface in some areas (Scott, et. al., 2001; Yon and Hendry, 1972, page 12; Schmidt et al., 1979, maps 1 and 3). It is absent due to erosion and dissolution in the northern-most and northeastern portions of the county (Yon and Hendry, 1972). Yon and Hendry (1972) report a band of "potential limestone aggregate" extending from the Citrus County line southeast in the eastern half of the county into Pasco County. The Suwannee Limestone is mapped in an area in northern Hernando County and along the coast in Hernando County (Figure 2). Exposures of more than 75 feet have been measured in Hernando County quarries. FDOT-approved aggregate is produced from the Suwannee Limestone at two mines in Hernando County, northwest of Brooksville along US-98 (See Yon and Hendry (1972), Scott (2001), and Arthur, et. al. (2008)).

Overburden thickness above the Suwannee Limestone in Hernando County is quite variable. The Geologic Map of Florida (Figure 2) shows areas of Suwannee Limestone in Hernando County (Scott et. al., 2001). The map shown in Figure 2 was created using the convention of removing up to 20 feet of undifferentiated sediments that were above a recognizable formation. As a result, in the areas where Suwannee Limestone is mapped, the overburden may be up to 20 feet thick. Away from the areas mapped as Suwannee Limestone, the overburden thickens significantly. Miocene

Hawthorn Group (green on the map) and Quaternary undifferentiated sediments (yellow on the map) overlie the Suwannee Limestone in much of Hernando County. These sediments, which comprise the intermediate aquifer system/intermediate confining unit and the surficial aquifer system, can reach thicknesses exceeding 100 feet (Yon and Hendry, 1972; also see Arthur, et. al., 2008, for thickness maps Plates 55 and 57). The amount of overburden in Hernando County far exceeds the thin overburden at the King Road site.

Areas that possibly contain accessible aggregate-quality Suwannee Limestone in Hernando County, including the eastern half of the county, are developing quickly. As a result, large land tracts containing mineable reserves are not likely to be available. Much of the mineable reserves in northern Hernando County have been exploited. It is unlikely that a large enough tract could be found to sustain such an operation due to development and already-in-place mining facilities.

D. Marion/Sumter Counties

Avon Park Formation underlies Marion and Sumter Counties. But, Avon Park does not occur within 20 feet of the surface and, with the exception of a limited portion of western-most Marion County, it is overlain by the Ocala Limestone (Scott et. al., 2001; Arthur et. al., 2008, Plates 39 and 40). The Ocala Limestone varies from absent to less than 50 feet thick in western-most Marion County to more than 100-feet thick (Arthur, et. al., 2008, Plate 40). The Geologic Map of Florida (Figure 2) shows Ocala Limestone in western Marion and Sumter Counties (Scott, et. al., 2001). The map was created using the convention of removing up to 20 feet of undifferentiated sediments that were above a recognizable formation. As a result, in the areas where Ocala Limestone is mapped, the overburden may be up to 20 feet thick. Away from the areas mapped as Ocala Limestone, the overburden thickens significantly. Miocene Hawthorn Group (green on the map) and Quaternary undifferentiated sediments (yellow on the map) overlie the Ocala Limestone in much of this area. These sediments which comprise the intermediate aquifer system/intermediate confining unit and the surficial aquifer system can reach thicknesses exceeding 100 feet.

Because the Avon Park Formation becomes deeper in the subsurface away from the crest of the Ocala Platform and becomes less dolomitic with more soft limestone occurring, the occurrence of FDOT-quality limestone aggregate from the Avon Park Formation in almost all of Marion County and all of Sumter County is limited. Moreover, the expense of removing the thick overburden and mining of the Ocala Limestone in order to mine the Avon Park Formation, with limited reserves at best, is prohibitive.

E. Alachua County

Alachua County is underlain by Ocala Limestone. The Ocala Limestone in Alachua County consists of fossiliferous limestone that may be soft to hard (Williams, et. al., 1977, p. 38). The percentage of aggregate-quality limestone is very limited in the Ocala Limestone as shown by the listings of FDOT aggregate quality-sources in FDOT District 2, which includes Alachua County, where only a few aggregate producers are listed (FDOT website). This further suggests the very limited occurrence of aggregate-

quality limestone meeting FDOT-specifications within the Ocala Limestone in Alachua County.

The Ocala Limestone is quite thick in Alachua County as shown by Arthur et al. (2008, Plate 40). The Avon Park Formation underlies the Ocala Limestone but is of unknown aggregate quality due to its depth. None of the existing or abandoned mines in the county encountered the Avon Park Formation.

Alachua County land values have increased significantly over the past decade (Gainesville Sun, June 2, 2006). The property maps on the Alachua County Property Appraiser's website indicate that it would be difficult if not impossible to obtain enough acreage to develop a mine capable of producing at least 3 million tons of aggregate per year.

F. Pasco and Northern Hillsborough Counties

The Avon Park Formation underlies this entire area, but is too deep – 100 to 500 feet below sea level (Arthur, et. al., 2008, Plate 38) – to be mined. The Ocala Limestone ranges from approximately 75 feet above sea level in eastern-most Pasco County to more than 300 feet below sea level in western Hillsborough County (Arthur, et. al., 2008 Plate 39). The Suwannee Limestone occurs from more than 75 feet above sea level in parts of Pasco County to 300 feet below sea level in southern Hillsborough County (Arthur et al., 2008, Plate 41). The Suwannee Limestone varies from absent in northeastern and eastern Pasco County to more than 200 feet thick in southeastern Hillsborough County. Both the Ocala Limestone and the Suwannee Limestone are composed of soft limestone with limited hard zones. The Ocala Limestone and the Suwannee Limestone are mined in Pasco County. There is one mine producing FDOT-approved base rock (FDOT website). There are no mines producing FDOT-approved aggregate. The areas within Pasco and Hillsborough Counties that potentially have aggregate-quality Suwannee Limestone are developing quickly. As a result, large tracts containing mineable reserves are not likely to be available.

G. Clay County

The geologic framework of Clay County precludes mining FDOT-approved or any other aggregate-quality limestone. Clay County is underlain by limestone but it occurs at a depth that is too deep or is too poor quality for any mining activity. The top of the Ocala Limestone, which is also the top of the Florida aquifer system, occurs between – 50 feet mean sea level (msl) in the southwest corner of Clay County and – 450 feet msl in the northeastern corner of the County (Scott and Hajishafie, 1980). The Ocala Limestone is overlain by Hawthorn Group, the Cypresshead Formation and younger sand and clay often attributed to the Pleistocene Epoch (Scott, 1988; Clark et. al., 1964). The only limestone near the surface in portions of Clay County is found in the upper portion of the Hawthorn Group. It is a sandy, clayey, often phosphatic, poorly to moderately indurated limestone that has no aggregate potential (Scott, 1988; Clark et. al., 1964).

H. Lake and Polk Counties

Much of Lake County and the northern portion of Polk County are well within the 70-mile market radius. There are a number of aggregate sand-mining operations but no limestone mines that currently operate in this area. The only portion of the area with any potential for limestone production is in northern-most Polk County near the Pasco County line. Several old, now abandoned, mines are in this area. It is unclear if these mines ever produced significant quantities of aggregate. The mining occurred in the Ocala Limestone, which is usually a soft, friable limestone that does not contain significant amounts of FDOT aggregate-quality limestone. Moreover, northern Polk County lies within the environmentally sensitive Green Swamp. To the extent there are limestone reserves remaining in this area, the availability will be limited by development, environmental issues and public land.

I. Southern Taylor County

Reserves of FDOT aggregate-quality rock occur in southern Taylor County, west of Perry. Dolomitized Suwannee Limestone is mined in this area. It is approximately 80 feet thick based on the mapping of Green et al. (2008) although the thickness varies. Rupert (1996) states that the Suwannee was up to 50 feet thick in southern Taylor County and thinned to the east and southeast due to erosion and dissolution. Yon (1966) states that the Suwannee may exceed 300 feet thick in southern-most Jefferson County just west of Taylor County. East and south of Taylor County, the Suwannee Limestone is absent and the first limestone encountered in the subsurface is the Ocala Limestone. It becomes thicker to the west toward the Apalachicola Embayment (Figure 1). As it thickens, the formation becomes more deeply buried and is not mineable.

The Suwannee Limestone has very little overburden in southern Taylor County. It is underlain by soft Ocala Limestone. All active FDOT aggregate mining occurs in the western end of southern Taylor County. Perry is approximately 95 miles from the proposed King Road mine site, and the locations in western Taylor County which can produce FDOT quality aggregate are approximately 110-15 miles away.

J. Dixie and Gilchrist Counties

Avon Park Formation underlies Dixie and Gilchrist Counties. However, the Avon Park is overlain by the Ocala Limestone and does not occur within 20 feet of the surface (Scott et. al., 2001; Miller, 1986). The Ocala Limestone consists of fossiliferous limestone that may be soft to hard (Williams, et. al., 1977, p. 38). The percentage of aggregate-quality limestone is very limited in the Ocala Limestone as shown by the listings of FDOT aggregate quality-sources in FDOT District 2, which includes Dixie and Gilchrist Counties, where no aggregate producers are shown on the FDOT map (FDOT website). This further suggests the very limited occurrence of aggregate-quality limestone meeting FDOT-specifications within the Ocala Limestone in this region. The Geologic Map of Florida (Figure 2) shows Ocala Limestone throughout nearly all of Dixie County and portions of Gilchrist County (Scott, et. al., 2001). The map was created using the convention of removing up to 20 feet of undifferentiated sediments that were above a recognizable formation. As a result, in the areas where Ocala Limestone is

mapped, the overburden may be up to 20 feet thick. The Ocala Limestone varies from less than 100 feet thick in southern-most Dixie County to more than 300-feet thick in northern Dixie and Gilchrist Counties (Miller, 1986). Away from the areas mapped as Ocala Limestone, the overburden thickens significantly. Miocene Hawthorn Group (green on the map) and Quaternary undifferentiated sediments (yellow on the map) overlie the Ocala Limestone in much of this area. These sediments which comprise the intermediate aquifer system/intermediate confining unit and the surficial aquifer system can reach thicknesses exceeding 100 feet.

The Avon Park Formation becomes deeper in the subsurface away from the crest of the Ocala Platform and becomes less dolomitic with more soft limestone occurring. As a result of the depths below land surface and the thickness of Ocala Limestone overlying the Avon Park Formation, there is no potential for the occurrence of FDOT-quality limestone aggregate from the Avon Park Formation in Dixie and Gilchrist Counties. Moreover, the expense of removing the thick overburden and mining of the Ocala Limestone in order to mine the Avon Park Formation is prohibitive.

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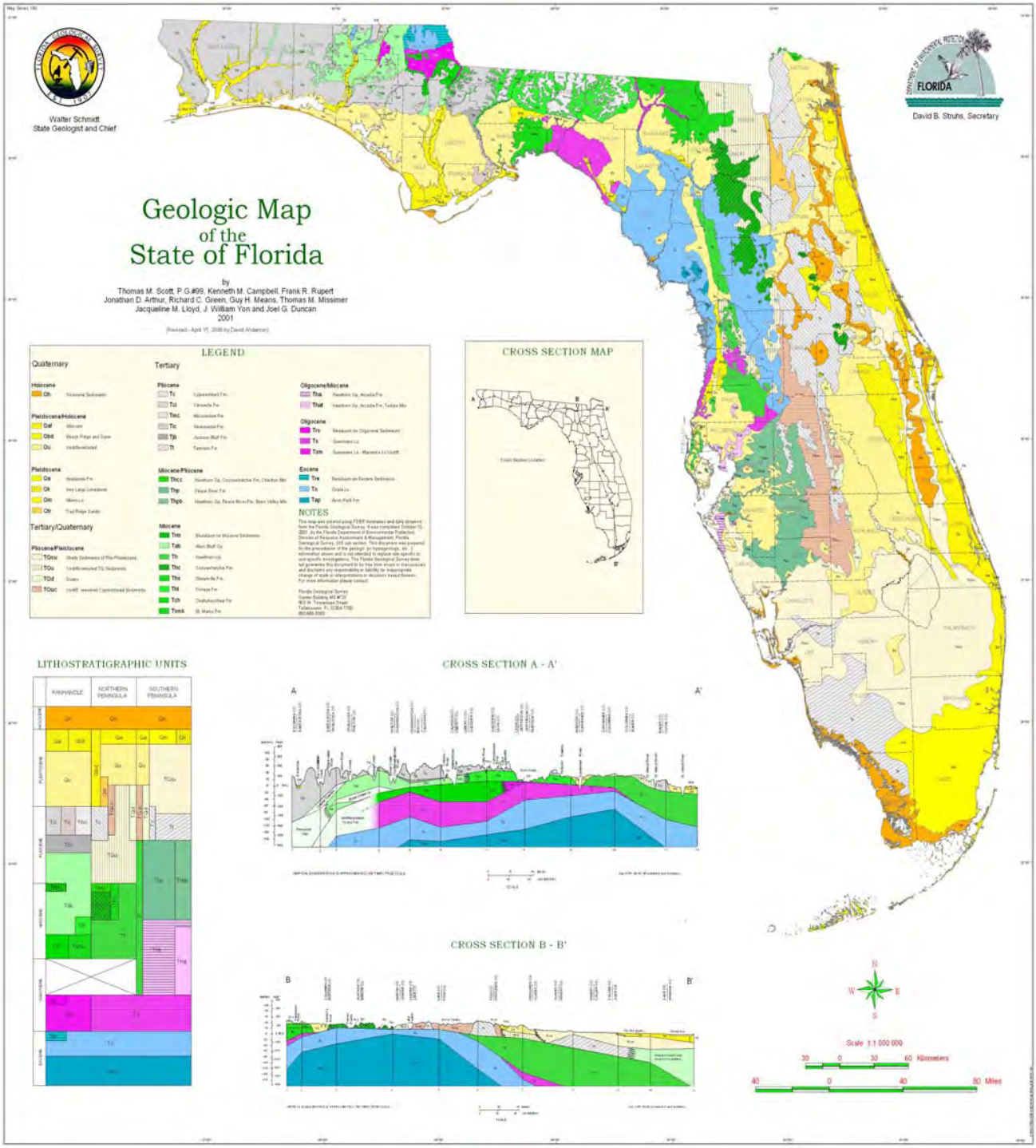
Appendix A


Walter Schmidt
State Geologist and Chief
FLORIDA
David B. Struhs, Secretary
Geologic Map
of the
State of Florida
by
Thomas M. Scott, P.G.#99, Kenneth M. Campbell, Frank R. Rupert
Jonathan D. Arthur, Richard C. Green, Guy H. Means, Thomas M. Missimer
Jacqueline M. Lloyd, J. William Yon and Joel G. Duncan
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CROSS SECTION MAP
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NORTHERN PENINSULA
SOUTHERN PENINSULA
CROSS SECTION A - A'
CROSS SECTION B - B'
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Appendix B

Thomas M. Scott Biography

Thomas M. Scott, Senior Principal Geologist, SDII Global Corporation, Tampa, FL, April 2009 to present. BA, University of South Florida (1971); MS, Eastern Kentucky University (1973); PhD, Florida State University (1986). Florida Geological Survey 1974-2009; Assistant State Geologist for Geological Investigations, Florida Geological Survey 1985-2009. Research interests: Cenozoic lithostratigraphy, geologic history, karst geology and hydrogeology. Licensed professional geologist (Florida #99), Certified Professional Geologist (American Institute of Professional Geologists #4950). More than 150 publications, maps, abstracts including the 2001 geological map of Florida and the 2004 Bulletin 66 "Springs of Florida". Awards – "Hero of Industry" Award from Florida Section of American Institute of Professional Geologists, 1992; Donald C. Haney Outstanding Alumnus Award, Eastern Kentucky University, 1996; 2001 Florida Geological Survey Employee of the Year; Outstanding Alumni Award from the University of South Florida Geology Alumni Society, 2002; elected as a Fellow of the Geological Society of America, 2004; Florida Springs Protection Award, 2009; Florida Geological Survey Lifetime Achievement Award, 2009.

Environmental Evaluation of Practicable Alternatives for Proposed Tarmac King Road Limestone Mine

SEPTEMBER 2010

PREPARED BY

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ENTRIX
Down to Earth. Down to Business.

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ENVIRONMENTAL EVALUATION OF PRACTICABLE ALTERNATIVES FOR PROPOSED TARMAC KING ROAD LIMESTONE MINE

Tarmac America LLC, a Titan America Business ("Tarmac"), has prepared an alternatives analysis pursuant to 40 C. F. R. § 230.10 of the Clean Water Act to assist the U. S. Army Corps of Engineers (the "Corps") in its evaluation of the proposed King Road Limestone Mine in Levy County, Florida. This alternatives analysis determined that mining a specific portion of the Avon Park limestone outcrop formation in Levy County would meet the overall project purpose and that the proposed site was the least environmentally damaging practicable alternative. This environmental assessment describes the analysis of key environmental features that Tarmac undertook to make the determination that the King Road site would meet the overall project purpose while causing the least amount of environmental impact on potential sites within the Avon Park Formation.

To meet the overall project purpose, the mine site needs to include a large mining footprint (the preferred site has 2,756.9 acres), plus additional land for support facilities (the preferred site has 900+ acres). Additional acreage also is needed so that the mine site can best be configured to avoid any significant environmental features within the ownership (the preferred site has 4,750.5 acres). Any unavoidable wetland impacts would need adequate compensatory mitigation within the same watershed (Waccasassa River HUC 8 Basin), although the mitigation site need not be immediately contiguous. A mitigation site has been identified for the preferred alternative, and the mine site plus the mitigation site total 9277 acres. Only the mine site requirements have been used as constraints for placement of the mine, but a mitigation site adequate to mitigate for impacts to wetlands on the chosen alternative must be available.

The "Nature Coast" region is characterized by environmental features associated with a flat, limestone-dominated topography with higher elevations in the east with sandy soils of significant depth over the limestone, grading westwards into limestone flats, and then into coastal islands and extensive salt marshes along the coast. Historically, much of the study area was mesic and hydric hammock ("Gulf Hammock"), but over the past 50+ years most of the hammocks have been converted to intensively managed pine plantations, except in areas that are too wet to plant. The Floridan Aquifer discharges in this general region via springs and streams that flow west toward the Gulf of Mexico. Much of the region is wetland as a result of the low-lying topography, aquifer discharge zone, and inability of rainfall to percolate far downward due to the high water table and limestone. The environmental component of this alternatives analysis looks at environmental constraints to determine what areas have the least impact on the water resources combined with minimizing constraints to other environmental features.

Mining can only occur where the Avon Park Formation exists and at depths within reach of a large dragline (< 120 feet)—currently the only practicable method of extracting deposits of durable limestone (see Appendix 3 of Tarmac's Practicable Alternatives Report). Exploratory drilling and testing results available to Tarmac have indicated that some areas of the Avon Park Limestone Formation in Levy County can produce high-quality aggregates meeting FDOT specifications. Furthermore,

outcroppings of the Avon Park Formation in this region have been mapped and are available from the FDEP, so potential areas of durable limestone with minimal overburden are known. As detailed data on overburden depth are not available, the Avon Park limestone outcrop areas A - D have been buffered by 2.5 miles to ensure that all potentially minable areas were included in the analysis (Figure 1). Areas further from these outcroppings are presumed to decrease in limestone quality and/or increase in depth of overburden. The King Road site itself bears this out, as areas furthest away from the surface outcropping have lower quality rock. Tarmac also is aware that some of the Avon Park Formations identified for Levy County lack additional high quality mineable rock. For example, the Florida Rock Gulf Hammock mine in area B recently closed as a result of problems with pyrites in the deposit, and none of the mines in area D in Citrus County produce FDOT-grade aggregate.

Within the known Avon Park outcropping, avoidance of flowing surface waters and significant wetland resources are considered to have the highest priority.

In this region, streams range from small intermittent systems that flow only during climatically wet periods to clear, stream-fed systems that flow over limestone bedrock (Wekiwa River, a tributary of the Waccasassa River) to perennial blackwater streams (lower Withlacoochee River) whose water is darkly tannic due to flowing extensively through swamps. For purposes of this analysis, suitable areas were considered to be those which would have the least impact on mapped streams (Figure 2). A “mining less suitable” buffer of 0.5 mile was placed around each stream identified in the National Hydrography Dataset GIS (a nationally available set of data prepared by USGS), recognizing that the stream courses may not be precisely mapped but that higher-quality (contiguous) wetlands are typically associated with such systems. Lands more than 0.5 mile from mapped streams are assumed to be less environmentally sensitive. Based only on mapped streams (Figure 2), land in the vicinity of Avon Park Limestone outcrop area D has the fewest steams (but included the Withlacoochee River), areas A and C have intermediate densities of streams, and area B has the most streams (including the Waccasassa River and its mapped tributaries). The extremely high density of mapped streams in outcrop area B renders most of this deposit potentially unmineable from a permitting perspective.

In addition to mapped streams, Tarmac has avoided natural (unditched) steam channel tributaries of unmapped streams, as these high-quality undisturbed aquatic resources are difficult to reclaim or mitigate and therefore the FDEP prefers they be avoided if possible. No public, quantitative data sources are available to evaluate unmapped natural stream channel tributaries, so the chrono-series of imagery available on Google Earth was visually inspected to identify potential intermittent stream hotspots and areas that may be more suitable for large-scale mining in outcrop areas A – D. This analysis indicated the fewest unmapped intermittent streams occurred in area D, but revealed a much more complicated pattern of intermittent streams, particularly in locations without mapped streams in outcrop areas A, B and C (“green” areas in Figure 2). In outcrop area A (north of the existing conservation easement boundary; see Figure 4), intermittent stream channels intrude and connect to the mapped streams. Similarly, the “green” area south of U. S. 19 in area B contains two major north-to-south oriented intermittent streams. Inspection of imagery (later confirmed by field review) showed that

the mapped stream in the northeastern quadrant of the proposed King Road mine parcel in outcrop area C (Figure 2) actually does not connect to Spring Run to the north, but rather travels due west and then south about one-half mile to connect to another intermittent stream. Finally, numerous intermittent stream channels also are present between Spring Run and Tenmile Creek in the northern parts of outcrop area C. From strictly the perspective of mapped and unmapped streams, Tarmac determined that portions of outcrop areas A, C and D potentially could support a limerock mine, and area B was unsuitable.

Wetlands are present throughout the assessment area. The amount of wetlands, however, varies. Areas with the more wetlands are considered to be less suitable for mining (Figure 3). An estimate of wetland acreage is made by dividing the study area into 0.5-mile grids and quantifying the amount of wetlands mapped by the National Wetlands Inventory (NWI) as follows: grids having less than 50% wetlands are considered to be "most suitable," grids with between 50 and 80% wetlands are classified as "less suitable" and those with more than 80% wetlands are classified as "least suitable." Based on NWI coverages, Avon Park Limestone outcrop area D has the lowest density of wetlands, followed by areas B, C and A, respectively.

However, the NWI maps do not necessarily reflect wetland quality or quantity in intensively managed landscapes such as the Gulf Hammock region. The chrono-series of imagery available on Google Earth is particularly useful for this purpose because by switching among images in different years and seasons, dormant wetland hardwoods are easily detected in winter frames, as is the extent of planted or harvested pine. For example, although the King Road mine parcel is mapped as having a higher percentage of NWI wetlands than Avon Park outcrop area A (Figure 3), the Google Earth imagery clearly shows a much higher proportion of Avon Park outcrop area A being composed of wetland hardwoods relative to the King Road mine site, which has more lower quality, planted pine habitat.

Tarmac also has evaluated impacts to conservation lands. Most of the coast within the study area falls within the Waccasassa Bay Preserve State Park, and Plum Creek Timber Company has granted a conservation easement over lands connecting this park to Goethe State Forest to the east (Figure 4). Lands under conservation easements cannot be selected for mining, as excavation is not a permitted use under such an easement. The Waccasassa Bay Preserve State Park is considered to be a "mining not suitable area" with a 0.5- mile "mining not desirable" buffer outside of its boundary. Conservation easement areas and state forest ownerships are considered to be "mining not suitable" but no buffer has been placed around them. Potions of all four Avon Park Limestone outcrop areas fall within portions of existing conservation easements and were within 1 mile of state parks (Figure 4).

Impacts to rare species also have been mapped. Known locations of rare plants and animals were obtained from the Florida Natural Areas Inventory (FNAI) database and mapped (Figure 5). These have not been buffered as the data is considered inadequate in terms of detail and completeness to identify specific habitats or the overall distributions of the plants and animals. No detailed surveys have been conducted on the private lands, so rare species occurrence on those lands can only be surmised. Sites or habitats known to support federally listed species are presumed to be more significant

than those supporting other species lists maintained by FNAI. Known occurrences of rare species are lowest in the vicinity of Avon Park Limestone outcrop area D (Figure 5), possibly because of the high human density in this region (see Figures 7 and 8 below) and/or absence of surveys. The other three outcrop areas have similar numbers of occurrences of rare species, and many of these locations are associated with conservation lands (Figure 5) that had been surveyed more thoroughly. Federally listed species (bald eagle nests and Eastern indigo snakes) are broadly distributed in this region.

Tarmac further has sought to identify storm surge areas. The potential environmental consequences of mining within a storm surge area is not entirely known, but some impact is judged probable given the porosity of the rock and the potential for salt water to fill the mine pits and get into the aquifer. Areas mapped by the National Disaster Network, Florida Division of Emergency Management as being in the storm surge zone for tropical storms are mapped as "least suitable." Areas within the storm surge of Category 1, 2 or 3 Hurricanes are mapped as "suitable," and areas within Category 4 or 5 Hurricanes are mapped as "most suitable" (Figure 6). Compared to Avon Park Limestone outcrop areas C and D, greater portions of areas A and B are in storm surge areas deemed least suitable (Figure 6).

Tarmac also has evaluated considerations of property ownership and availability. To be a practicable alternative, Tarmac needs to acquire a site of adequate size for mining, support facilities, avoidance of high-quality aquatic resources and the ability to provide compensatory mitigation for unavoidable impacts from a willing seller(s) in the study area. Acquiring a large parcel of land from multiple parties is difficult and costly. Single ownership from a willing seller is the strongly preferred alternative. Inholdings within a mine site also are impracticable, because of access requirements and safety (MSHA and OSHA) concerns for unwilling sellers. Figure 7 provides parcel ownership information for the study area.

Avon Park Limestone outcrop area D contains many thousands of parcels (Figure 7) and thus is inappropriate for a mine site. The southern half of area B and the eastern third of area C contain tens to hundreds of parcels, making these areas also infeasible. Furthermore, the northern half of area B was split by U. S. 19, and operationally, mining on both sides of this major arterial road is impracticable. From a property ownership perspective, the only feasible mining locations are in outcrop areas A and C, both of which are largely owned by Plum Creek Timber Lands. Plum Creek has been unwilling to lease or sell portions of area A. Distance from human population centers also is a factor to consider. In general, large limestone mines cannot receive the required zoning and land use permits if they are in or near urbanized areas. Human population estimates (Figure 8) indicate that Avon Park Limestone outcrop area D is too urbanized for a mine and areas A, B and C all averaged 0-25 people per square mile. Levy County parcel ownership maps (Figure 7) provide a more refined evaluation of smaller enclaves of likely human occupation.

In summary, this environmental analysis determined that Avon Park Limestone Formation outcrop area D was too heavily populated to site a new mine, and the few remaining unpopulated areas in area D already had mines that could not produce FDOT-grade aggregate. The remaining outcrop areas have a much lower human population density, relatively large areas under single ownership, and an agricultural land use

designation that makes mining potentially feasible. The southern half of outcrop area B has numerous property owners or is under a conservation easement, whereas the northern half of B is split by U. S. 19 and has a very high density of mapped and unmapped streams with associated high-quality riparian wetlands. These multiple factors make outcrop area B unsuitable as a large-scale mine site. Outcrop areas A and C have similar densities of wetlands, but a higher proportion of Avon Park outcrop area A is composed of wetland hardwoods when compared to the King Road mine site, which has a larger proportion of lower quality, planted pine habitat. From this important perspective, mining in area C at the proposed King Road site is the least environmentally damaging practical alternative among the available Avon Park outcrop formations.

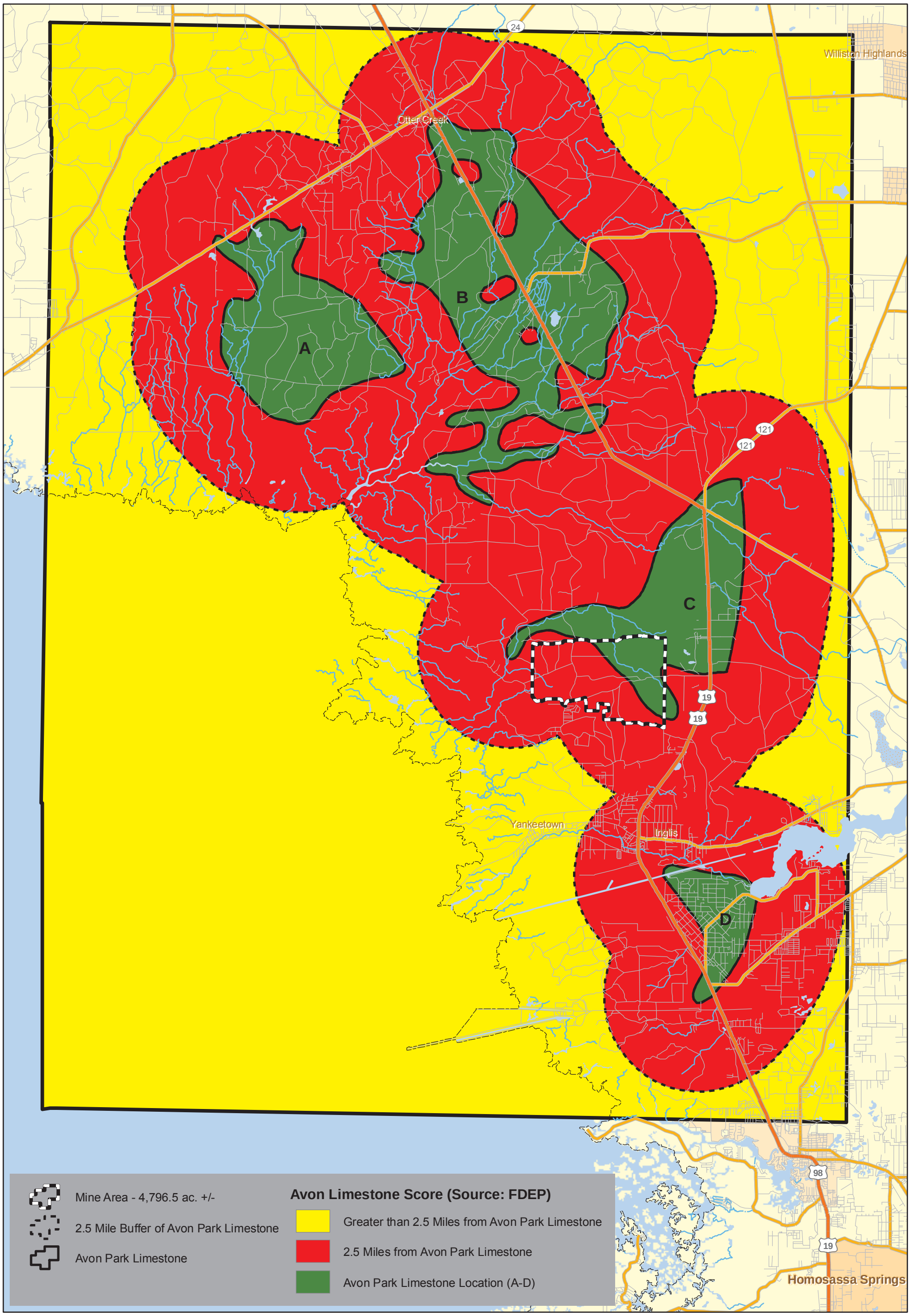

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Figure 1 - Avon Park Limestone Suitability

Tarmac King Road Limestone Mine
Levy County, Florida

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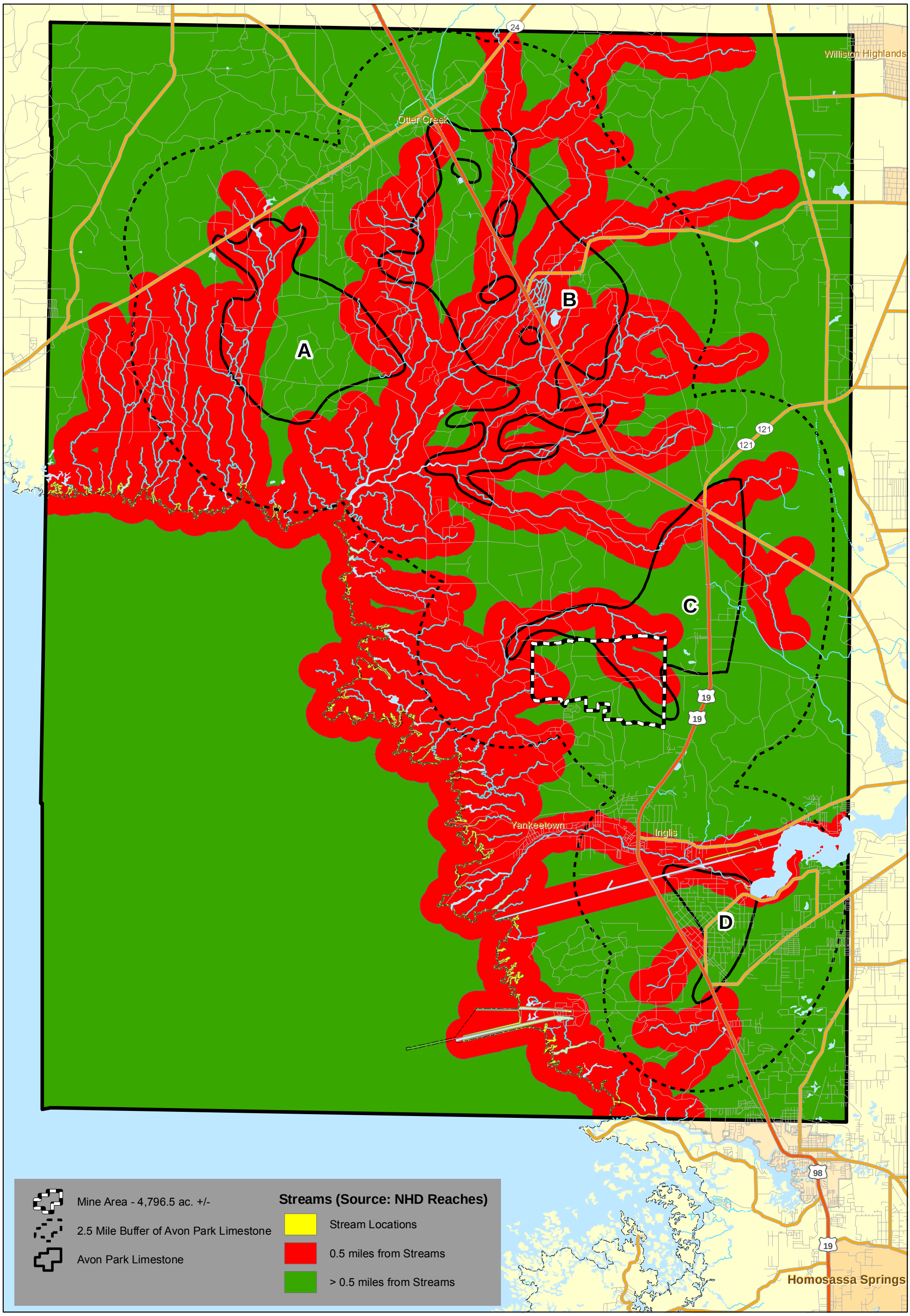

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Figure 2 - Streams Suitability

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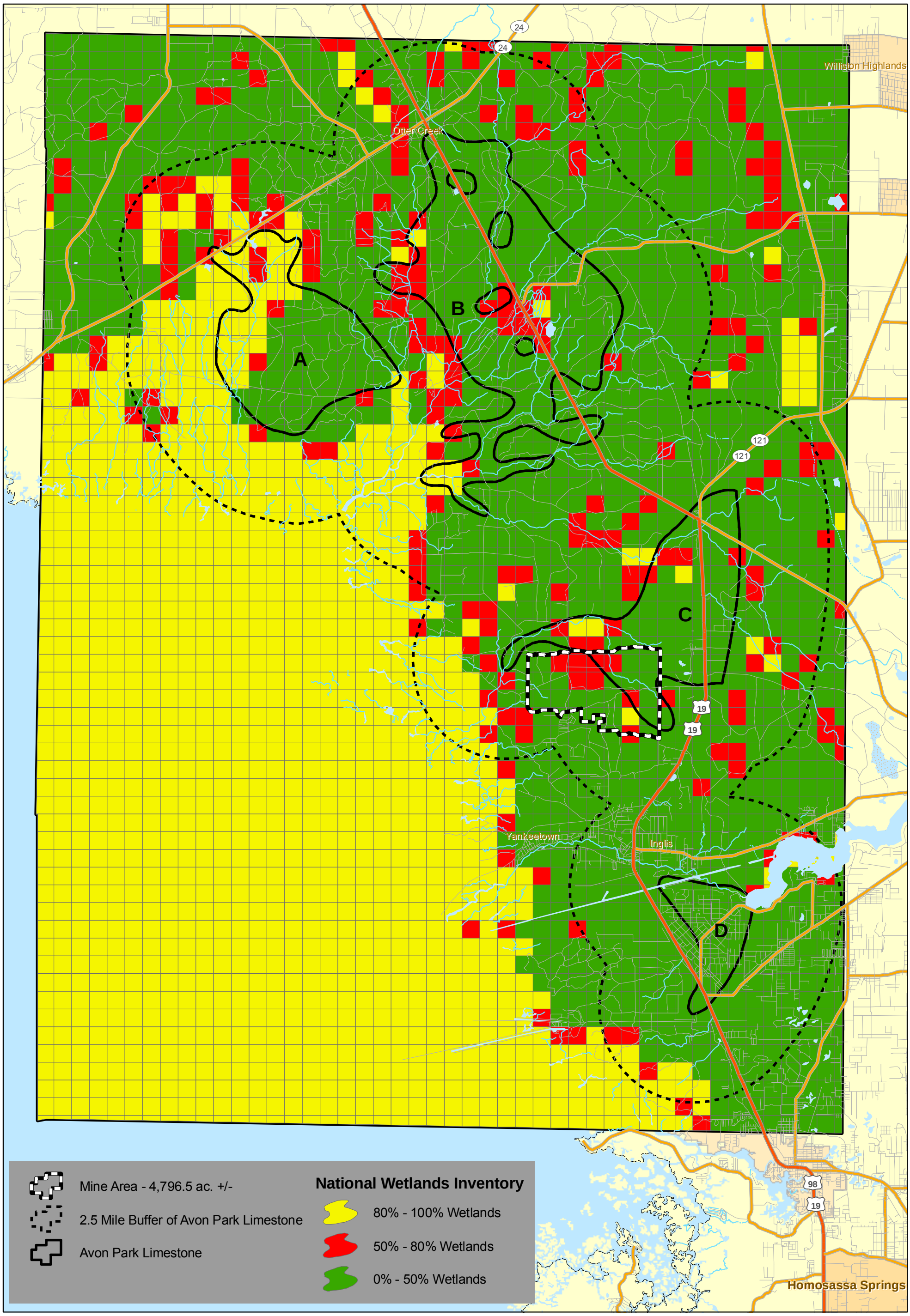

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Figure 3 - NWI (National Wetlands Inventory)

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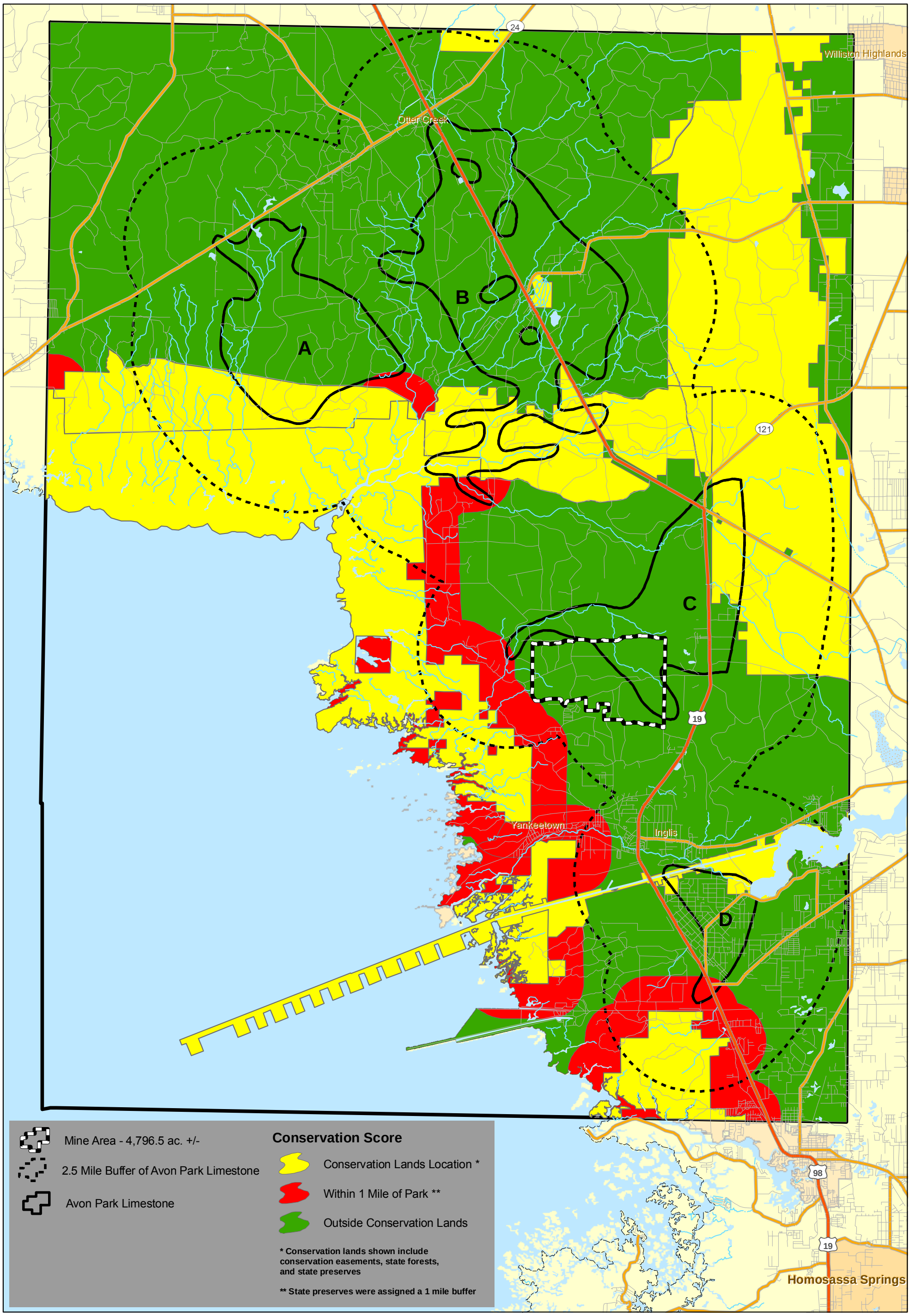

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Figure 4 - Conservation Lands

Tarmac King Road Limestone Mine
Levy County, Florida

Image: 2008

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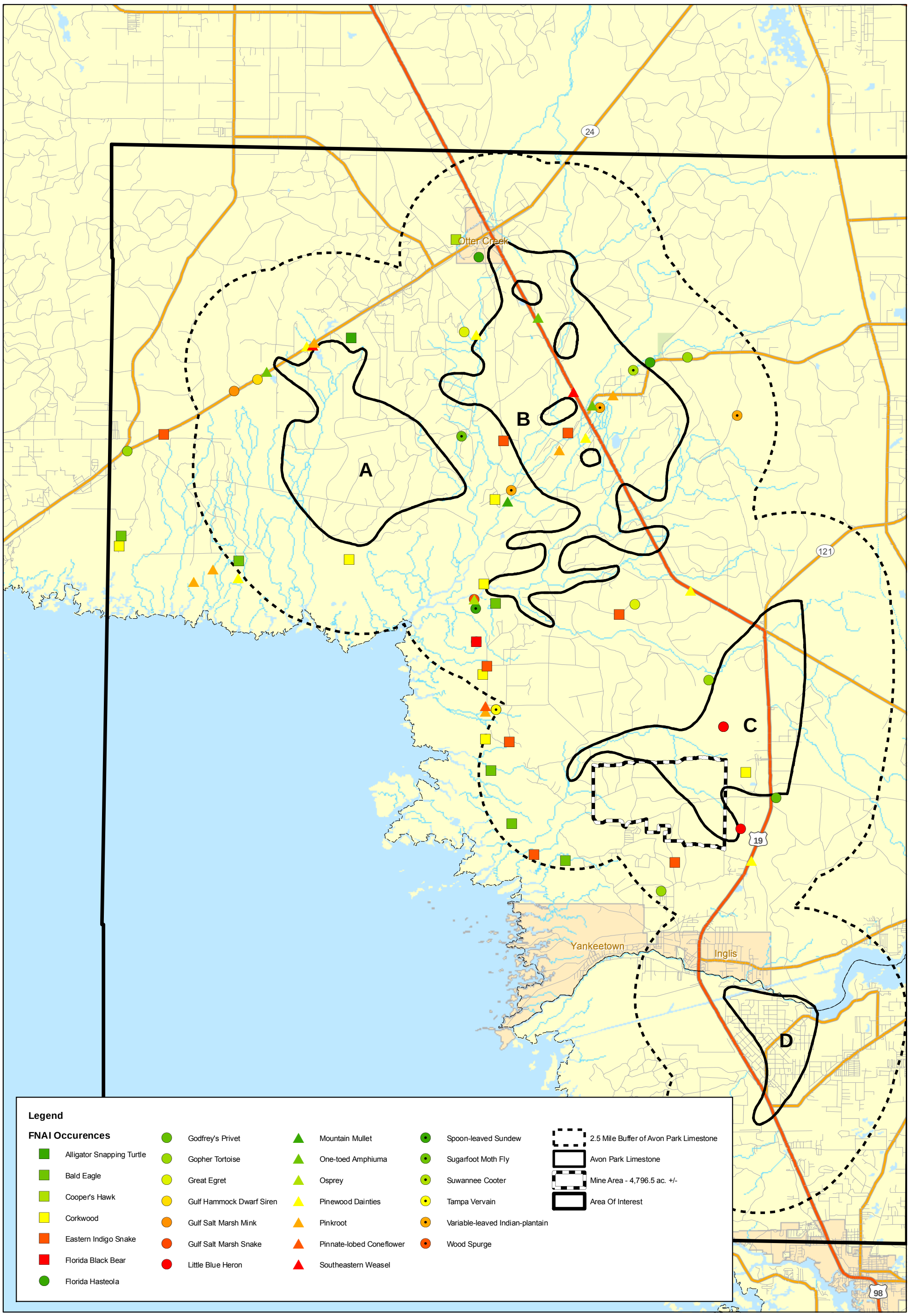

0 2.5 5 7.5 Miles

0 4,024 8,048 12,072 Meters

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Figure 5 - FNAI

Tarmac King Road Limestone Mine
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Image: Basemap

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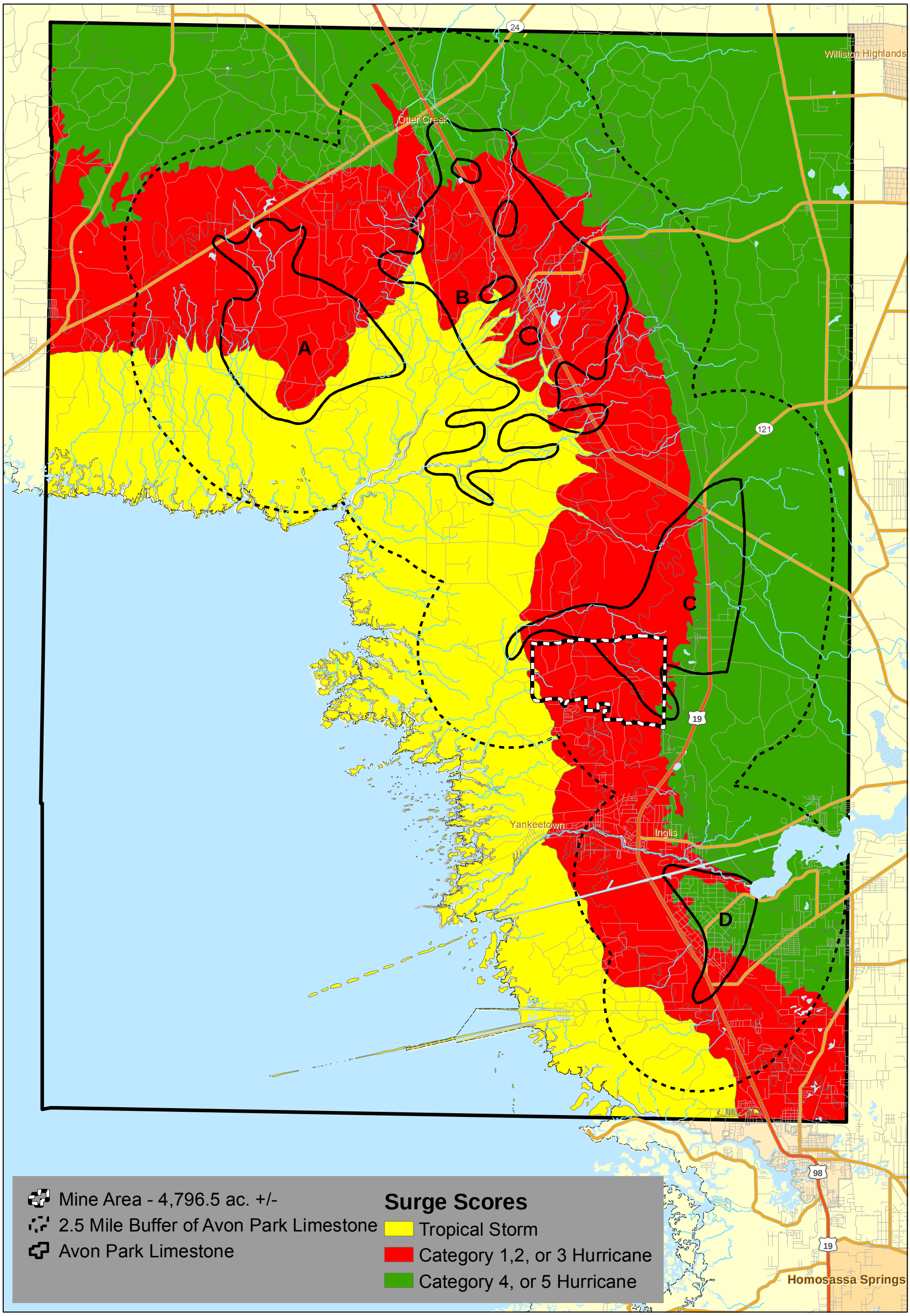

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Figure 6 - Storm Surge Suitability

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Levy County, Florida

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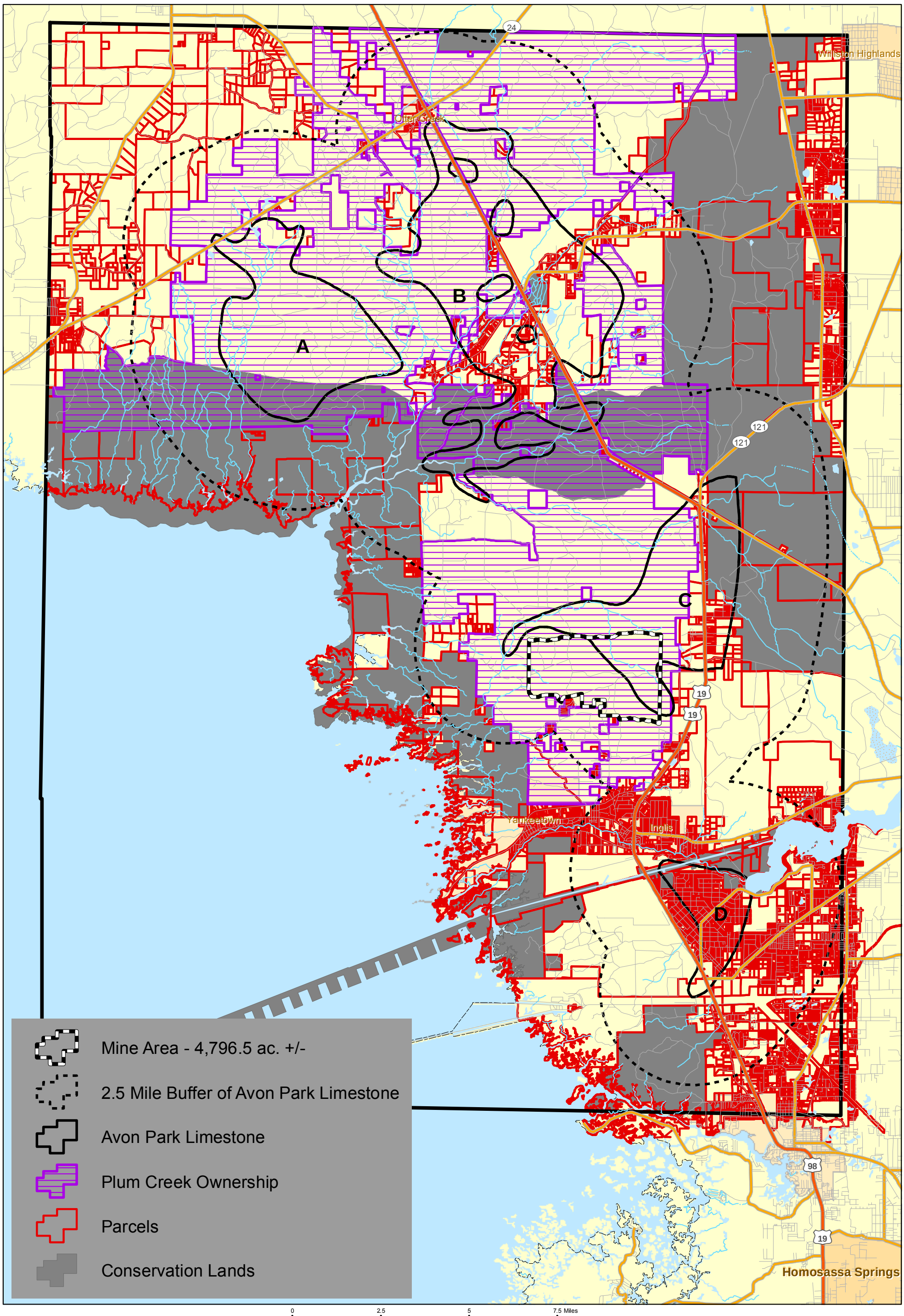

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Figure 7 - Parcels

Tarmac King Road Limestone Mine
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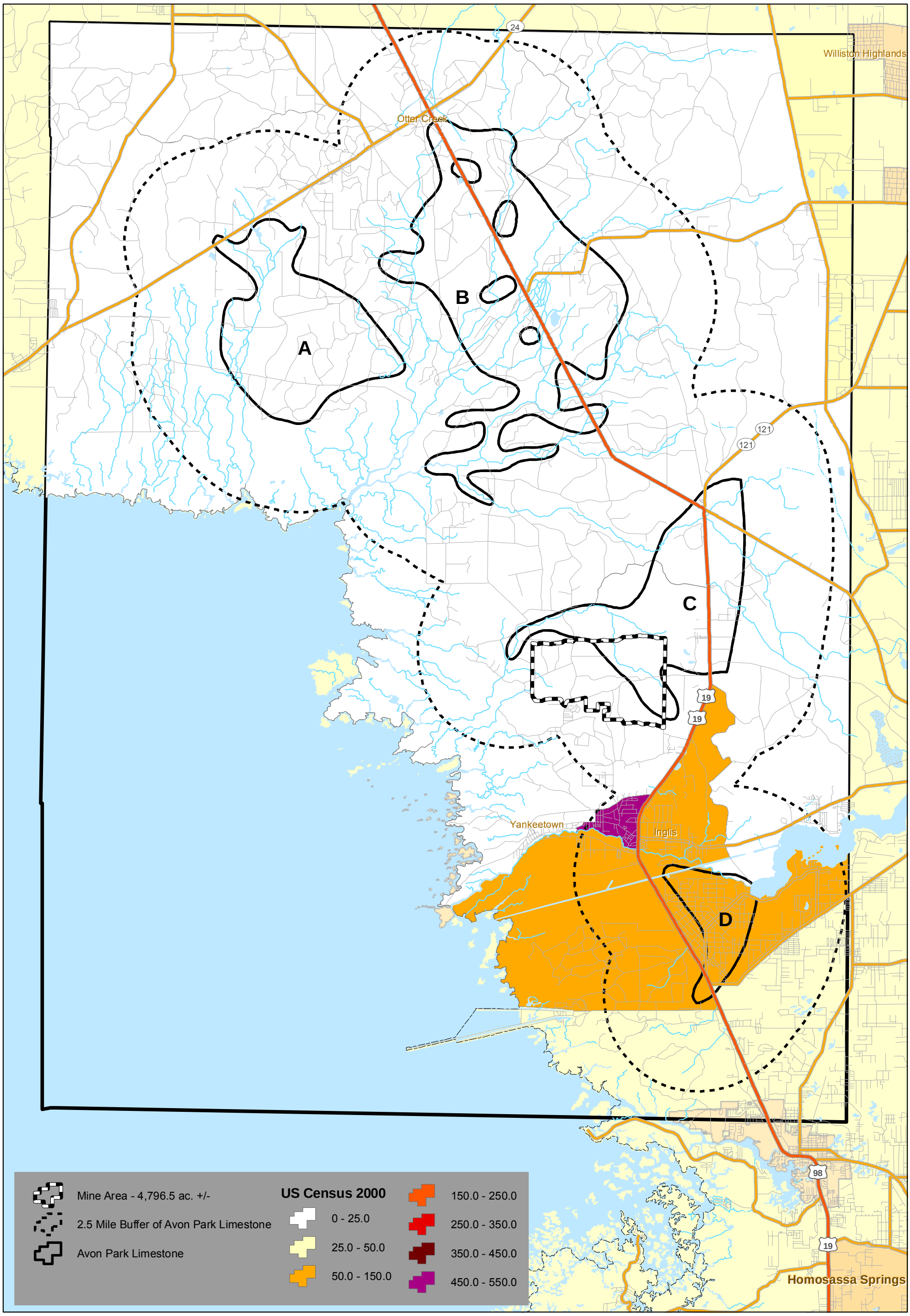

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Figure 8 - Population Density

Tarmac King Road Limestone Mine
Levy County, Florida

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McLEAN ENGINEERING CO., INC.
P.O. Box 2587, 815 South Main, Moultrie, GA 31776/31768, (229) 985-1148

August 2, 2010

Tarmac America, LLC
Cindy Burns, Project Engineer
455 Fairway Drive
Deerfield Beach, FL 33441

Reference: Central Florida Electric Cooperative, Inc.
King Road Substation – Streams Suitability

Dear Ms. Burns:

In response to your request for a cost estimate for the relocation of the proposed King Road Substation site, we offer the following:

		Cost per Mile	Total Cost
• Right-of-Way Acquisition (100' R/W width @ $15,000/acre)	=	$175,000	$2,100,000
• 230 kV Transmission Line (labor & materials)	=	$475,000	$5,700,000
• Transmission Engineering/Surveying	=	$ 58,500	$ 700,000
TOTAL ESTIMATED COST OF TRANSMISSION			**$8,500,000**
• Proposed 230-25 kV Substation	=		$6,400,000

This estimate was prepared using costs from other transmission projects recently completed in this area. Also enclosed, as requested, is my Employee Profile as credentials for preparing the estimate.

Please let us know if you have any questions or comments, or if we can assist in any way.

Yours truly,

McLean Engineering Company, Inc.

By _____
Greg Gladin

GG:ec
Enc.

Copy to: Mike Campbell, Executive Vice President & General Manager, Central Florida ECI
Ben Dawson, Director of Engineering, Central Florida ECI

EMPLOYEE: Gregory D. Gladin (Greg)

PRIMARY JOB RESPONSIBILITY: Field Engineer

YEARS OF EXPERIENCE: McLean Engineering Company, Inc.
24 Years

EXPERIENCE AND QUALIFICATIONS:

Greg's entire work experience has been in the power engineering field. He has had extensive field experience in connection with design, staking, and construction supervision of transmission (through 138kV) and distribution projects. He is also involved in all aspects of substation design, contract preparation and construction supervision. An important aspect of Greg's staking work is insuring conflict avoidance with all other types of utilities. He has been responsible for the firm's acceptance inspection for these types of projects. He is also experienced in the preparation and supervision of distribution construction contracts, contract closeout, and final documents. He has electrical system inventory/evaluation experience on military bases. Greg is also familiar with special permitting (highway and railroad). He is highly valued by our Company and clients.

EDUCATION:

Drafting and Design
Moultrie Area Vocational Technical School, 1986

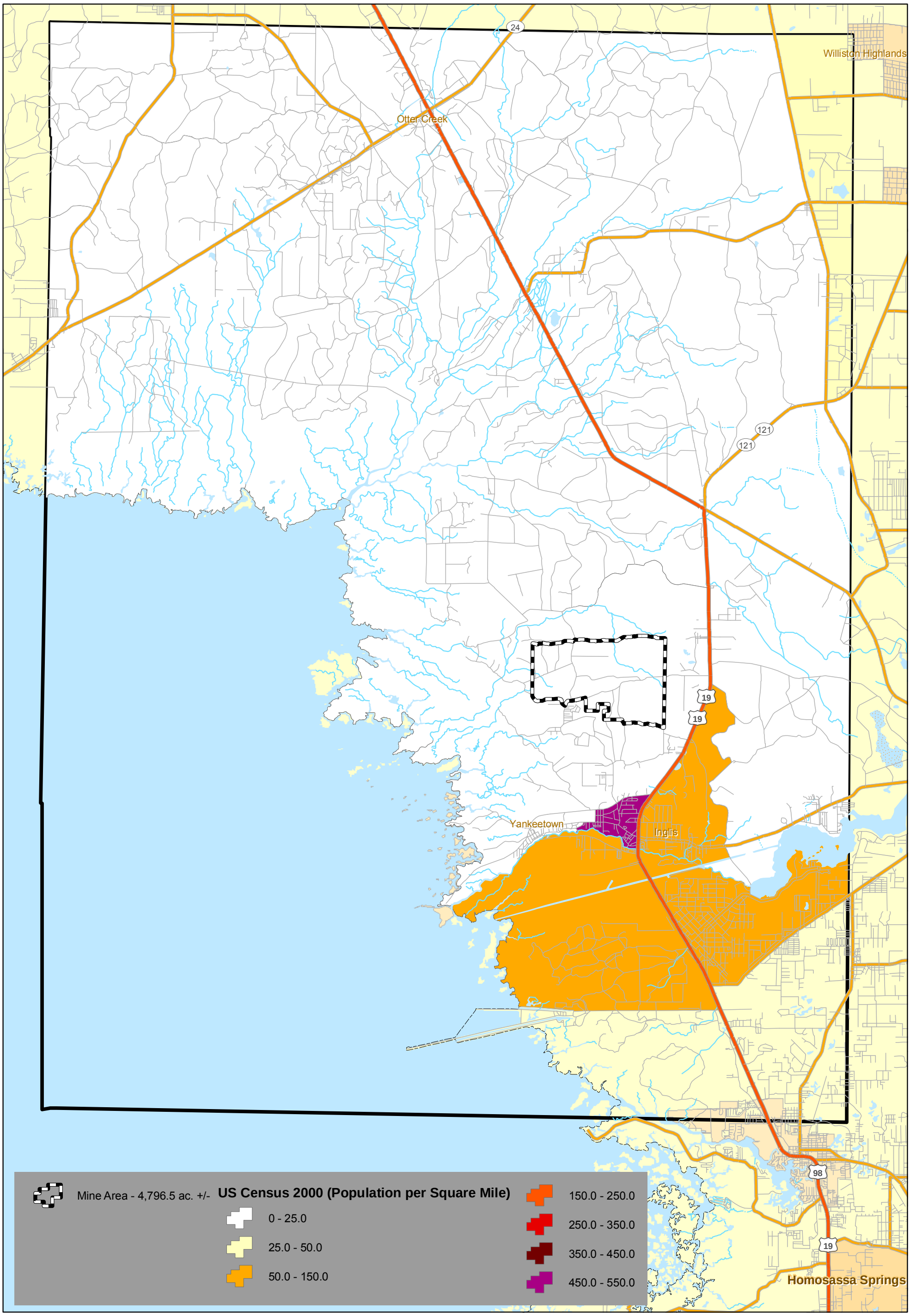

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Figure 1 - Population Density

Tarmac King Road Limestone Mine
Levy County, Florida

Image:2008

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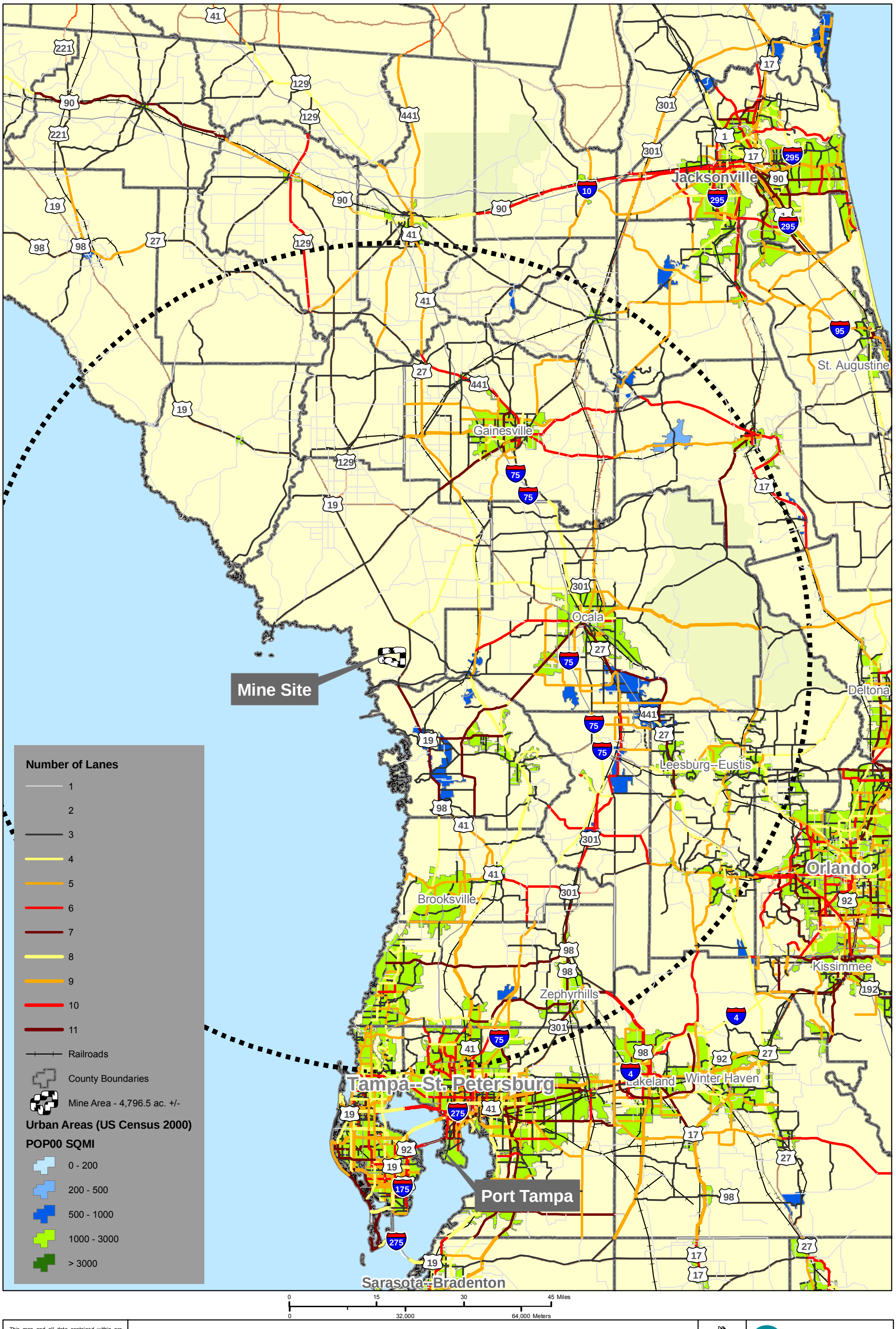

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Figure 2 - Market Area

Tarmac King Road Limestone Mine
Levy County, Florida

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Date: 12/29/2009Rev. Date: 05/26/2010 PM: SRD GIS Analyst: JBR Map Document: fig2_market_areas_B_gda_20100526.mxd Project Number: 7856-001 PDF Document:fig2_market_areas_B_gda_20100526.pdf Plot Size: 11 x 17

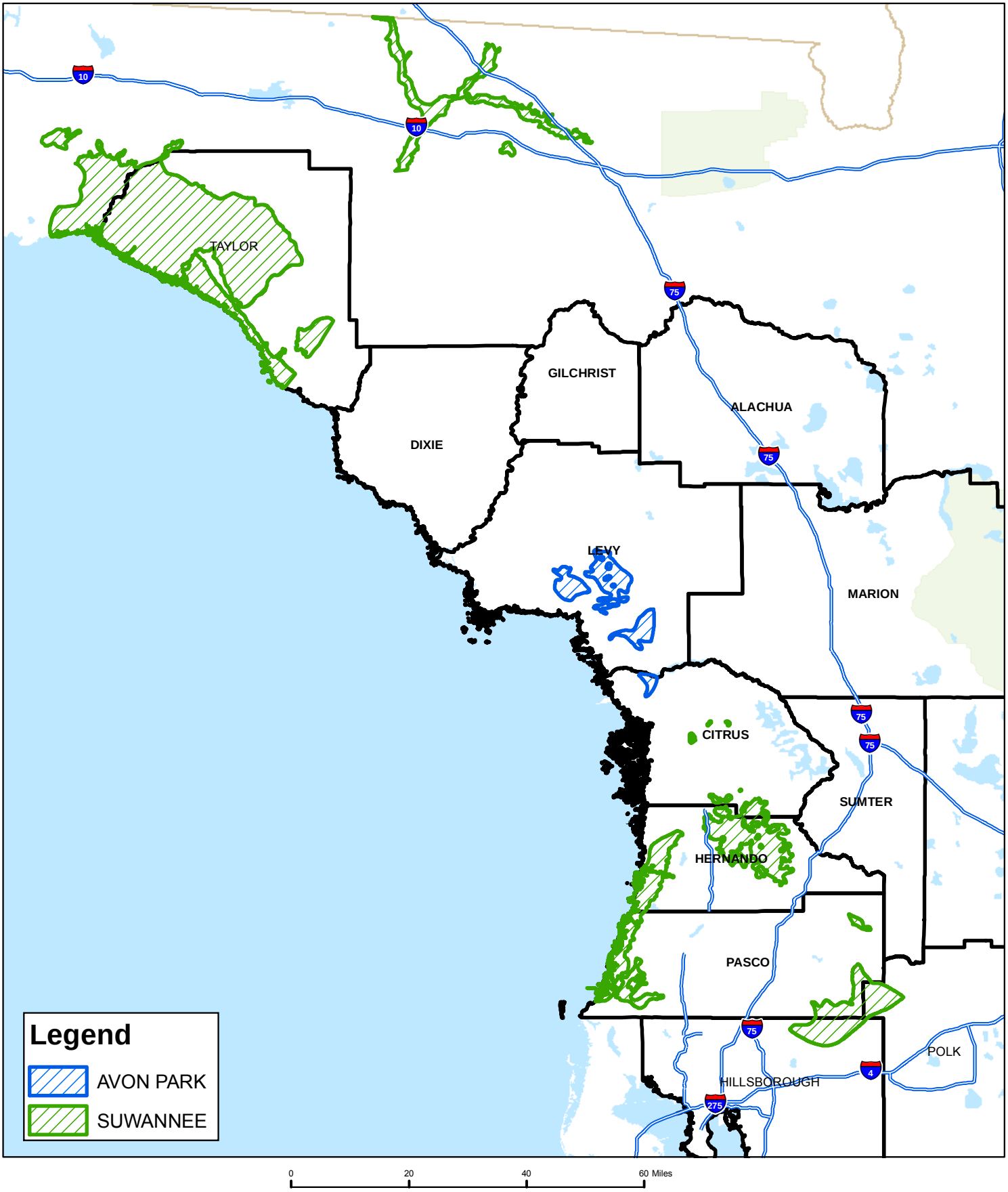

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Figure 3 - Avon Park and Suwannee Formation Outcroppings

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Date: 08/30/2010 Rev. Date: xx/xx/xx PM: XXX GIS Analyst:JBR Map Document: fig3_lu_geology_A_20100830.mxd Project Number: 7856-001 PDF Document: fig3_lu_geology_A_20100830.pdf Plot Size: 8.5 x 11

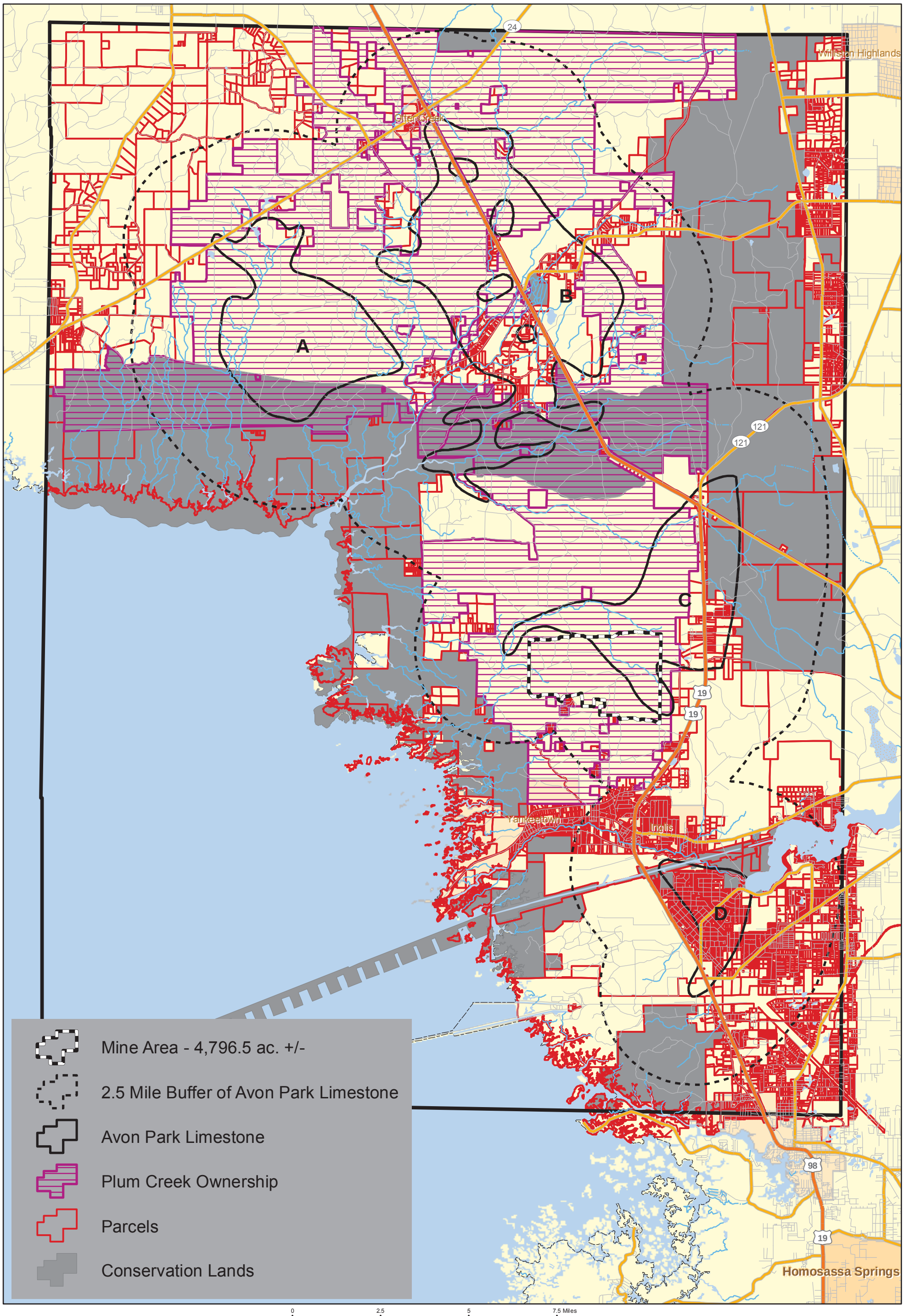

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Figure 4 - Parcels

Tarmac King Road Limestone Mine
Levy County, Florida

Image:2008

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Date: 12/21/2009Rev. Date: 08/17/10 PM: SRD GIS Analyst: JBR Map Document: fig4_parcels_20100512.mxd Project Number: 7856-001 PDF Document:fig4_parcels_20100512.pdf Plot Size: 11 x 17

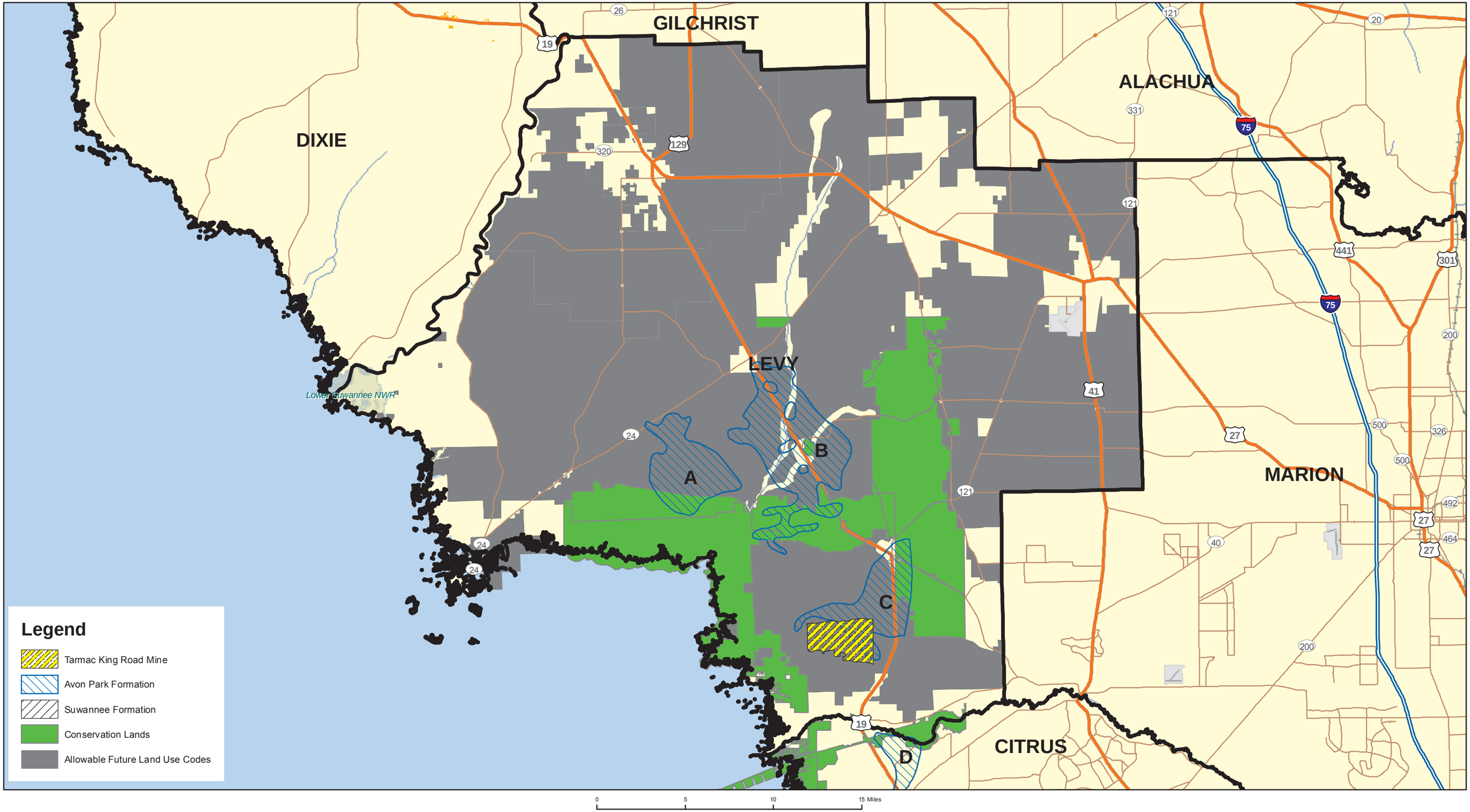

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Figure 5 - Suitable Land Use

Levy County, Florida

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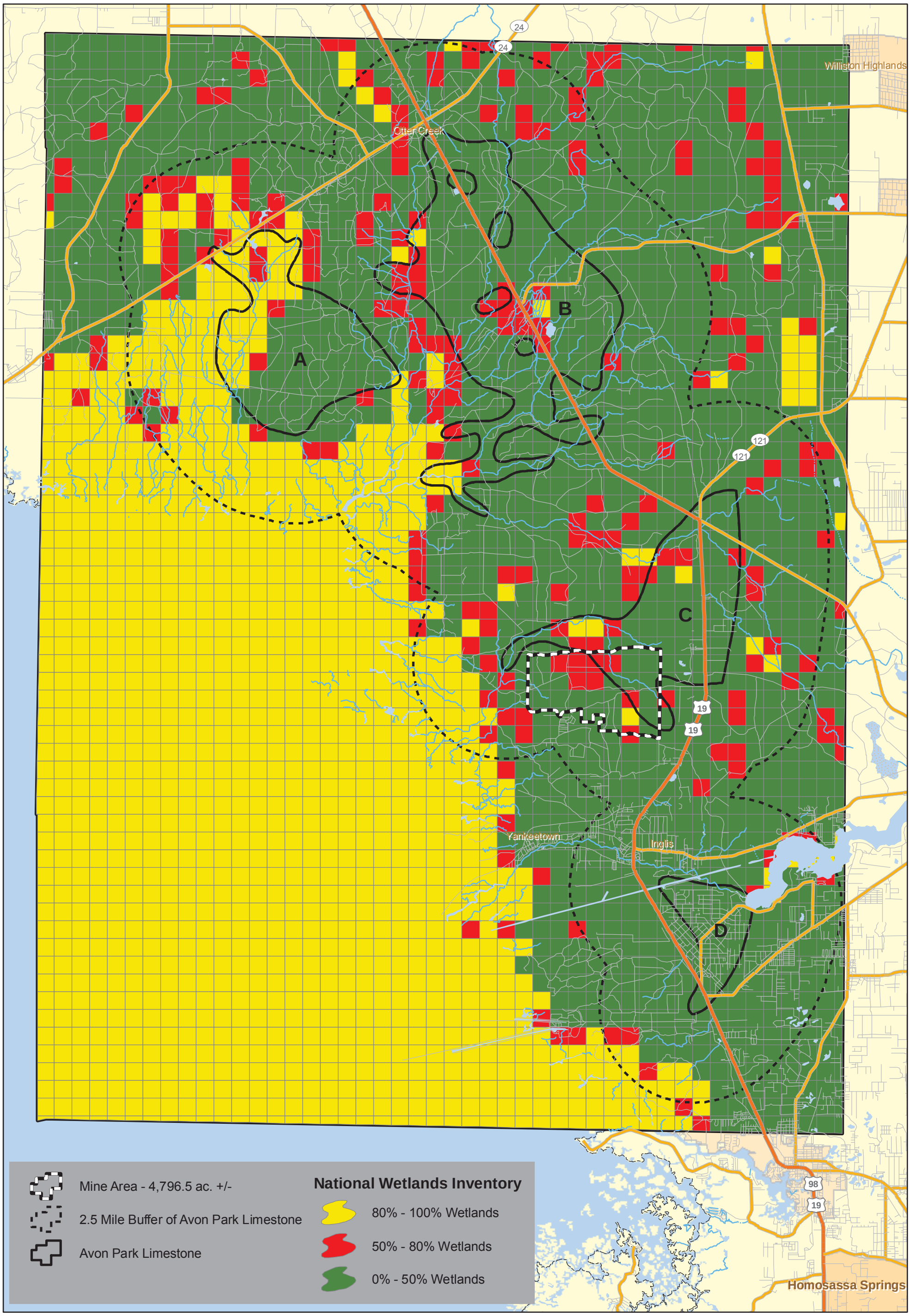

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Figure 6 - NWI (National Wetlands Inventory)

Tarmac King Road Limestone Mine
Levy County, Florida

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Date: 12/21/2009Rev. Date:05/12/10 PM: SRD GIS Analyst: JBR/MAB Map Document: fig6_nwi_20100512.mxd Project Number: 7856-001 PDF Document:fig6_nwi_20100512.pdf Plot Size: 11 x 17

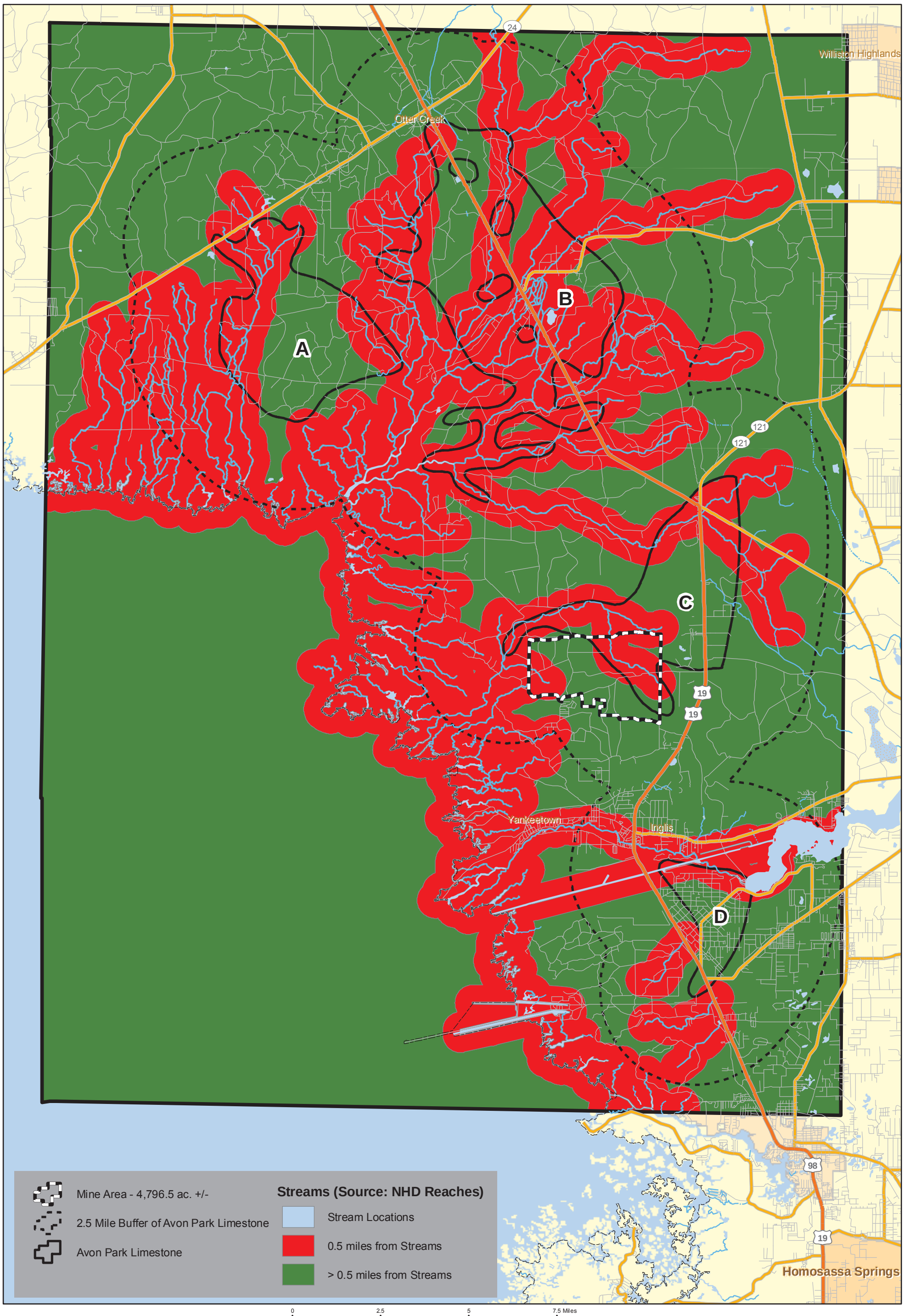

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Figure 7 - Streams Suitability

Tarmac King Road Limestone Mine
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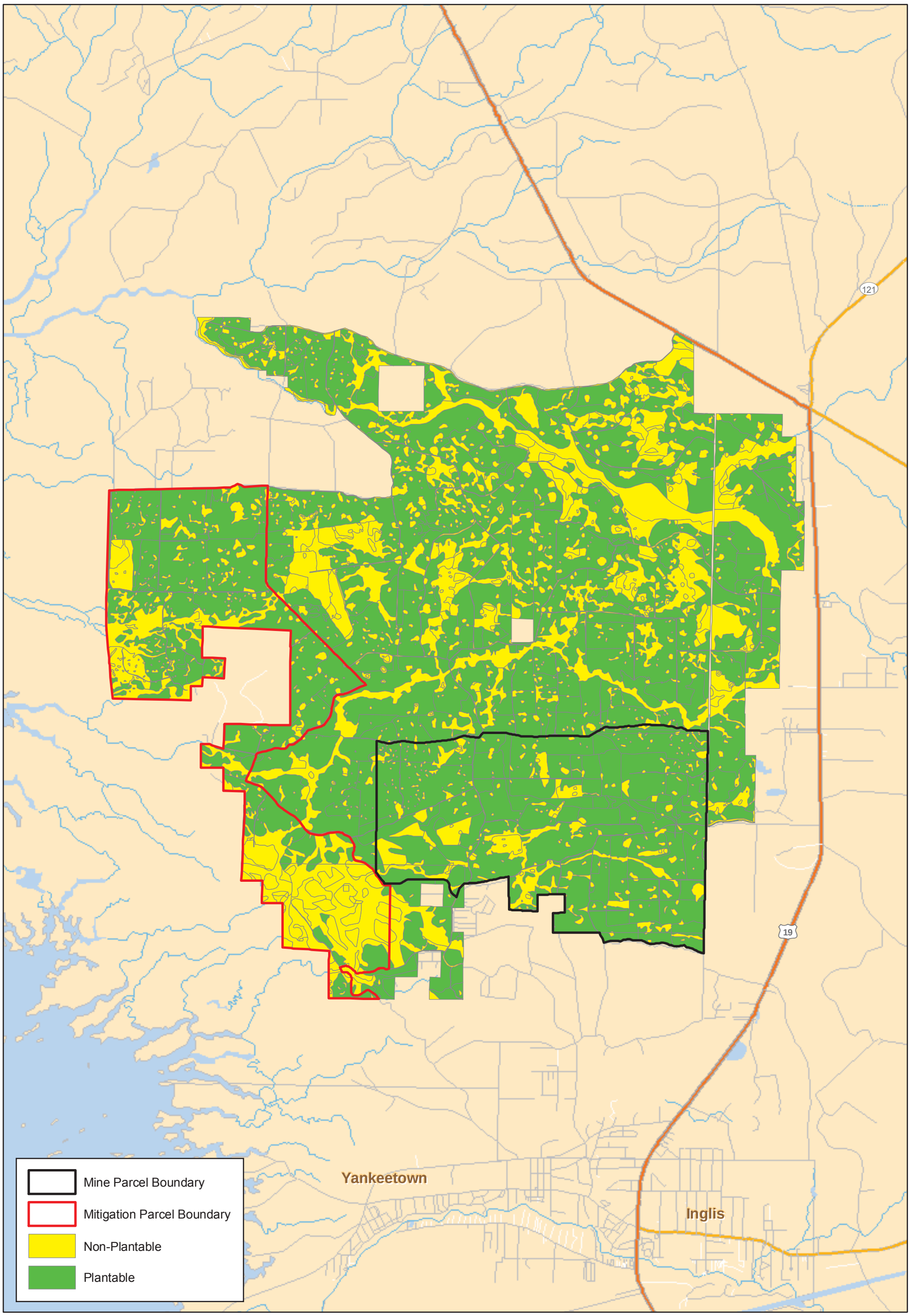
Date: 12/21/2009Rev. Date: 05/12/10 PM: SRD GIS Analyst: JBR/MAB Map Document: fig7_streams_20100512.mxd Project Number: 7856-001 PDF Document:fig7_streams_20100512.pdf Plot Size: 11 x 17



0 1 2 Miles
0 1,600 3,200 Meters

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Figure 8 - Plantable vs. Non-Plantable Plum Creek Land

Tarmac King Road Limestone Mine
Levy County, Florida

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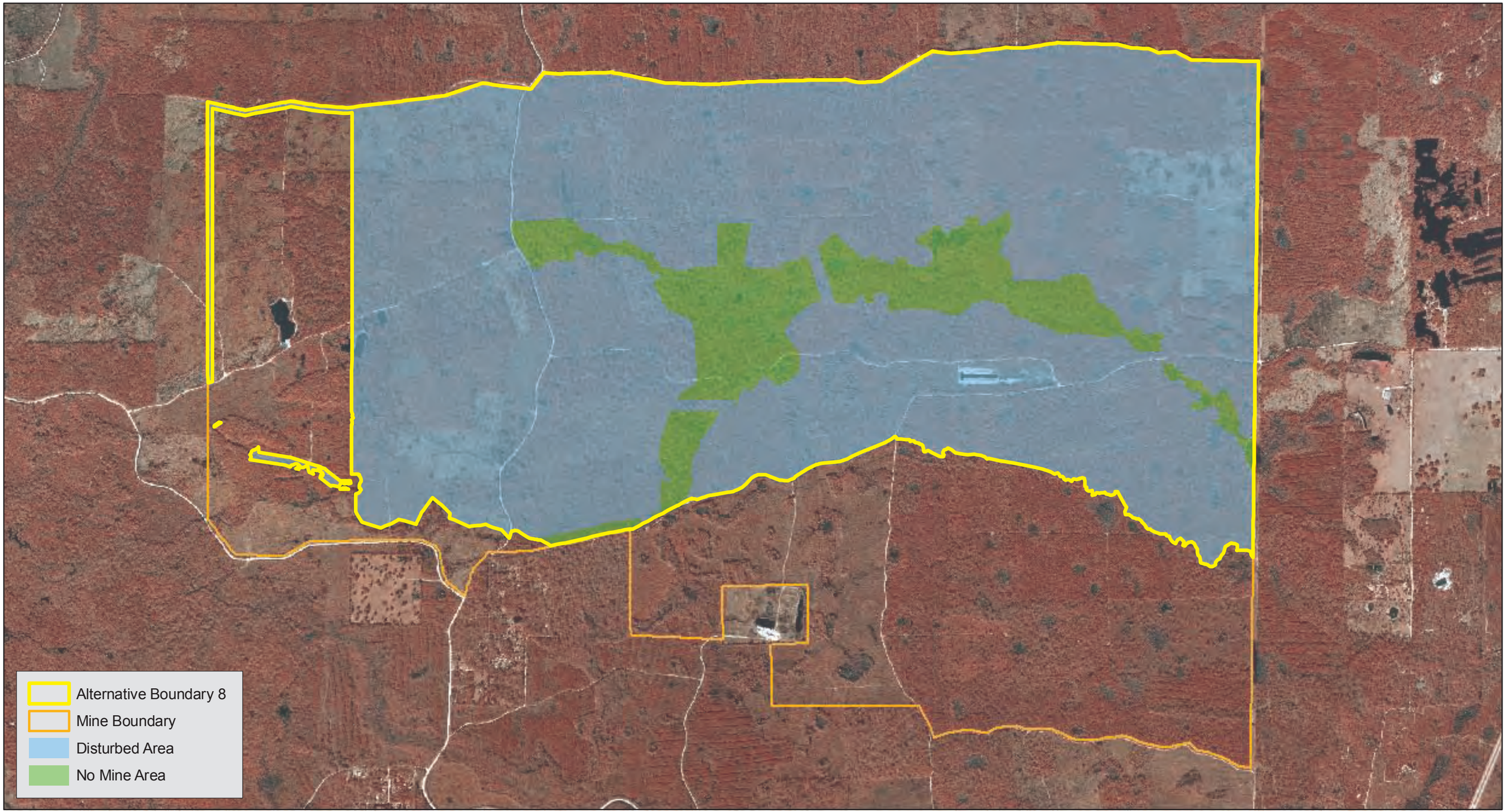
Date: 2010-05-21 Rev. Date: 06/01/10 PM: JSG GIS Analyst: ACW Map Document: fig8_plantability_20100521_1_acw.mxd Project Number: 7856-001 PDF Document: fig8_plantability_20100521_1_acw.pdf Plot Size: 11 x 17



0 1,700 3,400 5,100 Feet

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Figure 9 - USACE Alternative Boundary 8 - UMAM Evaluation

Tarmac King Road Limestone Mine
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Image:2007 IR

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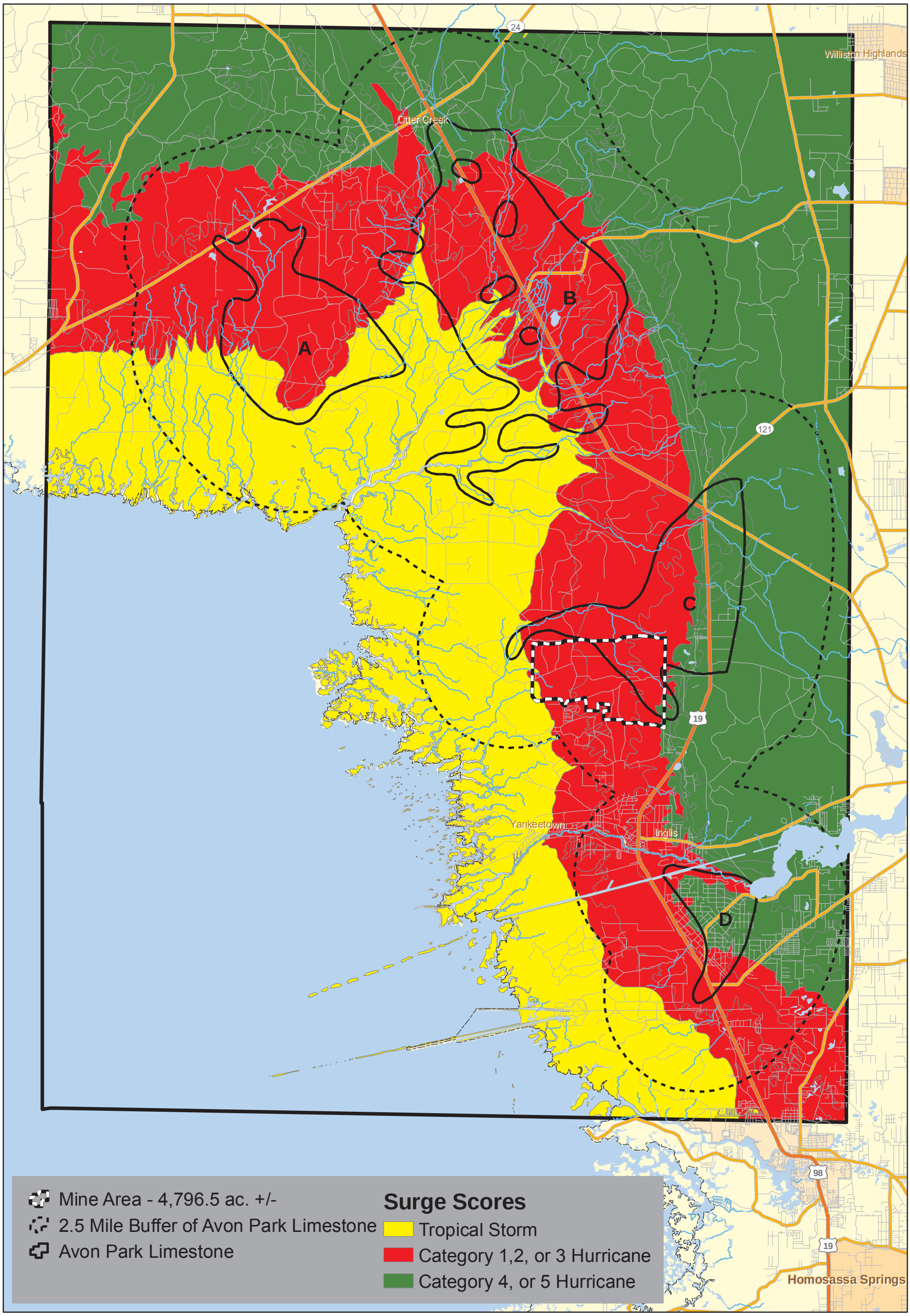

0 2.5 5 7.5 Miles
0 4,024 8,048 12,072 Meters

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Figure 10 - Storm Surge Suitability

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Levy County, Florida

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Date: 12/21/2009Rev. Date: 05/12/10 PM: SRD GIS Analyst: JBR/MAB Map Document: fig10_surge_20100512.mxd Project Number: 7856-001 PDF Document:fig10_surge_20100512.pdf Plot Size: 11 x 17

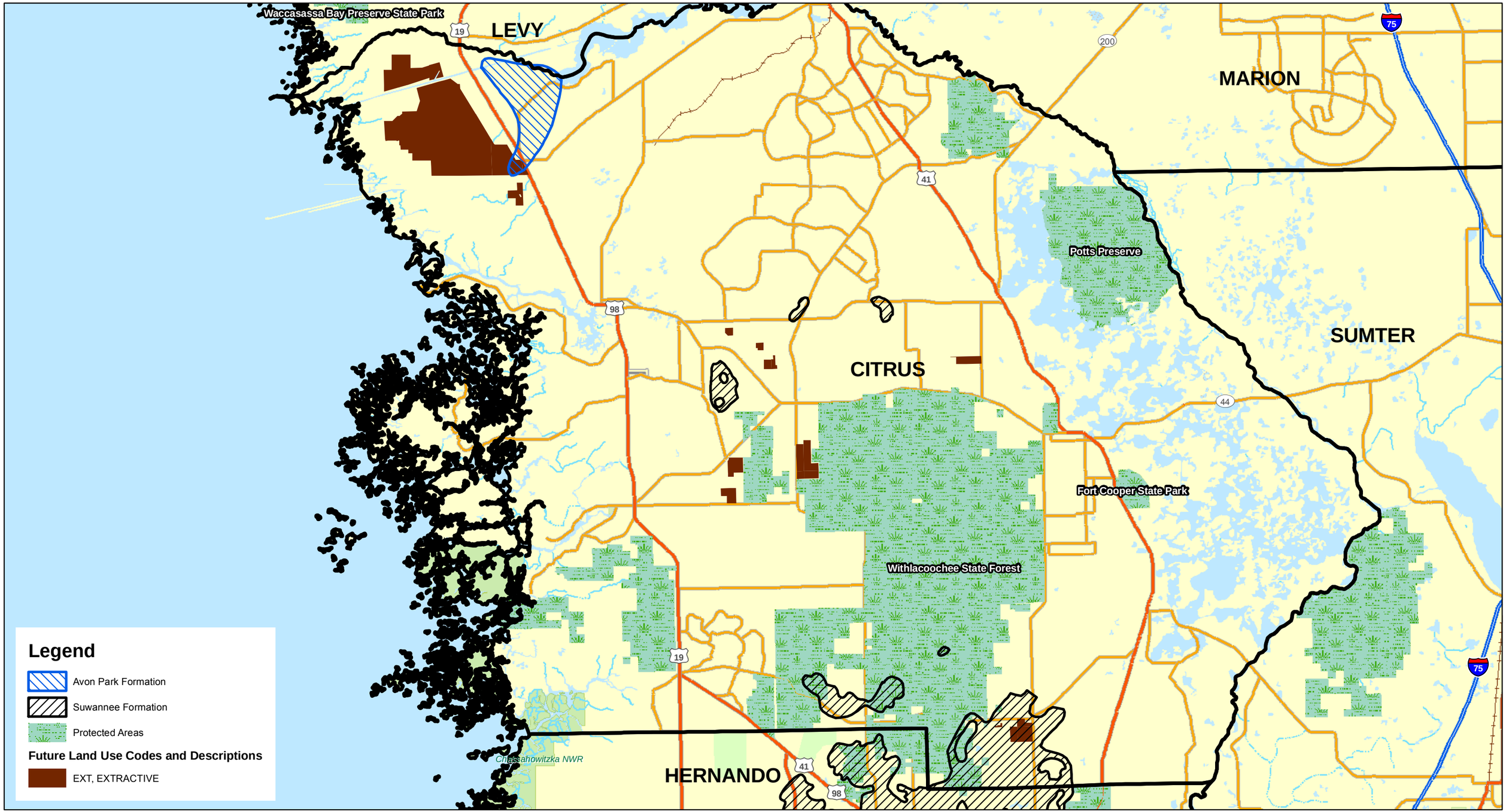

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Figure 11 - Suitable Land Uses

Citrus County, Florida

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Date: 03/30/10 Rev. Date: xx/xx/xx PM:MEE GIS Analyst: MAB Map Document:fig12_Citrus_FLUM_20100406_1_jmb.mxd Project Number: 7856-001PDF Document: fig12_Citrus_FLUM_20100406_1_jmb.pdf Plot Size: 11 x 17

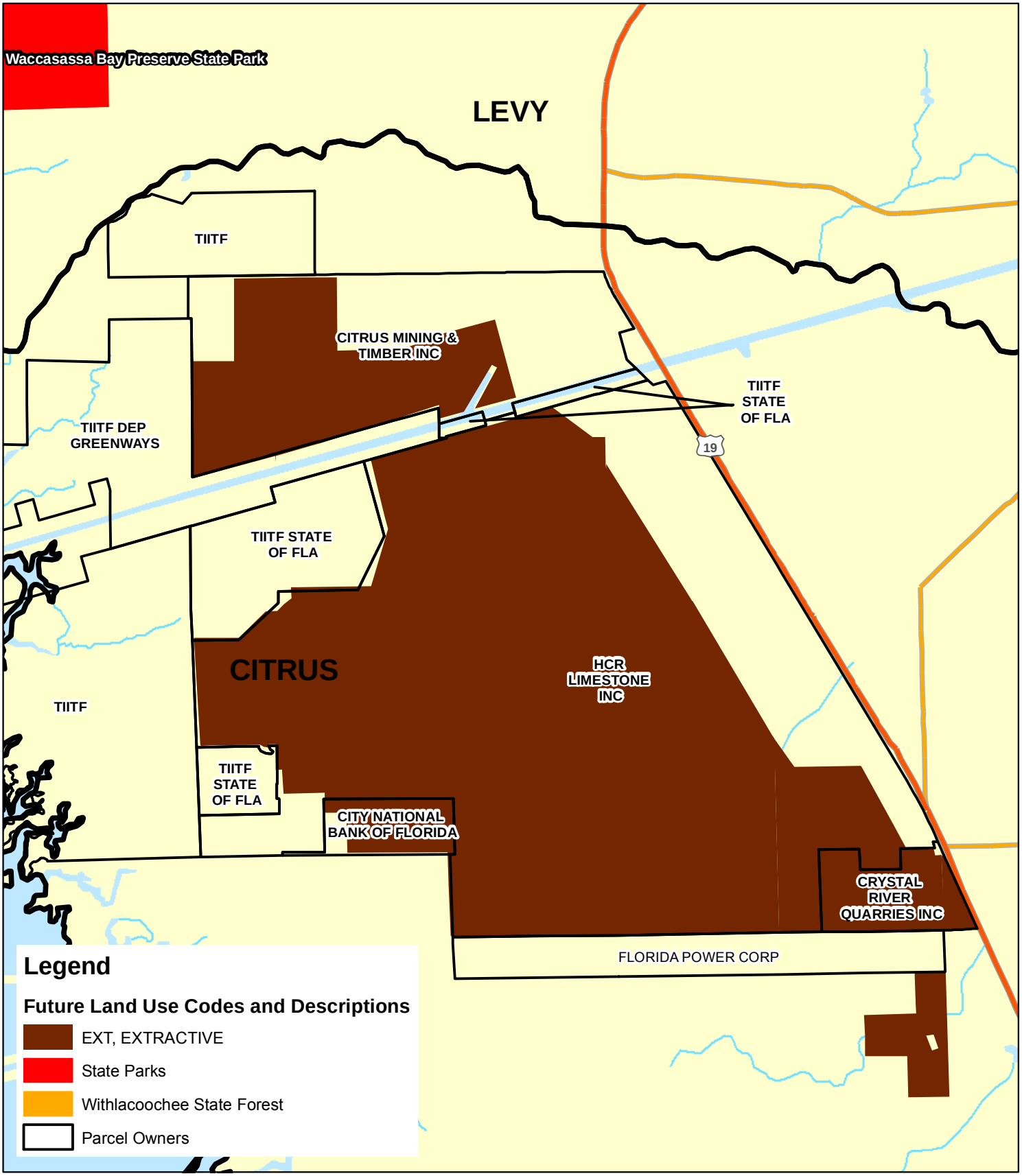

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Figure 12 - Property Owners Map

Suitable Land Use
Citrus County, Florida

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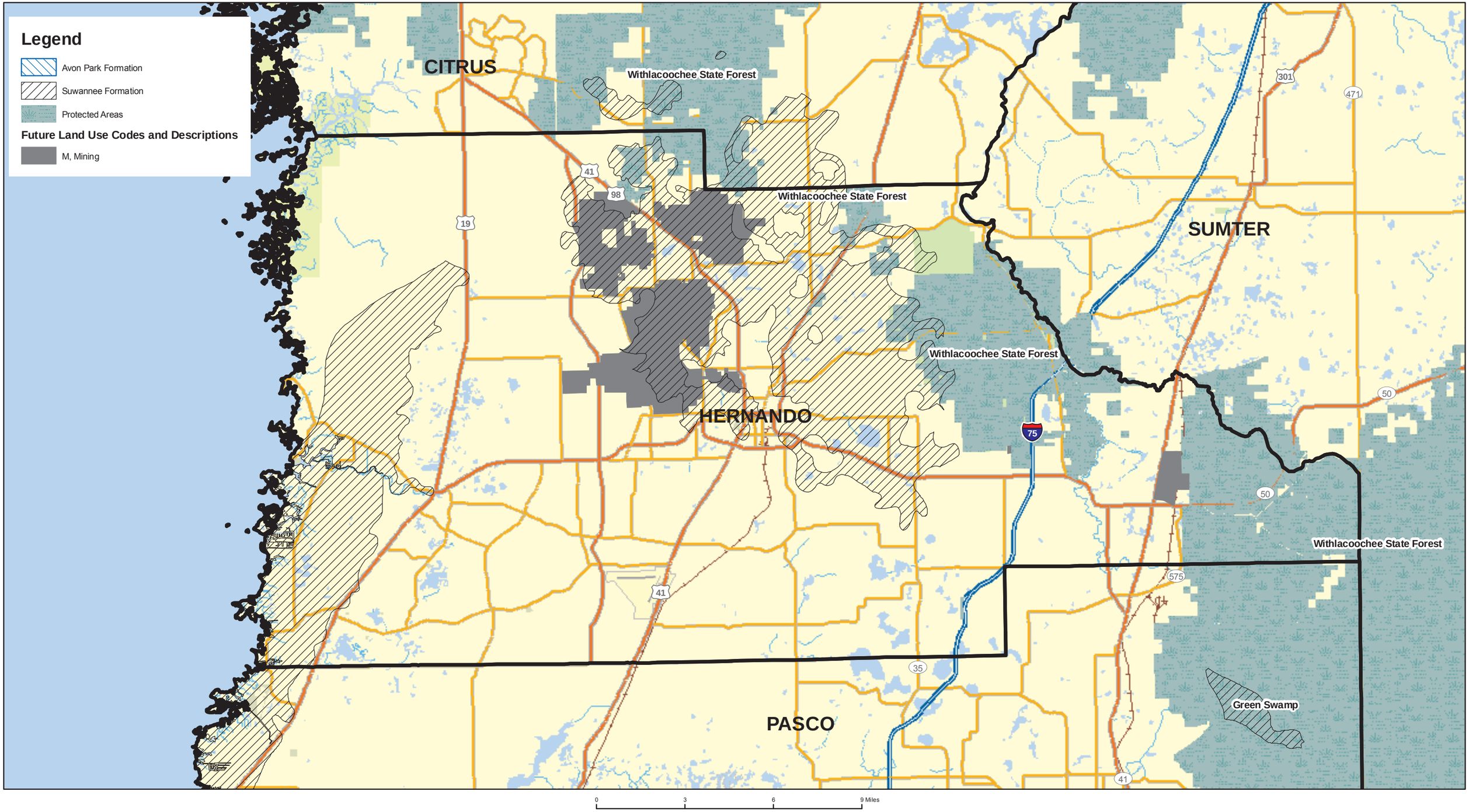

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Figure 13 - Suitable Land Use

Hernando County, Florida

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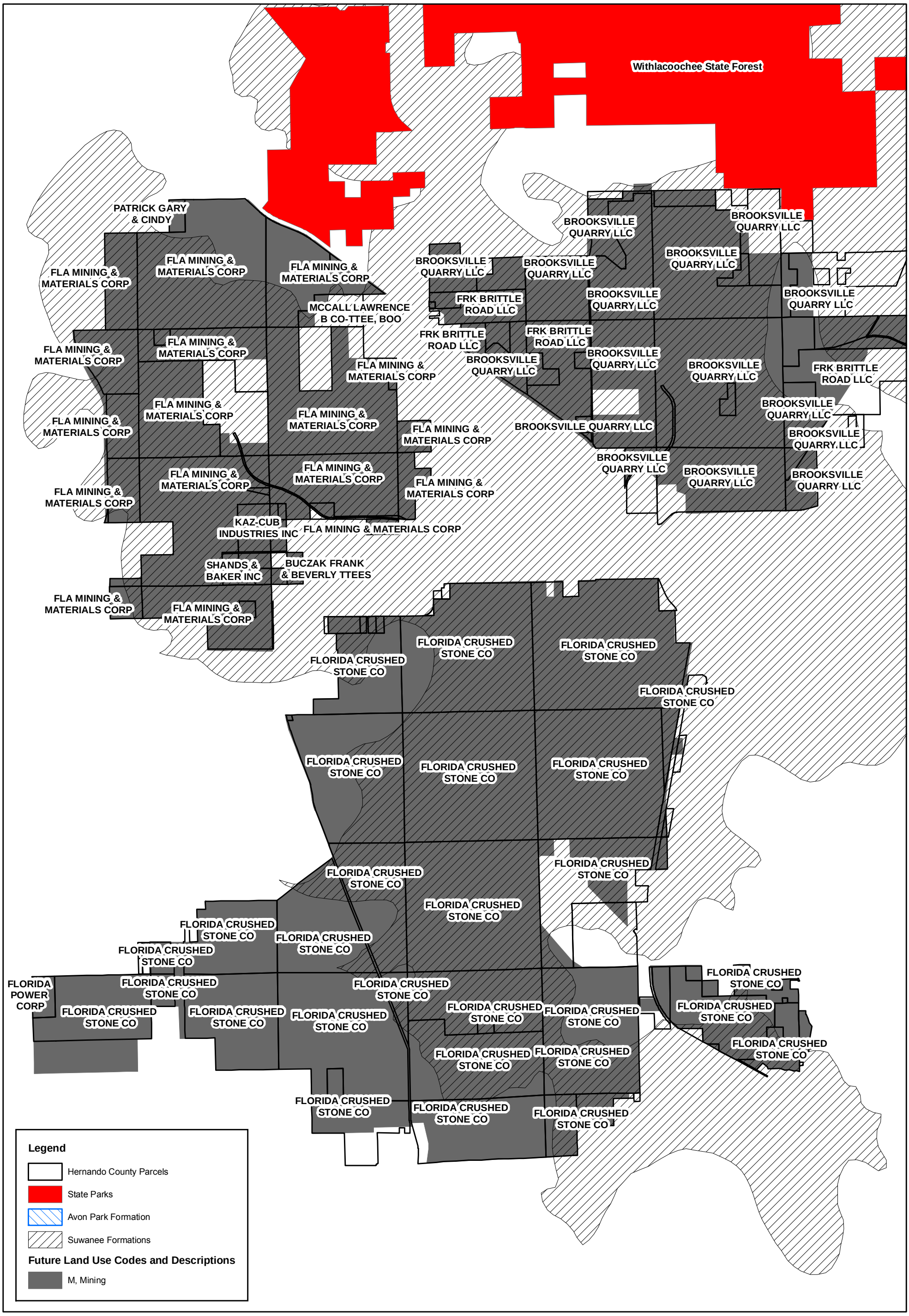

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Figure 14 - Property Owners & Suitable Lands

Hernando County Florida

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Date: 04/14/10 Rev. Date: xx/xx/xx PM: MEE GIS Analyst: LBF Map Document: Hernando_Ownership_FLUM_20100414_1_lbf.mxd Project Number: 07856001.00 B740 PDF Document: Hernando_Ownership_FLUM_20100414_1_lbf.pdf Plot Size: 11 x 17

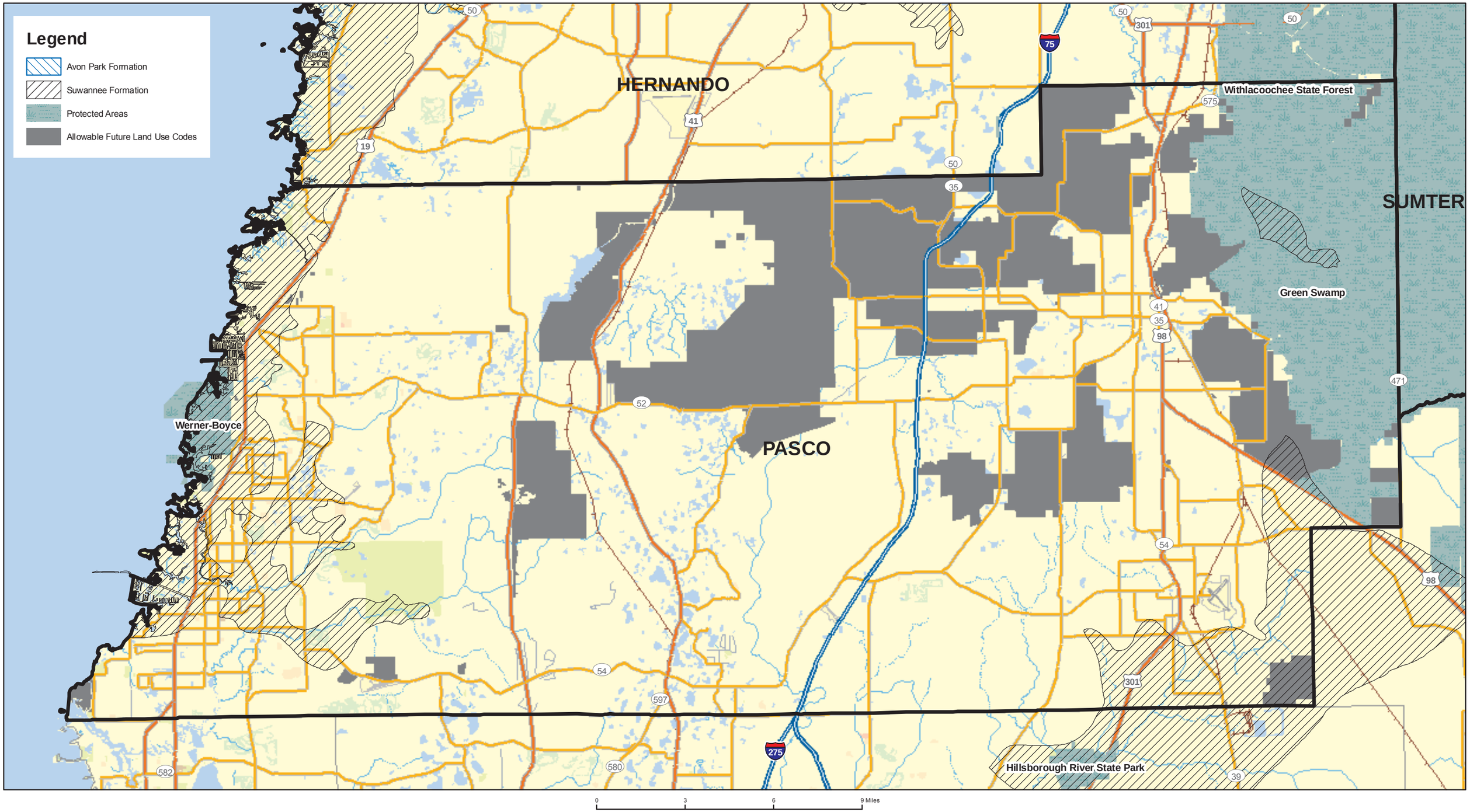

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Figure 15 - Suitable Land Use

Pasco County, Florida

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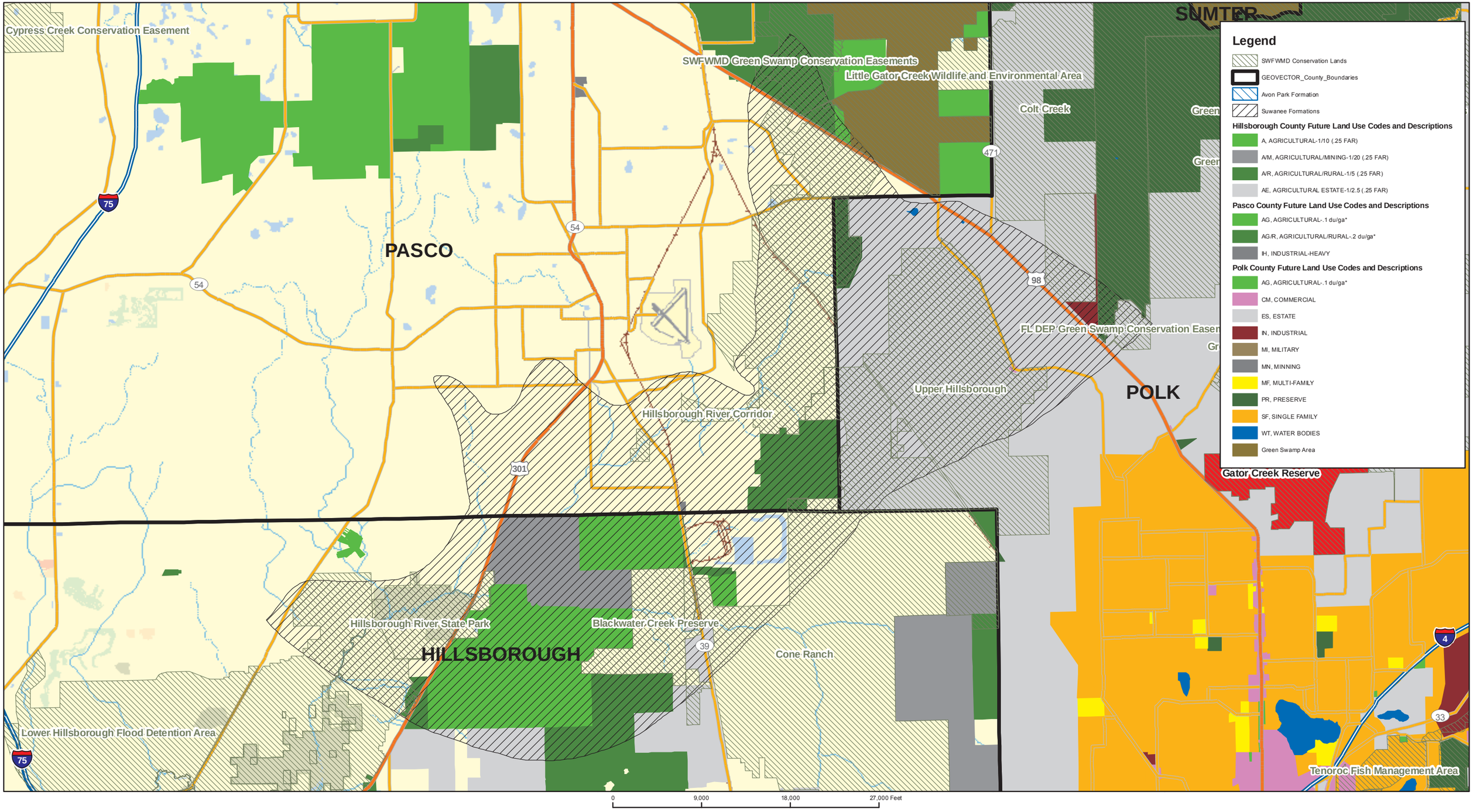

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Figure 16 - Suitable Land Use

SE Pasco, NE Hillsborough & NW Polk Counties, Florida

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Date: 03/29/10 Rev. Date: 08/05/10 PM:MEE GIS Analyst: MAB Map Document:fig16_SE_Pasco_NE_Hillsborough_NW_POLK_FLUM_20100805_1_mab.mxdProject Number: 7856-001PDF Document: fig16_SE_Pasco_NE_Hillsborough_NW_POLK_FLUM_20100805_1_mab.pdf Plot Size: 11 x 17

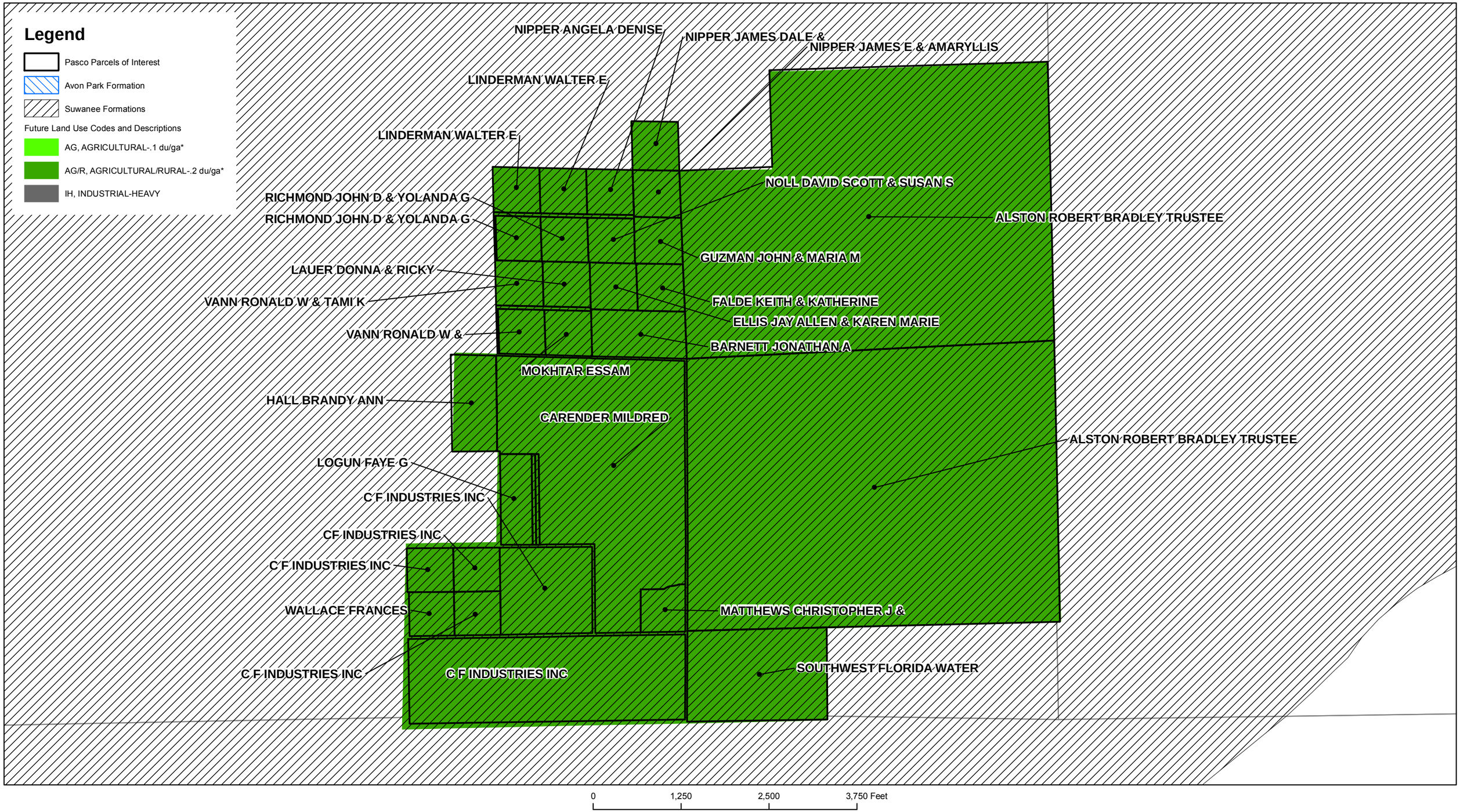

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Figure 17 - Property Owners & Suitable Land Use

Pasco County, Florida

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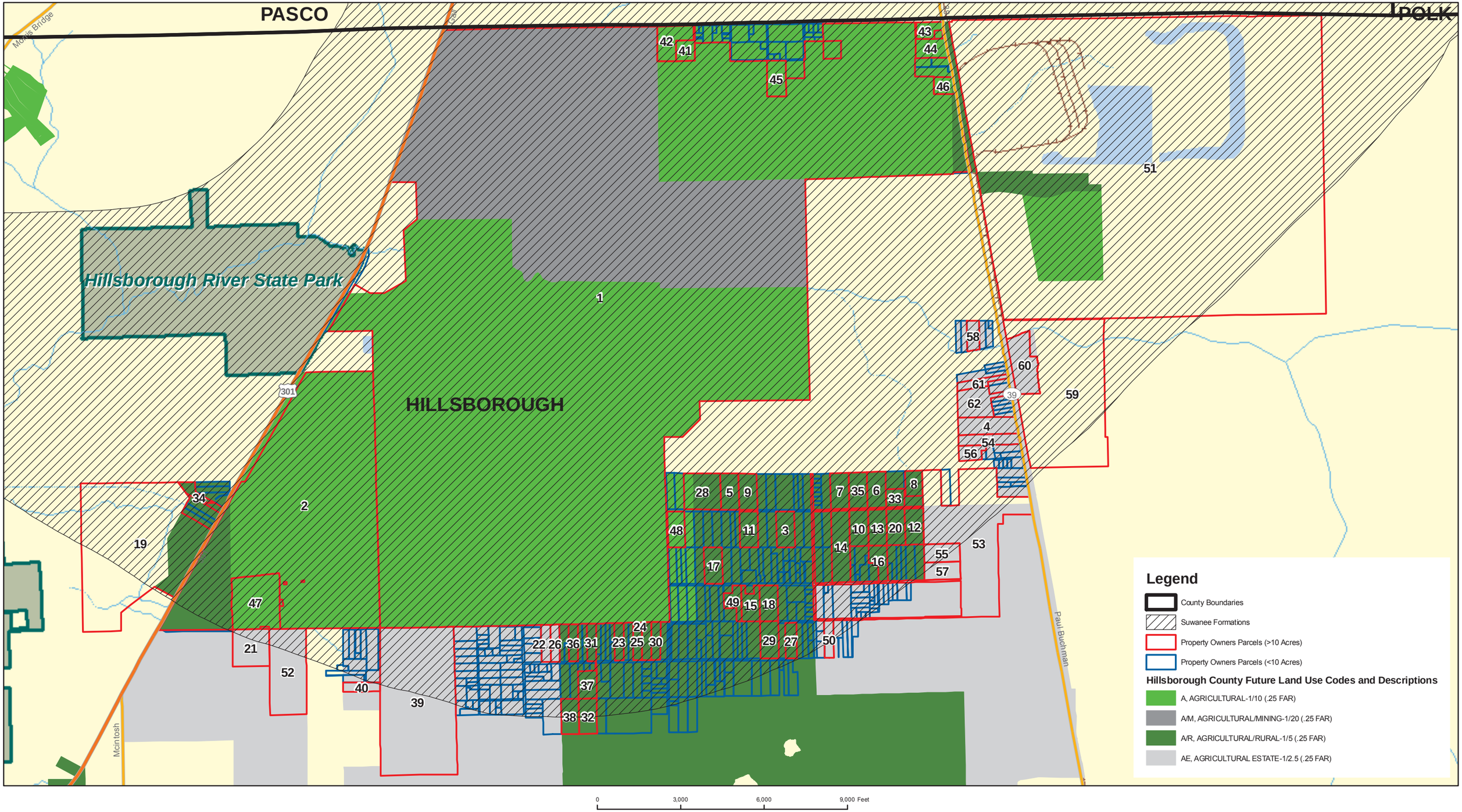

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Figure 18 - Property Owners & Suitable Land Use

Hillsborough County, Florida

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Coordinate System:
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Date: 07/14/10 Rev. Date: 08/12/10 PM:MEE GIS Analyst: KMNR Map Document: fig18_Hillsborough_Requested_Area_Property_Owners_20100812_1_mab.mxdProject Number: 7856-001PDF Document: fig18_Hillsborough_Requested_Area_Property_Owners_20100812_1_mab.pdf Plot Size: 11 x 17

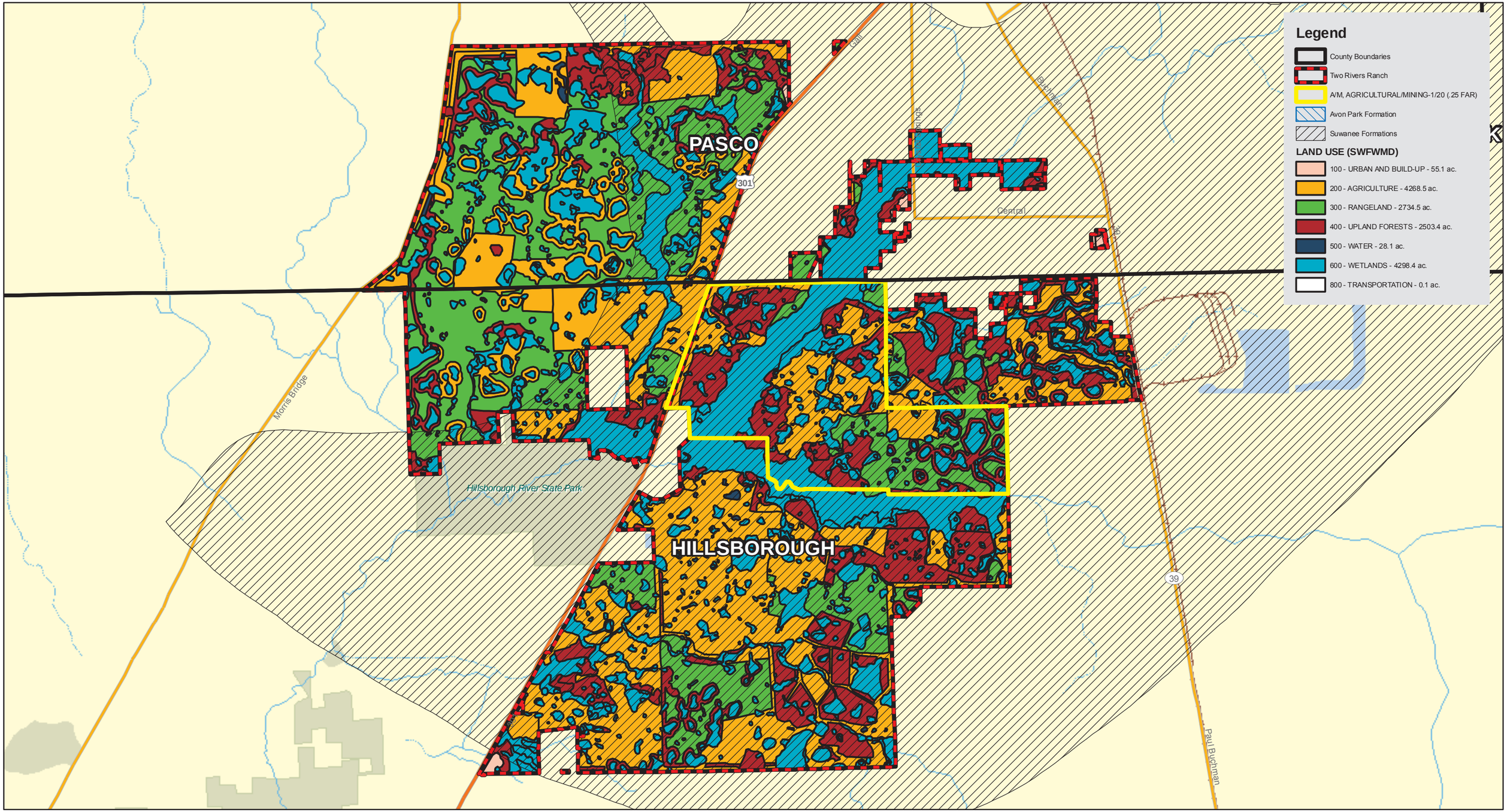

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Figure 19 - SWFWMD & Suitable Land Use
Two Rivers Ranch

SE Pasco, NE Hillsborough & NW Polk Counties, Florida

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Date: 08/05/10 Rev. Date: PM:MEE GIS Analyst: MAB Map Document:fig19_Two_Rivers_Ranch_SWFWMD_20100805_1_mab.mxdProject Number: 7856-001PDF Document: fig19_Two_Rivers_Ranch_SWFWMD_20100805_1_mab.pdf Plot Size: 11 x 17

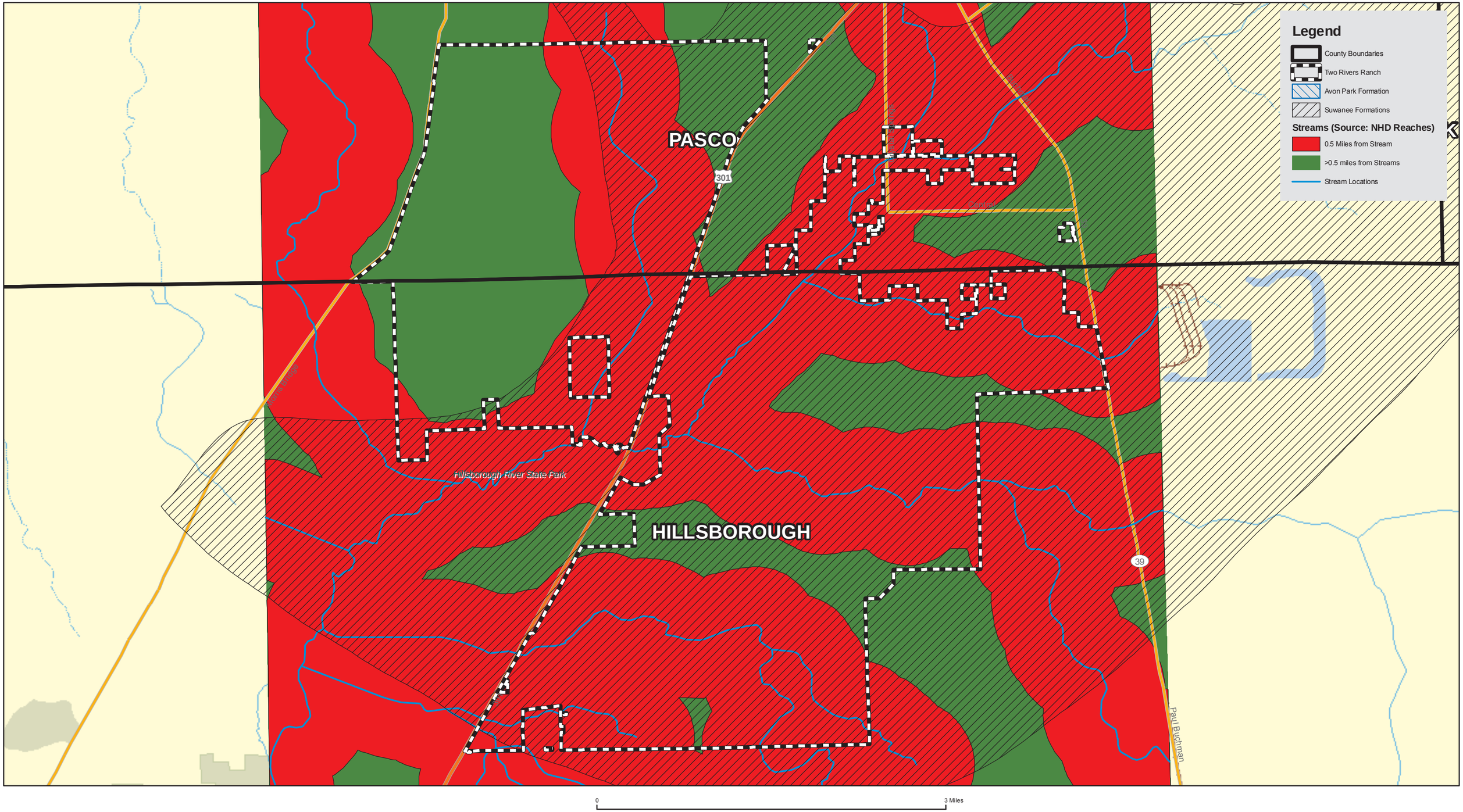

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Figure 20 - Stream Locations
Two Rivers Ranch

SE Pasco, NE Hillsborough & NW Polk Counties, Florida

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Date: 08/05/10 Rev. Date: PM:MEE GIS Analyst: MAB Map Document:Two_Rivers_Ranch_streams_20100805_1_mab.mxdProject Number: 7856-001PDF Document: Two_Rivers_Ranch_streams_20100805_1_mab.pdf Plot Size: 11 x 17

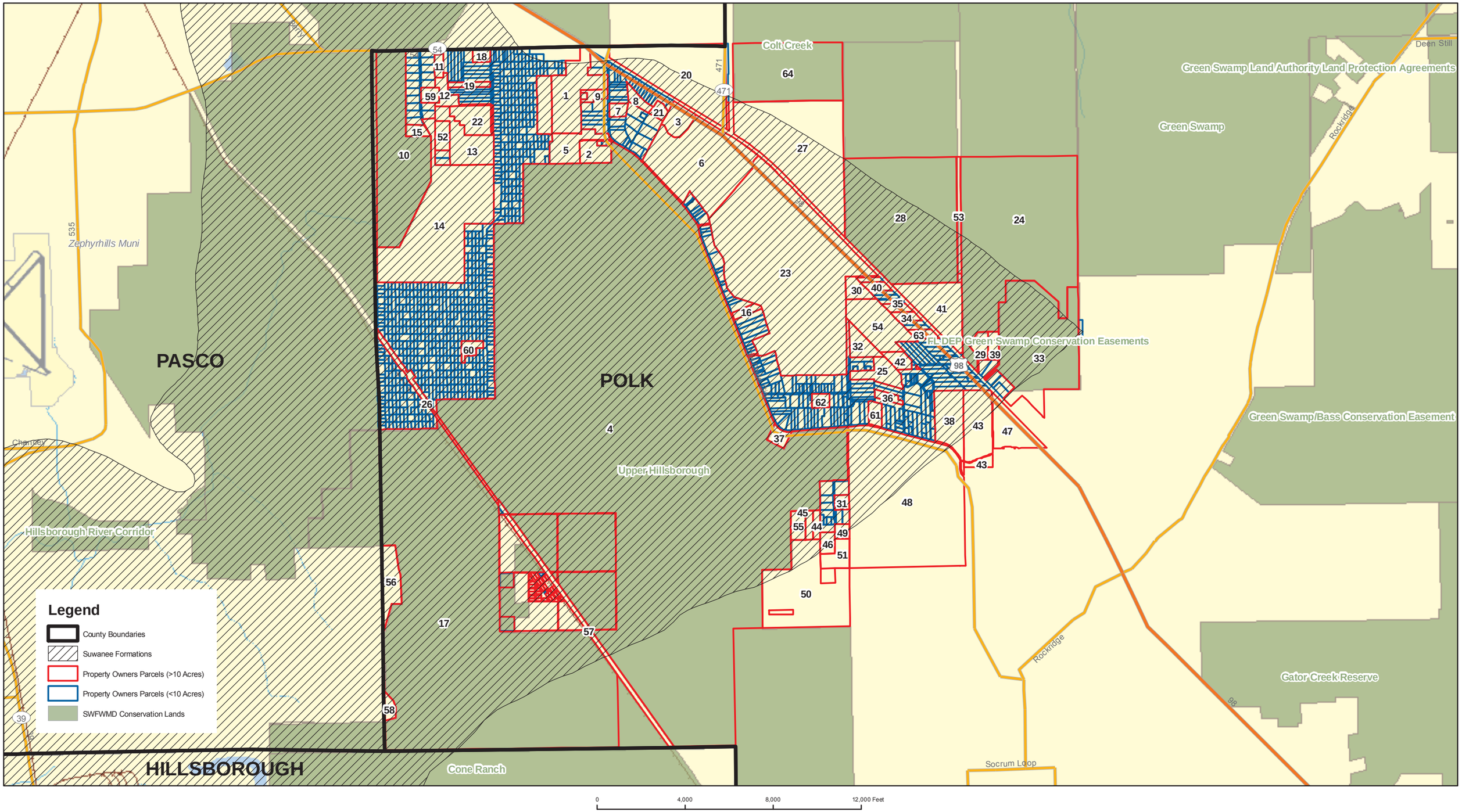

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Figure 21 - Property Owners & Suitable Land Use

Polk County, Florida

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Coordinate System:
NAD 1983 UTM Zone 17N feet

Date: 07/15/10 Rev. Date: 07/20/10 PM:MEE GIS Analyst: MAB Map Document: fig21_Polk_Requested_Area_Property_Owners_Con_20100715_1_lbf.mxdProject Number: 7856-001PDF Document: fig21_Polk_Requested_Area_Property_Owners_Con_20100715_1_lbf.pdf Plot Size: 11 x 17

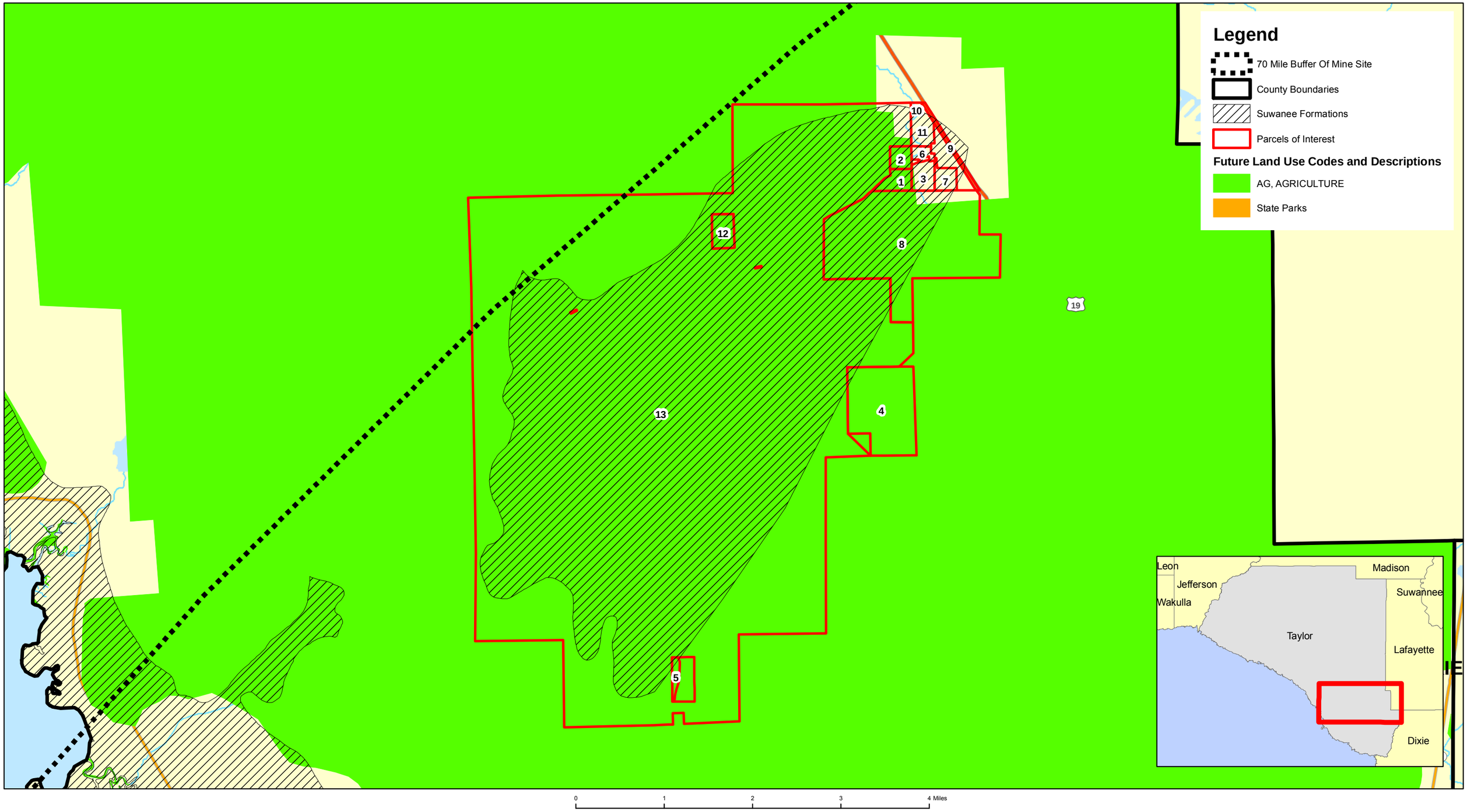

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Figure 22 - Property Owners & Suitable Land Use

Taylor County, Florida

Parcel Data:
Taylor County 08/2009

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Riverview, FL 33578-3625
ph. (813) 664-4500
fx (813) 664-0440
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Coordinate System:
NAD 1983 UTM Zone 10N feet

Date: 07/12/10 Rev. Date: xx/xx/xx PM:MEE GIS Analyst: MAB Map Document:Taylor_FLUM_20100712_1_mab.mxd Project Number: 7856-001PDF Document: Taylor_FLUM_20100712_1_mab.pdf Plot Size: 11 x 17

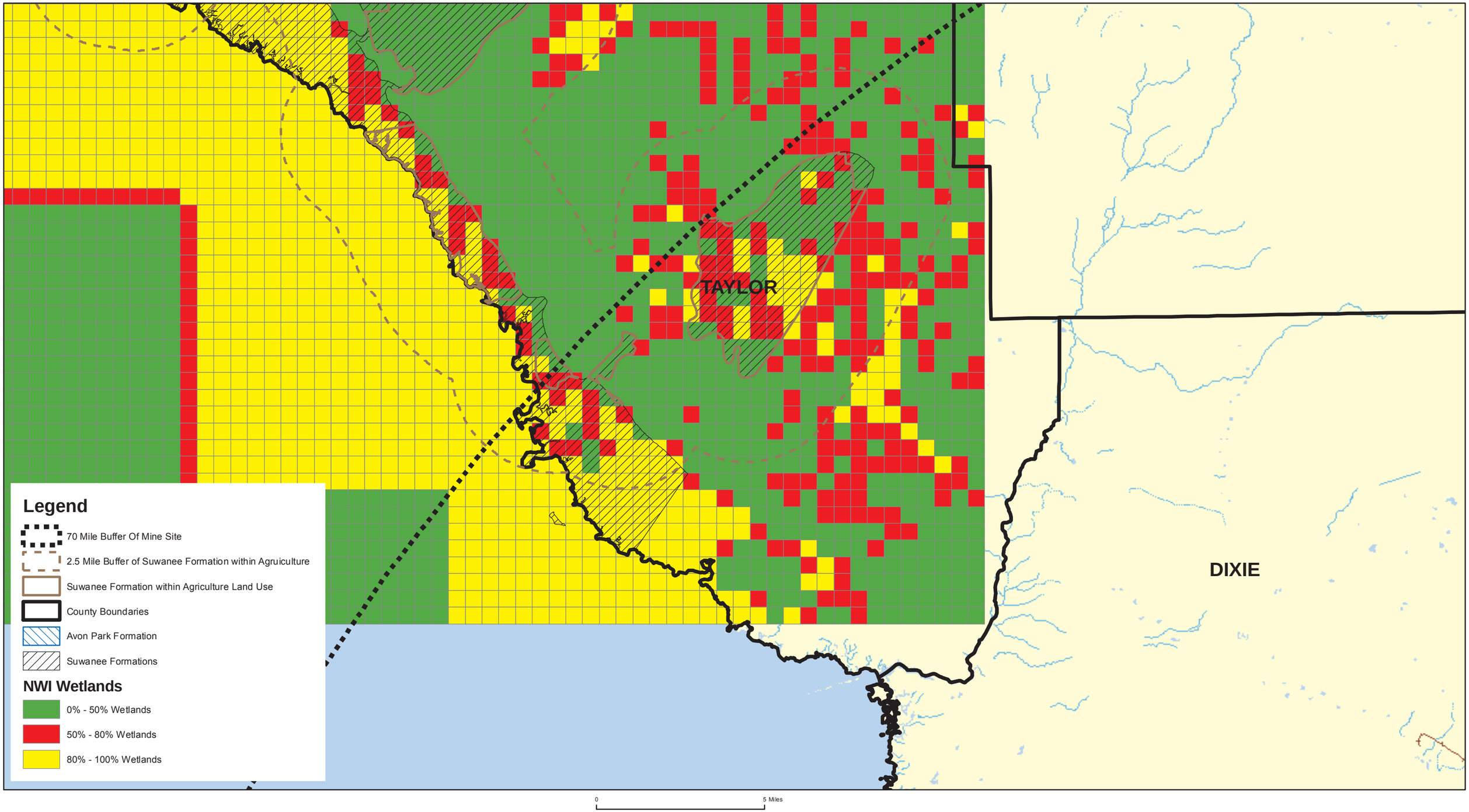

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Figure 23 - NWI Wetlands

Taylor County, Florida

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Coordinate System:
NAD 1983 UTM Zone 10N feet

Date: 07/14/10 Rev. Date: 08/12/10 PM:JSG GIS Analyst: KMNR Map Document:fig23_Taylor_NWI_20100812.mxd.mxd Project Number: 7856-001PDF Document: fig23_Taylor_NWI_20100812.mxd.pdf Plot Size: 11 x 17

APPENDIX D
TARMAC KING ROAD GROUNDWATER FLOW MODELING

APPENDIX D
TARMAC KING ROAD GROUNDWATER FLOW MODELING

D.1 INTRODUCTION

This appendix presents the additional details of the groundwater modeling effort conducted to support analyses presented in the main body of the *Draft Tarmac King Road Limestone Mine Environmental Impact Statement (King Road EIS)* for the proposed limestone mining. Multiple scenarios (base condition and alternatives) related to varying degrees of proposed mining at the site were considered and their impacts on groundwater seepage at the regional scale and mine site were evaluated. This appendix presents the modeling approach, including a brief discussion of development of the groundwater model utilized in the analysis. The tables referenced in this appendix are included in the text except those related to recharge values. These are included as Tables A–1 and A–2 in Attachment A, which follows this appendix. Due to the size of the figures, only the key figures are included in the text; remaining figures have also been included in Attachment A.

D.1.1 Conceptual Site Model

A conceptual site model (CSM) is used to aid in the building of a groundwater flow model by providing a framework for the design and a selection of numerical parameters used to predict the movement of water. As a groundwater flow model is a three-dimensional mathematical representation of the flow of water from the ground surface down through and within a porous matrix of rock, a CSM is used as a framework to build the flow model and correctly assign values to critical numeric values. Many of these parameters are discussed in the following sections.

A CSM describes the site environment and is the starting point for building a groundwater flow model. A CSM is a conceptualization of the mine site physical environment and is constructed based upon data related to land topography and environment (e.g. wetland, upland) site geology (surface and subsurface), hydrostratigraphy, and regional and local groundwater movement. As described in Chapter 3, examination of regional geology reports, boring logs, and water level measurements allowed for construction of a conceptual hydrogeology-based model that considers the natural fluctuation of the water table and flow of water within the local and regional area. For example, the description of the rock cuttings generated during the advancement of borings through the rock layers beneath the mine site is used in construction of conceptual geologic cross sections (see Chapter 3, Figure 3–9, for an example). Additionally, water level measurements recorded in monitoring wells both within the site and in the outlying areas provide data that can be interpreted to assess seasonal and storm-related water level fluctuations. For use in evaluating impacts on groundwater flow from rock mining, the CSM is modified to reflect physical changes to the environment as a result of rock mining, such as removal of wetlands and digging of mine pits.

In addition to the physical elements, the flow model must also include elements of the hydrologic cycle. These elements include the amount of precipitation that falls within the model domain, the net volume of water taken up by plants and lost to evaporation, and the net volume of water transported via surface drainage out of the model domain. In addition, the surface factors that influence water flowing into the subsurface include land slope, volume of the available drainage ways, and the type and distribution of natural vegetation (e.g., forest land, wetland). Each of these factors must be assigned numerical values since they may control the net input of water into the groundwater system.

Several physical elements of the Tarmac King Road Limestone Mine CSM were difficult to transfer or replicate in the flow model, including the wetlands as areas of retained water above the water table, the variations in the evapotranspiration rate for the local area, the rapid recharge of waters from the near surface to the saturated interval, and the presence of springs. In summary, the CSM is a synthesis of all available data that describes the physical setting of the mine site and adjacent areas to be incorporated into the flow model domain. The CSM is conceptual and the model is mathematical—neither can truly replicate nor account for the many factors in nature that control both the volume and pathways of water flow in the subsurface.

D.2 GROUNDWATER FLOW MODEL DEVELOPMENT

The development of a groundwater flow model is a complex process with the intent to create a mathematical model capable of predicting the volume, direction, and change in groundwater system within the domain of the model area. The groundwater system must be conceptualized, numbers assigned to key variables, and results calibrated to known values. The development process is iterative, with numerous model runs completed to refine predictions to be within an acceptable tolerance of measured and known target values, which are typically, measured water levels from monitoring wells located within the model domain. As with all predictive tools, the output of the model must be used considering the limitations embedded in the model, the assumptions made during model construction, and the representativeness of the model output relative to real world values. The following sections provide a discussion of the King Road groundwater flow model construction details, assumptions, and limitations.

D.2.1 Code Selection

MODFLOW (McDonald and Harbaugh 1988), a modular three-dimensional finite-difference groundwater flow code developed by the U.S. Geological Survey (USGS), was used to perform groundwater flow simulation for this environmental impact statement (EIS). MODFLOW is capable of simulating both transient and steady state saturated groundwater flow. Different boundary conditions are available, including specified head, areal recharge, injection/extraction wells, evapotranspiration, drains, streams or rivers, and lakes and wetlands. Aquifers can be simulated as unconfined, confined, or a combination of confined and unconfined using this code.

MODFLOW 2000 was selected for groundwater flow analysis of the Tarmac King Road Limestone Mine site because it is a public domain model, is widely used by the scientific community, has been rigorously verified and validated, and provides the flexibility of using a variety of pre- and post-processing software. The program code is well documented and is readily adaptable to a variety of groundwater flow systems. In addition, MODFLOW has been previously used for this site by Ardaman and Associates (2008). The King Road Limestone Mine Site Groundwater Flow Model uses several components of the available MODFLOW packages and features. A brief discussion of the core features is provided in Table D–1.

Table D–1. MODFLOW Packages Used in the King Road Limestone Mine Site Groundwater Flow Model

Package	Description	Notes
Core		
Basic and Output Control	Defines stress periods, time steps, starting heads, grid specifications, units, and output specifications.	Handles the primary administrative tasks associated with a simulation.
Block-Centered Flow	Specifies steady state versus transient flag, cell sizes, anisotropy, layer types, and hydrogeologic data for each layer.	Derived primarily from geologic data used to construct the model.
Surface Water Stresses and Processes		
Recharge	Simulates aerially distributed recharge to a water table during each stress period.	
Drain	Simulates groundwater interchanges with canals that can drain the aquifer. Water removed by the drains is removed permanently from the model.	Used to simulate groundwater loss to creeks and springs.
Lake	Simulates interaction between mining lakes (quarries) or reservoirs and the groundwater system.	Computes lake stages and performs an accounting of inflows/outflows.
General Head Boundary	Simulates groundwater exchange between selected cells and a specified boundary as a function of water level difference.	Boundary heads are based on potentiometric maps generated from observed groundwater levels.
Water Supply and Management		
Well	Simulates withdrawals from wells.	Includes public water supply, irrigation, and aquifer storage and recovery wells.
Solution Algorithms		
Geometric MultiGrid	A mathematical solution algorithm internal to the model.	Usually used.

D.2.2 Model Discretization

Groundwater models are developed by dividing the area of the model domain into a sequence of horizontal rows and vertical columns to facilitate mathematical calculations. The horizontal rows are typically conceptualized as layers based on geologic units documented within the model domain. Dimensionally, each layer is divided by columns into discrete cells and each cell is assigned attributes (e.g., a hydraulic conductivity value). The resulting model resembles a three-dimensional grid of rows and columns projected to the lateral and vertical limits of the model boundaries. MODFLOW uses the properties assigned to each block to perform calculations related to groundwater movement.

D.2.2.1 Model Area

The King Road Limestone Mine Site Groundwater Flow Model covers an area of 77,670 feet by 60,670 feet, or approximately 169 square miles (see Figure D–1). This larger area was selected to ensure that the natural flow conditions surrounding the proposed mine site were sufficiently incorporated into the effort. Where possible, the model boundaries were selected to correspond to natural flow boundaries. The model boundary was extended sufficiently to the north and east to reduce the impact of these arbitrary northern and eastern boundaries on the flow conditions.

D.2.2.2 Model Layers

Vertically, the model extends from the ground surface to the predicted bottom of the Floridan Aquifer. The bottom of the Floridan Aquifer was set at 700 feet National Geodetic Vertical Datum (NGVD). This depth setting made the model applicable to assess quarrying activities through the thickness of the entire aquifer even though mining depth is projected to be only to a depth of approximately 120 feet below ground surface. Each model layer was subdivided horizontally into a block-centered grid with 280 columns and 209 rows with variable spacing (see Figure D–1). Grid spacing ranged from 1,000 feet

at the outer model boundary to 100 feet within the footprint of the proposed mine site. Finer spacing of grids (e.g., smaller block size) within the mine site footprint was intended to attain greater resolution of seepage impacts and resulting changes to the water table depth. Greater resolution allows for assessment of water level changes on wetland areas within and adjacent to the mine site, and as discussed in Chapter 5 of this EIS, for assessment of the effectiveness of mitigation actions.

Vertically, the model domain was divided into six layers as follows:

- Layer 1 extends from the groundwater table to the top of the next layer (Layer 2)
- Layers 2 through 6 extend from the top of Layer 2 to a depth of –700 feet NGVD

The topography (top elevation of Layer 1) was based on Light Detection and Ranging (LIDAR) survey data collected and provided by Tarmac America, LLC (see Figure D–2). The higher-resolution topography within the mine site from the LIDAR was meshed at the survey boundary with lower-resolution topography survey data as provided by commercial data sources. The topography varied from a high of approximately 108 feet NGVD in the northeast to a low of –2 feet NGVD in the southeast of the model domain.

The configuration of Layers 2 through 6 was set using available geologic data, primarily the cross-section lines described in Chapter 3 of this EIS. The cross-section construction was beneficial in creating the interpreted geologic layers, as stated in Chapter 3; however, the ability to resolve lateral and vertical changes in rock properties was limited with only boring logs. The bottom of Layer 1 was set arbitrarily at the middle of the topography and Layer 2 bottom elevations. Table D–2 provides the minimum and maximum elevation for each of the six layers.

Table D–2. King Road Limestone Mine Site Groundwater Flow Model Layer Minimum and Maximum Elevations

Layer Number	Maximum Elevation (feet NGVD)	Minimum Elevation (feet NGVD)
1	50	–21
2	19	–45
3	–63	–126
4	–146	–209
5	–242	–305
6	–700	–700

Key: NGVD=National Geodetic Vertical Datum.

D.2.3 Model Boundary Conditions

A critical aspect of developing a groundwater model is defining the water flows that enter and leave the model domain at the model boundaries. The development of inflow and outflow is performed by assigning water level values at the model boundaries—if the water level is higher at the boundary than within the model, then the flow at that boundary will be inward. The King Road Limestone Mine Site Groundwater Flow Model outer boundaries consist of the following (as depicted in Figures D–3 and D–4):

- A coastal boundary (located along the western boundary of the model)
- A northern boundary (located some distance from the mine site boundary)
- An eastern boundary (located some distance from the mine site boundary)
- A southern boundary along the Withlacoochee River (intersection of model domain and surface water feature)

There are three types of boundary conditions that are generally considered in developing groundwater flow models: (1) no-flow boundary – the flux across the boundary is set to zero (i.e., no water is allowed to exchange at the model boundary); (2) constant head boundary – head at the boundary does not vary with time (i.e., water can be exchanged at the boundary, but at a fixed rate); and (3) general head boundary (GHB) – head at the boundary can change with time (i.e., seasonal change), water can either flow into or out of the groundwater system through this boundary, and water can flow across the boundary at a varying rate dependent on recharge events, seasonal change, pumping, land use change. GHB was considered the most appropriate boundary conditions for the EIS model; therefore, the GHB Package was applied along the model boundaries.

Potentiometric maps were created in 2-month intervals to determine the head distributions for developing the time-dependent GHB boundary conditions. Overall change in head from May 16, 2006, to September 19, 2006, for any particular location along the northern and eastern boundaries of the model domain ranged from 1.5 feet to 3.3 feet along the northern boundary and –0.54 feet to 1.1 feet along the eastern boundary for this time period. Heads along these boundaries are time dependent. Head values along the northern boundary vary more than values along the eastern boundary. The eastern boundary of the model is near a groundwater divide and therefore provides a lower flux across that boundary. Over time, water levels were used to simulate fluxes through the GHB cells. Generally, the western face of the boundary includes the Gulf of Mexico. Water levels along this face were set to 0 feet NGVD to simulate the median sea level of the coastal boundary. The western boundary is represented by GHB conditions that allow a varying flow rate into the Gulf of Mexico. The GHB conditions along the southern portion of the EIS model allow for variation of stages (i.e., seasonal change) in the Withlacoochee River and Lake Rousseau over time. Water levels for this boundary were estimated from potentiometric surfaces that considered observed groundwater levels in the model domain and observed stages in the Withlacoochee River.

The conductance terms for these boundaries were set through calibration (discussed in Section D.3).

Figures D–3 and D–4 show the active/inactive cells in the model domain (gray-shaded cells are inactive). Groundwater flow was simulated only through the active domain cells. Specifically, Figure D–3 shows the active domain cells for the top-most layer (Layer 1) of the model. As indicated in Figure D–3, drain cells are designated within the model domain and are located along primary stream flowpaths. These cells are so designated to allow stream to aquifer interactions. In MODFLOW, a drain represents a feature that accepts groundwater and toward which flow is convergent. In essence, drain cells allow removal of groundwater from the aquifer. Figure D–4 shows the active domain cells for the remaining layers (Layers 2 through 6) of the model and depicts the groundwater production wells within the domain. The production wells are not present in all model layers, but rather are projected into the appropriate layers.

D.2.4 Model Calibration and Simulation Periods

Calendar year (CY) 2006 was selected as a representative calibration period for this EIS modeling effort. A constraint of the model setup and calibration was the available water level measurement data. CY 2006 was selected as the best time period for which both onsite well data and offsite water level data were available with sufficient measurements. The weather station data from Inglis Lock, located within a few miles of the mine site, indicated that CY 2006 was an average hydrologic year with a total rainfall of 52 inches. Therefore, in order to simulate the average conditions over a long period of time, CY 2006 was selected as the EIS model calibration period. However, to further capture the wet and dry conditions, transient simulations using hydrological data from CY 2003 through CY 2008 were performed to evaluate the future conditions.

To set the boundary condition, CY 2006 was divided into six 2-month sub-periods. The boundary condition within each sub-period was assumed steady. Representative potentiometric surface maps were developed for each sub-period (see Attachment A, Figures A–1a through A–1f) to define water level elevations for each sub-period. Using these maps and data, stages were assigned to the outer boundary conditions.

D.2.5 Parameter Distributions and MODFLOW Packages

The assignment of properties to a MODFLOW model should ideally be based on site-specific knowledge of the values (or range) for each programmable variable, yet this is rarely possible. For this EIS model, data collected to date at the Tarmac King Road Limestone Mine site and publicly available data for the local region were used in assigning values to model input parameters. In addition, values and ranges of values were available in the model constructed by Ardaman and Associates for the Tarmac King Road Limestone Mine site and in a large regional model constructed by the USGS and Suwannee River Water Management District (Grubbs and Crandall 2007).

D.2.5.1 Hydraulic Conductivity

Hydraulic conductivity *(K)* is key parameter in the MODFLOW program. This parameter varies locally and regionally, especially in karst areas, for which few measurements are typically available. Hydraulic conductivity values for carbonate rocks can range from 10^{-3} to 10^{4} feet per day, reflecting a broad range in flow properties (Anderson and Woessner 2002). Carbonate rock hydraulic conductivities can increase by several orders of magnitude due to existing pores and fractures in the rock becoming enlarged due to solution weathering. Bush and Johnston (1988) performed an aquifer test in the eastern portion of the EIS model that gave a Transmissivity value of 20,000 square feet per day. (Transmissivity is also a measure of flow, yet considers the dimension of thickness.) The aquifer thickness where the test was performed was 475 feet thick, which results in a hydraulic conductivity value of 42 feet per day. Planert (2007) created a regional groundwater flow model for the Suwannee River Basin that included the EIS model in the southern portion of the regional model. Hydraulic conductivities used in the Suwannee River Basin model were 500 feet per day (Planert 2007). The groundwater flow model of Ardaman & Associates (2008) ranged from 9 to 464 feet per day, with lower values in the eastern portion of the model and higher values in the western portion of the model.

For the King Road Limestone Mine Site Groundwater Flow Model, a range of values was assigned to address the uncertainty of hydraulic conductivity values due to a lack of field measurements. Therefore, an initial hydraulic conductivity range of 28 feet per day (10^{-2} centimeters per second) to 2,800 feet per day (1 centimeter per second) was chosen to account for the possibility of increased secondary permeability in Layers 2 through 6 and was used for PEST [parameter estimation software] (discussed in Section D.3) calibration. Similarly, the initial hydraulic conductivity range in Layer 1 was 28 feet per day to 2,800 feet per day to account for the presence of Ocala Limestone in the western portion of the model area, which is considered ...very permeable with well developed secondary porosity and a highly irregular karstified surface" (Sacks 1996). However, PEST was unable to calibrate the model based on the initial range of hydraulic conductivities (showing the largest sensitivity to Layer 1 *K* high-end values). Therefore, *K* range (maximum value) was increased by an order of magnitude (2,800 feet per day to 28,000 feet per day) for Layer 1 to allow water to move through at a quicker rate (evidenced on field observations based on hydrograph analysis). Increasing the *K* range allowed PEST to calibrate the model, which resulted in a calibrated *K* value for the western part of Model Layer 1 of 8,950 feet per day. This increased *K* removed the need to use conceptual drains in Layer 1 to account for the wetlands. The calibrated *K* was able to reproduce observed heads in monitoring wells and was verified by reproducing heads in transect wells (that were not used in the model calibration) screened in Layer 1. The calibrated K value was also verified based on the hydrograph analyses following the method used by Kincaid (2009), and the quick responsiveness of groundwater fluctuations after a storm event, as observed in the hydrographs showing high *K* values, which are representative of the site groundwater system with wetlands.

D.2.5.2 Recharge Determination

Rainfall recharge rates are a key input parameter in MODFLOW and can be assigned to vary temporally and to vary within the model domain. Recharge rates determine the amount of water entering the model from the ground surface. Recharge data were determined over the model domain using the HELP [Hydrologic Evaluation of Landfill Performance] model (Schroeder et al. 1994). Input into the HELP model consisted of daily rainfall, evapotranspiration, mean daily temperature, and solar radiation values (Schroeder et al. 1994). Daily rainfall data for the Tarmac King Road Limestone Mine site area were obtained from the Southwest Florida Water Management District (SWFWMD), Inglis Lock Weather

Station (SWFWMD 2009), for CYs 2003 through 2008 (i.e., period of simulation). Two separate hydrological models using HELP were developed based on the different hydrogeologic settings representing the two areas within the King Road Limestone Mine Site Groundwater Flow Model domain (see Attachment A, Figure A–2). The two sets of HELP models calculated daily recharge values (see Attachment A, Tables A–1 and A–2) and were used in the MODFLOW program across the model domain.

D.2.5.3 Other Parameters and Inputs

The design of the MODFLOW program allows the incorporation of additional source code (packages) specific to modeling site-specific components that affect water movement, such as the presence of lakes, canals, rivers, or wetlands. The following text provides a brief description of the packages used in the King Road Groundwater Flow model.

Quarries or Lakes. The modeling of multiple lakes created during mining required use of a lake package. To assess the impact of the lakes per alternative, the King Road Limestone Mine Site Groundwater Flow Model incorporated the LAK3 Package into MODFLOW 2000 (ESI 2007a). The lake footprints for all of the alternatives are shown in Chapter 2 of this EIS. The lakes in the flow model extended down to the base of Layer 3 to simulate excavation depth below ground surface. Initial mean, minimum, and maximum lake stage elevations were input based on potentiometric maps and model elevations. The final lake stages were computed by the model. Daily precipitation and daily evaporation values were needed for the lake package setup (ESI 2007b). Daily precipitation data were obtained from the Inglis Lock Weather Station (SWFWMD 2009), and daily evaporation data were obtained from a weather station in Lisbon, Florida (NCDC 2009).

For lakes proposed to be backfilled with unconsolidated waste rock and fines, a specific isotropic hydraulic conductivity for Layers 1 through 3 was assigned to the cells occupied by lakes. It is recognized that the backfilled lakes will not have the same flow properties as undisturbed rock adjacent to the pits, discussed in Chapter 4. Backfilled lakes were assigned a hydraulic conductivity based on a range of values for unconsolidated deposits of gravel size (Freeze and Cherry 1979).

Drains. In the King Road Limestone Mine Site Groundwater Flow Model, the creeks and springs in Layer 1 were modeled as drains. The base of the drain was set at 0.5 feet above the Layer 1 bottom. The conductance terms for the drains were set through auto calibration using PEST (Doherty 2004). PEST is discussed in Section D.3, "Model Calibration."

Initial Condition. Water level elevations for all the active cells in the King Road Limestone Mine Site Groundwater Flow Model were set at the beginning of a simulation to represent initial conditions. A representative potentiometric surface was developed for January 1, 2006. Using this surface, water level elevations were assigned to all King Road Limestone Mine Site Groundwater Flow Model cells.

Pumpage. Production wells were included in the model (see Figure D–4) to account for water withdrawals at these locations, even though they are located at the southern boundary of the model domain. The production wells supply water to the Town of Yankeetown and Town of Inglis. Production data for these wells were obtained from the respective water departments. The pumpage rate for each well was held constant through the simulation period.

Hydrogeologic properties used for all geologic units (Layers 1 through 6) are presented in Table D–3. In general, the properties of these layers were based on the properties of the units. The King Road Limestone Mine Site Groundwater Flow Model uses hydrogeologic data from numerous investigations conducted by the USGS, SWFWMD, U.S. Army Corps of Engineers (USACE), Ardaman and Associates, Inc., and Florida Department of Environmental Protection (FDEP). The hydraulic conductivity values used are discussed in Section D.3 below.

Table D–3. Hydrogeologic Properties Used in King Road Limestone Mine Site Groundwater Flow Model

Model Layer	Minimum Layer Thickness (feet)	Maximum Layer Thickness (feet)	Hydraulic Conductivity (Along Row) (*x* axis)		Primary Storage	Secondary Storage	Type
			Minimum (feet per day)	Maximum (feet per day)			
1	5	40	28	2,800	–	0.01–0.20	Unconfined (Transmissivity varies)
2	5	44	28	2,800	Range	0.01–0.20	Confined/Unconfined (Transmissivity varies)
3	82	82	28	2,800	Range	0.01–0.20	Confined/Unconfined (Transmissivity varies)
4	83	83	28	2,800	Range	0.01–0.20	Confined/Unconfined (Transmissivity varies)
5	96	96	28	2,800	Range	0.01–0.20	Confined/Unconfined (Transmissivity varies)
6	395	458	28	2,800	Range	0.01–0.20	Confined/Unconfined (Transmissivity varies)

Notes: Layers 1, 2, and 6 have variable thicknesses. Layers 3, 4, and 5 have a constant thickness throughout the model domain.

D.3 MODEL CALIBRATION

Calibration is the process of adjusting hydrogeologic parameters and boundary conditions of a model to match simulated and observed hydrogeologic conditions within a reasonable limit. In general, this method involves an iterative procedure of adjusting hydraulic properties and/or boundary conditions of the model. The water levels of CY 2006 were selected for history matching. The model calibration was performed by comparing measured water levels at monitoring sites to computed water levels and adjusting model parameters as appropriate to reduce errors to an acceptable level for the selected year. The PEST software developed by Doherty (2004) was used for performing the model run iterations necessary to fine-tune parameters. PEST is a parameter estimation code that automatically determines the best parameter values for a model as configured. The model parameters include, but are not limited to, hydraulic conductivities, recharge rates, river cell conductance, and anisotropic ratios (e.g., K_x:K_y, K_x:K_z, K_y:K_z). It has been recommended (Hill 1998) that using parameter estimation, robust estimation of parameter values is possible when the parameters have sensitivities within two orders of magnitude of the most sensitive parameter. Therefore, initial parameter sensitivities were performed to select the parameters for robust estimations.

D.3.1 Calibration Targets

A calibration target represents a point within the model domain at which measured water level data is available and at which the model output should closely replicate those data. The most common targets are locations such as springs, monitoring wells, or lakes with wells. Figure D–5 shows the target locations used for calibration of the King Road Limestone Mine Site Groundwater Flow Model. Three kinds of targets were included: (1) the USGS wells in the region and (2) the monitoring wells within the mine site, which were used for the calibration purposes, and (3) the transect piezometers installed on site for a wetland delineation study (e.g., T-1snk), which were used for model verification purposes. Available water levels for USGS wells and monitoring wells within the simulation period (CY 2006) were used as targets for these wells.

D.3.1.1 Hydraulic Conductivity Zonation

The achievement of a calibrated model can be most influenced by the assignment of *K* values on a per cell, per layer, or per area basis. If sufficient data are available, *K* can be varied in the two horizontal directions (K_x and K_y) and in the vertical direction (K_z). The condition of having different flow properties in different directions is the property of anisotropy (Fetter 1988) and is common in the heterogeneous flow

systems of carbonate aquifers. Table D–4 provides a listing of K_x, K_y, and K_z hydraulic conductivities and anisotropic ratios assigned to 10 zones of the King Road Limestone Mine Site Groundwater Flow Model. Figure D–6 depicts the hydraulic conductivity zones for model Layer 1, with similar zones for model Layers 2 through 6 depicted in Figure D–7. The assignment of 1:1 ratios for both $K_{x,y}$ and K_z reflects a lack of site-specific data and therefore, is a limitation in the model construction.

Table D–4. Hydraulic Conductivity and Anisotropic Ratios for Model Zones

Model Zone	K_x (feet per day)	K_y (feet per day)	Anisotropic Ratio (horizontal to horizontal) (K_x:K_y)	Anisotropic Ratio (horizontal to vertical) ($K_{x,y}$:K_z)
1	28	28	1:1	1.6:1
2	8,950	8,950	1:1	10:1
11	2,800	2,800	1:1	1:1.004
12	1,523	1,523	1:1	1:1
13	28	28	1:1	1:1
14	28	28	1:1	1:1
15	28	28	1:1	1:1
16	2,800	2,800	1:1	1:1
17	28	28	1:1	1:1
18	48	48	1:1	1:1

D.3.2 Calibration Results

The calibration results with respect to estimated hydraulic conductivity distribution, specific storage, specific yield, and predicted water levels in the target wells are discussed in the following sections.

D.3.2.1 Estimated Hydraulic Conductivity Values

The calibration results with respect to estimated horizontal hydraulic conductivity values are presented in Figures D–6 and D–7 and Table D–4. Estimated horizontal hydraulic conductivity values range from 28 to 8,950 feet per day, with an average of 197 feet per day.

D.3.2.2 Estimated Specific Storage and Specific Yield Values

The estimated specific storage and specific yield values are presented in Table D–5. The specific storage values range from 1×10^{-7} to 1×10^{-4} per foot, with an approximate average of 1×10^{-6} per foot. A specific yield value of 0.1 was estimated throughout the model domain.

Table D–5. Estimated Specific Storage and Specific Yield

Model Zone	Specific Storage (per foot)	Specific Yield (per foot)
1	1.00×10^{-5}	9.99×10^{-2}
2	1.00×10^{-5}	1.00×10^{-1}
11	2.28×10^{-5}	1.00×10^{-1}
12	1.00×10^{-7}	1.00×10^{-1}
13	1.00×10^{-7}	1.00×10^{-1}
14	1.00×10^{-7}	1.05×10^{-1}
15	1.00×10^{-4}	1.00×10^{-1}
16	1.00×10^{-7}	1.00×10^{-1}
17	1.00×10^{-7}	1.00×10^{-1}
18	1.00×10^{-7}	1.00×10^{-1}

D.3.2.3 Predicted Water Levels in Target Wells

The successful calibration of a groundwater flow models is achieved when there is close agreement between the measured values (e.g., observed) and computed values of a model run. For the King Road Limestone Mine Site Groundwater Flow Model, the match between observed and computed groundwater levels was determined using calculated residuals. A residual reflects the deviation between the observed and the computed groundwater levels. Other comparison values are the mean error, or bias, and the residual standard deviation for each station. Table D–6 summarizes the calibration results for the flow model. The overall residual mean is 0.60 feet, the residual standard deviation is 1.06 feet, and the range in target values is 69.4 feet. Therefore, the mean is close to zero, and the standard deviation is 0.015 (1.5 percent) of the range in target values. Similar statistics for each well are provided in the table.

Table D–6. Calibration Residuals for Model Output Results

Target Well	Residual Mean (feet)	Residual Std. Dev. (feet)	Residual Minimum (feet)	Residual Maximum (feet)	Range (in Target Values) (feet)	Residual Mean/Range (percent)	Residual Std. Dev./Range (percent)
MW-1	–1.02	1.15	–2.85	2.42	69.4	–1.5	1.7
MW-2	–1.18	1.58	–2.22	0.63	69.4	–1.7	2.3
MW-3	0.03	1.06	–1.30	2.39	69.4	0.0	1.5
MW-4	5.97	0.44	5.49	6.35	69.4	8.6	0.6
MW-5	0.11	1.21	–2.02	3.14	69.4	0.2	1.7
MW-6	3.56	1.67	2.01	5.33	69.4	5.1	2.4
142	0.67	0.43	0.36	0.97	69.4	1.0	0.6
144	–0.20	0.55	–1.72	0.31	69.4	–0.3	0.8
150	0.68	1.73	–1.03	3.36	69.4	1.0	2.5
151	–1.56	1.72	–2.78	–0.34	69.4	–2.2	2.5
147	–0.45	0.13	–0.57	–0.32	69.4	–0.7	0.2
Overall	**0.60**	**1.06**	**–0.60**	**2.20**	**69.4**	**0.86**	**1.53**

Key: Std. Dev.=standard deviation.

Plots of the observed and simulated water levels over time for the wetland transect piezometers (see Figure D–8a), mine site monitoring wells (see Figure D–8b), and regional USGS observation wells (see Figure D–8c) are provided. As shown, especially for wells with extensive data points, the observed and computed track closely, representing a reliable prediction of water levels.

Given these residual statistics and observed versus simulated water levels plots, it is assumed that the King Road Limestone Mine Site Groundwater Flow Model is applicable for use in evaluation of groundwater changes for this EIS. This conclusion was further supported based on the model verification presented below.

D.4 MODEL VERIFICATION

For the purpose of model verification, simulations were performed to predict the water levels for the transect wells and were compared against the measured heads from these wells. The residual values, reflecting the deviation between the observed and the predicted groundwater levels, were calculated and are presented in Table D–7. Table D–7 also presents the residual standard deviation for each station, the minimum and the maximum residuals for the period of comparisons for each station, and the overall deviations. Based on the model verification results presented in Table D–7, it may be concluded that the calibrated King Road Limestone Mine Site Groundwater Flow Model can be used for evaluating the mining alternatives with reasonable confidence.

Table D–7. Model Verification Results

Verification Well	Residual Mean (feet)	Residual Std. Dev. (feet)	Residual Minimum (feet)	Residual Maximum (feet)	Range (in Verification Values) (feet)	Residual Mean/Range (percent)	Residual Std. Dev./Range (percent)
T-1snk	–0.08	0.82	–0.87	1.44	69.4	–0.1	1.2
T-2snk	–0.38	0.70	–1.12	0.93	69.4	–0.6	1.0
T-6snk	–1.26	0.66	–1.85	–0.01	69.4	–1.8	0.9
T-7snk	–0.03	0.77	–1.03	1.34	69.4	0.0	1.1
T-8snk	–2.19	0.43	–2.56	–1.19	69.4	–3.2	0.6
T-9snk	–0.16	0.67	–0.90	1.21	69.4	–0.2	1.0
T-10snk	0.71	0.70	–0.02	2.07	69.4	1.0	1.0
T-11snk	–0.02	0.75	–0.77	1.40	69.4	0.0	1.1
T-12snk	0.27	0.72	–0.65	1.13	69.4	0.4	1.0
Overall	**–0.48**	**0.67**	**–1.18**	**0.82**	**69.40**	**–0.7**	**1.0**

Key: Std. Dev.=standard deviation.

D.5 MODEL APPLICATION

Groundwater simulations for the baseline (pre-mining) and four of the seven proposed action alternatives (post-mining) were performed using the King Road Limestone Mine Site Groundwater Flow Model. Numerous simulations were completed to assess seepage change for each alternative, with each run preceded by a reconfiguring of the input files to adjust for land changes due to mining. The results of these simulations are provided in Chapter 4.

The King Road Limestone Mine Site Groundwater Flow Model was also used to simulate the changes to seepage volume changes (per alternative) to determine the effectiveness of the proposed mitigation plans. Results of each simulation provided output data for evaluation of seepage changes, groundwater elevations, and water budget analysis. The results of these simulations are provided in Chapter 5.

D.5.1 Seepage Analysis

A seepage analysis was performed for baseline or existing conditions (considered equivalent to Alternative 1) and four action alternatives (Alternatives 2, 3, 7, and 8) along selected transects (lines) and for selected periods. Output from MODFLOW was input to the USGS program Zone Budget (USGS 1990) to calculate subregional water budgets within the King Road Limestone Mine site groundwater model domain. In estimating the seepage through a given transect, the entire vertical cross section in the model along the selected transect was summed. The selected transects are shown in Figure D–9 and are described below (this description can also be found in Chapter 3 of this EIS).

- A-A′: Groundwater seepage from the east of the mine site boundary to the west (i.e., seepage from outside to inside through the eastern boundary of the mine site) through the north-south Transect A-A′ and the six layers of the model.

- B-B′: Groundwater seepage from the east to the west (i.e., seepage from inside the mining area through the western boundary of the Alternative 3 mining area) through the north-south Transect B-B′ located at the western edge of the Alternative 3 mining boundary.

- C-C′: Groundwater seepage from the east to the west (i.e., seepage from inside the mining area through the western boundary of the mine site) through the north-south Transect C-C’ located at the western mining boundary.

- D-D′ and G-G′: Groundwater seepage from the north to the south (i.e., seepage from outside to inside the mining area through the northern boundary of the Alternative 2 mining area) through the east-west Transects D-D′ and G-G′ and located at the northern edge of the Alternative 2 mining boundary.

- E-E′, F-F′, and H-H′: Groundwater seepage from the south to the north (i.e., seepage from outside to inside through the southern boundary of the Alternative 2 mining area) through the east-west Transects E-E′, F-F′, and H-H′ and located at the southern edge of the Alternative 2 mining boundary.

- I-I′: Groundwater seepage from the east of the mine site boundary to the west through the north-south Transect I-I′, located approximately 1 mile east of the mine site boundary that starts at the northern boundary of the model domain and ends at the southern boundary of the model domain.

- J-J′: Groundwater seepage from the north of the mine site boundary to the west through the east-west Transect J-J′, located approximately 1 mile north of the mine site boundary that starts at Transect I-I′ and ends at the western boundary of the model domain.

- K-K′: Groundwater seepage from the south of the mine site boundary to the north through the east-west Transect K-K′, located approximately 1 mile south of the mine site boundary that starts at Transect I-I' and ends at the western boundary of the model domain.

- L-L′: Groundwater seepage from the west of the mine site boundary to the east through the northwest-southeast Transect L-L′, located approximately 1 mile east of the western model boundary that starts at Transect J-J′ and ends at Transect K-K′.

As discussed previously, the simulation period for this analysis is January 2003 through December 2008. However, to remove the effects of initial conditions, the average seepage conditions were estimated using the seepage results from January 2004 through December 2008 (i.e., CY 2003 results were excluded from the overall average estimates). Because CY 2007 was considered a drought year, it was selected for evaluating dry conditions; similarly, because CY 2004 had the highest rainfall during the period of simulation, it was selected for evaluating wet conditions. The seepage analysis is discussed in detail in Chapter 4, Section 4.2.2, of this EIS. Simulation results were output every day for the entire period being analyzed. The results of the groundwater seepage analysis for the selected alternatives without mitigation are shown in Tables D–8, D–9, and D–10 for average conditions, the dry period, and the wet period, respectively. An analysis showing the seepage changes into the mine site and out from the mine site for all the alternatives compared with the baseline was performed and are is shown in Tables D–11, D–12, and D–13 for average conditions, the dry period, and the wet period, respectively. For average conditions, the maximum change of seepage into the mine site was predicted to be 13 percent for Alternative 2, and the minimum change of 0.1 percent was predicted for Alternative 7. Similarly, the maximum change in seepage out from the mine site was predicted to be 15.7 percent for Alternative 2, with the minimum change of 0.3 percent for Alternative 7.

Table D–8. Predicted 5-Year (Calendar Years 2004 through 2008) Average Seepage Rates[a] from Different Sections for Multiple Scenarios

Transects for Evaluating Seepage[b]	Seepage Flow Direction	Baseline (MGD)	Alternative 2			Alternative 3		
			MGD	Difference from Baseline (MGD)	Percent Change from Baseline	MGD	Difference from Baseline (MGD)	Percent Change from Baseline
Mine-Out Areas within Mine Site Boundary								
(G-G′+D-D′)	North to South	23.36	27.65	4.29	18.4	23.98	0.62	2.7
(E-E′+F-F′+ H-H′)	North to South	9.93	11.46	1.53	15.4	10.11	0.18	1.8
A-A′	East to West	7.42	7.19	–0.23	–3.1	7.03	–0.39	–5.3
B-B′	East to West	16.56	17.46	0.90	5.4	16.47	–0.09	–0.5
C-C′	East to West	24.43	28.32	3.88	15.9	24.26	–0.17	–0.7
Regional Areas Outside the Mine Site Boundary								
I-I′	East to West	131.16	131.18	0.02	0.0	131.12	–0.04	0.0
J-J′	North to South	93.96	95.76	1.80	1.9	94.19	0.23	0.2
K-K′	North to South	3.31	4.06	0.75	22.5	3.66	0.35	10.5
L-L′	East to West	89.36	92.05	2.68	3.0	88.97	–0.39	–0.4

Transects for Evaluating Seepage[b]	Seepage Flow Direction	Baseline (MGD)	Alternative 7			Alternative 8		
			MGD	Difference from Baseline (MGD)	Percent Change from Baseline	MGD	Difference from Baseline (MGD)	Percent Change from Baseline
Mine-Out Areas within Mine Site Boundary								
(G-G′+D-D′)	North to South	23.36	23.66	0.30	1.3	25.99	2.63	11.3
(E-E′ +F-F′+ H-H′)	North to South	9.94	10.15	0.21	2.1	11.53	1.59	16.0
A-A′	East to West	7.42	7.08	–0.34	–4.6	7.17	–0.25	–3.4
B-B′	East to West	16.56	16.04	–0.52	–3.2	17.44	0.87	5.3
C-C′	East to West	24.43	24.12	–0.32	–1.3	25.86	1.42	5.8
Regional Areas Outside the Mine Site Boundary								
I-I′	East to West	131.16	131.14	–0.02	0.0	131.10	–0.06	0.0
J-J′	North to South	93.96	94.02	0.06	0.1	95.02	1.06	1.1
K-K″	North to South	3.31	3.62	0.31	9.3	4.00	0.69	20.7
L-L′	East to West	89.36	88.98	–0.38	–0.4	90.58	1.21	1.4

[a] Seepage rates for 5-year average represent the predicted average of 2004 through 2008 (i.e., the period of simulation excluding the initial period of calendar year 2003).

[b] See Figure D–9 and Section D.5.1 for the location and description of the transects.

Key: MGD=million gallons per day.

Table D–9. Predicted Dry Period (Calendar Year 2007) Average Seepage Rates[a] from Different Sections for Multiple Scenarios

Transects for Evaluating Seepage[b]	Seepage Flow Direction	Baseline (MGD)	Alternative 2 MGD	Alternative 2 Difference from Baseline (MGD)	Alternative 2 Percent Change from Baseline	Alternative 3 MGD	Alternative 3 Difference from Baseline (MGD)	Alternative 3 Percent Change from Baseline
Mine-Out Areas within Mine Site Boundary								
(G-G′+D-D′)	North to South	23.27	27.2	3.93	16.9	23.69	0.42	1.8
(E-E′+F-F′+ H-H′)	North to South	9.46	11.16	1.70	18.0	9.68	0.22	2.3
A-A′	East to West	7.04	6.8	–0.24	–3.4	6.66	–0.38	–5.4
B-B′	East to West	15.81	16.97	1.16	7.3	15.91	0.10	0.6
C-C′	East to West	23.4	27.93	4.53	19.4	23.38	–0.02	–0.1
Regional Areas Outside the Mine Site Boundary								
I-I′	East to West	131.01	130.95	–0.06	0.0	130.92	–0.09	–0.1
J-J′	North to South	93.81	95.39	1.58	1.7	93.9	0.09	0.1
K-K′	North to South	2.04	2.93	0.89	43.6	2.5	0.46	22.5
L-L′	East to West	86.31	89.3	2.99	3.5	86.15	–0.16	–0.2

Transects for Evaluating Seepage[b]	Seepage Flow Direction	Baseline (MGD)	Alternative 7 MGD	Alternative 7 Difference from Baseline (MGD)	Alternative 7 Percent Change from Baseline	Alternative 8 MGD	Alternative 8 Difference from Baseline (MGD)	Alternative 8 Percent Change from Baseline
Mine-Out Areas within Mine Site Boundary								
(G-G′+D-D′)	North to South	23.27	23.44	0.17	0.7	25.82	2.55	11.0
(E-E′ +F-F′+ H-H′)	North to South	9.46	9.71	0.25	2.6	11.04	1.58	16.7
A-A′	East to West	7.04	6.72	–0.32	–4.5	6.8	–0.24	–3.4
B-B′	East to West	15.81	15.41	–0.40	–2.5	16.72	0.91	5.8
C-C′	East to West	23.4	23.19	–0.21	–0.9	24.82	1.42	6.1
Regional Areas Outside the Mine Site Boundary								
I-I′	East to West	131.01	130.95	–0.06	0.0	130.95	–0.06	0.0
J-J′	North to South	93.81	93.78	–0.03	0.0	94.86	1.05	1.1
K-K′	North to South	2.04	2.39	0.35	17.2	2.75	0.71	34.8
L-L′	East to West	86.31	86.08	–0.23	–0.3	87.53	1.22	1.4

a Seepage rates for dry period represent the predicted average of January through December 2007.
b See Figure D–9 and Section D.5.1 for the location and description of the transects.
Key: MGD=million gallons per day.

Table D–10. Predicted Wet Period (Calendar Year 2004) Average Seepage Rates[a] from Different Sections for Multiple Scenarios

Transects for Evaluating Seepage[b]	Seepage Flow Direction	Baseline (MGD)	Alternative 2 MGD	Alternative 2 Difference from Baseline (MGD)	Alternative 2 Percent Change from Baseline	Alternative 3 MGD	Alternative 3 Difference from Baseline (MGD)	Alternative 3 Percent Change from Baseline
Mine-Out Areas within Mine Site Boundary								
(G-G′+D-D′)	North to South	23.44	27.84	4.40	18.8	24.11	0.67	2.9
(E-E′ +F-F′+ H-H′)	North to South	10.88	12.32	1.44	13.2	10.99	0.11	1.0
A-A′	East to West	8.31	8	–0.31	–3.7	7.8	–0.51	–6.1
B-B′	East to West	17.95	18.53	0.58	3.2	17.76	–0.19	–1.1
C-C′	East to West	26.11	30.16	4.05	15.5	25.85	–0.26	–1.0
Regional Areas Outside the Mine Site Boundary								
I-I′	East to West	132.08	131.82	–0.26	–0.2	131.76	–0.32	–0.2
J-J′	North to South	93.99	95.81	1.82	1.9	94.26	0.27	0.3
K-K′	North to South	5.5	6.14	0.64	11.6	5.78	0.28	5.1
L-L′	East to West	94	96.79	2.79	3.0	93.4	–0.60	–0.6

Transects for Evaluating Seepage[b]	Seepage Flow Direction	Baseline (MGD)	Alternative 7 MGD	Alternative 7 Difference from Baseline (MGD)	Alternative 7 Percent Change from Baseline	Alternative 8 MGD	Alternative 8 Difference from Baseline (MGD)	Alternative 8 Percent Change from Baseline
Mine-Out Areas within Mine Site Boundary								
(G-G′+D-D′)	North to South	23.44	23.76	0.32	1.4	26.01	2.57	11.0
(E-E′ +F-F′+ H-H′)	North to South	10.88	11.1	0.22	2.0	12.57	1.69	15.5
A-A′	East to West	8.31	7.86	–0.45	–5.4	7.98	–0.33	–4.0
B-B′	East to West	17.95	17.31	–0.64	–3.6	18.77	0.82	4.6
C-C′	East to West	26.11	25.71	–0.40	–1.5	27.71	1.60	6.1
Regional Areas Outside the Mine Site Boundary								
I-I′	East to West	132.08	131.76	–0.32	–0.2	131.7	–0.38	–0.3
J-J′	North to South	93.99	94.07	0.08	0.1	94.97	0.98	1.0
K-K′	North to South	5.5	5.8	0.30	5.5	6.18	0.68	12.4
L-L′	East to West	94	93.45	–0.55	–0.6	95.33	1.33	1.4

[a] Seepage rates for wet period represent the predicted average of January through December 2004.
[b] See Figure D–9 and Section D.5.1 for the location and description of the transects.
Key: MGD=million gallons per day.

Table D–11. Predicted 5-Year (Calendar Years 2004 through 2008) Average Seepage Rates[a] Balance Around and Away from the Mine Site

Description[b]	Baseline	Alternative			
		2	3	7	8
Around Mine Site Boundary					
Seepage into the mine site	30.8	34.8	31.0	30.7	33.2
Percent change from baseline seepage in	–	13.0	0.6	–0.3	7.8
Seepage out from the mine site	34.4	39.8	34.4	34.3	37.4
Percent change from baseline seepage out	–	15.7	0.0	–0.3	8.7
Around Regional Areas (approximately a mile away from the mine site boundary)					
Seepage into the regional area	78.3	80.2	78.5	78.3	79.4
Percent change from baseline seepage in	–	2.4	0.3	0.0	1.4
Seepage out from the regional area	91.2	94.3	91.1	91.1	92.3
Percent change from baseline seepage out	–	3.4	0.1	–0.1	1.2

a Seepage rates for 5-year average represent the predicted average of 2004 through 2008 (i.e., the period of simulation excluding the initial period of calendar year 2003).
b See Chapter 4, Figure 4–2 for the locations of the two seepage balance areas.

Table D–12. Predicted Dry Period (Calendar Year 2007) Average Seepage Rates[a] Balance Around and Away from the Mine Site

Description[b]	Baseline	Alternative			
		2	3	7	8
Around Mine Site Boundary					
Seepage into the mine site	30.3	34.0	30.4	30.2	32.6
Percent change from baseline seepage in	–	12.2	0.3	–0.3	7.6
Seepage out from the mine site	32.9	39.1	33.2	32.9	35.9
Percent change from baseline seepage out	–	18.8	0.9	0.0	9.1
Around Regional Areas (approximately a mile away from the mine site boundary)					
Seepage into the regional area	78.1	79.8	78.2	78.0	79.2
Percent change from baseline seepage in	–	2.2	0.1	–0.1	1.4
Seepage out from the regional area	87.0	90.6	87.3	87.1	88.8
Percent change from baseline seepage out	–	4.1	0.3	0.1	2.1

a Seepage rates for dry period represent the predicted average of January through December 2007.
b See Chapter 4, Figure 4–2, for the locations of the two seepage balance areas.

Table D–13. Predicted Wet Period (Calendar Year 2004) Average Seepage Rates[a] Balance Around and Away from the Mine Site

Description[b]	Baseline	Alternative			
		2	3	7	8
Around Mine Site Boundary					
Seepage into the mine site	31.8	35.8	31.9	31.6	34.0
Percent change from baseline seepage in	–	12.6	0.3	–0.6	6.9
Seepage out from the mine site	37.0	42.5	36.8	36.8	40.3
Percent change from baseline seepage out	–	14.9	–0.5	–0.5	8.9
Around Regional Areas (approximately a mile away from the mine site boundary)					
Seepage into the regional area	78.8	80.6	78.9	78.7	79.7
Percent change from baseline seepage in	–	2.3	0.1	–0.1	1.1
Seepage out from the regional area	97.7	100.9	97.4	97.5	96.7
Percent change from baseline seepage out	–	3.3	–0.3	–0.2	–1.0

a Seepage rates for wet period represent the predicted average of January through December 2004.
b See Chapter 4, Figure 4–2, for the locations of the two seepage balance areas.

D.5.2 Impact on Wetlands

The presence or absence of water is the dominant factor in evaluating wetlands. Decreases in the local water table are expected to have adverse effects on wetland hydrology. An analysis was performed to determine the impact on wetlands due to implementation of the alternatives by assessing the effects on the hydrology. The evaluation of wetland impacts was intended to be completed using the Wetland Package for MODFLOW. This package is designed to simulate fluctuations of waters at the land surface, essentially extending the groundwater level above the surface topography. However, the Wetland Package was found to be unsuitable for the King Road Limestone Mine site as water level fluctuations were of a short duration and the magnitude of water level fluctuations was beyond the capability of the package to handle. Therefore, a different approach was utilized for this evaluation that included calibrating groundwater model using a much higher *K* value for the top layer of the model within the wetland areas. The evaluations were performed by predicting the changes in water table elevations for the multiple alternatives compared with the baseline. Potentiometric surface maps were developed for the analysis to assess the change in water levels, a factor considered critical in the viability of wetland sustainment. Figures D–10 and D–11 show the potentiometric surfaces in Layer 1 under baseline dry and wet conditions.

Figures D–12 and D–13 show the potentiometric surfaces in Layer 1 under Alternative 2 for the dry period and wet period. The figures for the remaining simulated alternatives for both dry and wet periods are provided in Attachment A, Figures A–3 through A–12. An analysis showing the drawdown/mounding effects on the site (i.e., both regional and mine site) was performed for two of the alternatives (i.e., Alternative 2 [the full mine-out alternative] and Alternative 7 [the least mining alternative]). The drawdown/mounding effects were developed by comparing the head difference between the baseline (Alternative 1) and Alternative 2, as well as between the baseline and Alternative 7 under average, dry and wet conditions (see Attachment A, Figures A–13 through A–18). The result for all other alternatives are expected to fall within these two alternatives. In addition, the simulated groundwater levels for the period of simulation under existing conditions were compared with the groundwater levels of Alternatives 2, 3, 7, and 8 for all the monitoring and transect wells. The figures showing the results of this analysis are presented in Attachment A, Figures A–19 through A–70. Chapter 4, Section 4.4, of this EIS provides a discussion of the impact analysis in more detail.

Modeling results indicate predicted water level fluctuations are not significant and likely should be considered only minimally in terms of evaluating impacts on wetlands. The evaluation of wetland impacts should depend upon the biological impact analysis rather than a modeled seepage analysis or predicted water table drawdowns.

D.5.3 Saltwater Intrusion Analysis

Analyses were performed to evaluate the impact of increased mining in the King Road area on the saltwater intrusion line along the coast of Gulf of Mexico. These analyses included (1) evaluation of seepage through the transect west of the King Road Limestone Mine site near the saltwater intrusion line; and (2) evaluation of groundwater seepage toward the Withlacoochee Bay from the mine site area that eventually discharges into the Gulf of Mexico. Tables D–14 through D–16 present the average, dry, and wet condition modeling results of seepage analysis along these transects for the baseline (no mining conditions), Alternative 2 (full mine-out alternative), Alternative 3, Alternative 7, and Alternative 8. If the percent change of seepage toward the Gulf of Mexico and Lake Rousseau is positive, then it may be concluded that there will not be any impact on the saltwater intrusion line. However, if the percent change of seepage toward the Gulf of Mexico and Lake Rousseau is negative, then there could be an adverse impact on the saltwater intrusion line. The results of this analysis indicate that for average conditions (see Table D–14), there will be positive changes of seepage toward the Gulf of Mexico and Lake Rousseau under Alternatives 2 and 8 compared with the baseline conditions (approximately 3.7 and 2.0 percent, respectively). Under Alternatives 3 and 7, the overall percent changes are 0.0 and –0.1 percent, respectively, compared with the baseline conditions. Therefore, it may be concluded that there will be no adverse impact on the saltwater intrusion line due to mining under Alternatives 2, 3, 7, or 8.

Table D–14. Predicted 5-Year (Calendar Years 2004 through 2008) Average Seepage Rates[a] Toward the Gulf of Mexico and Lake Rousseau for Multiple Scenarios

Transects for Evaluating Seepage[b]	Baseline (MGD)	Alternative					
		2			3		
		MGD	Difference from Baseline (MGD)	Percent Change from Baseline	MGD	Difference from Baseline (MGD)	Percent Change from Baseline
Mine-Out Areas within Mine Site Boundary							
(E-E′+F-F′+H-H′)	9.93	11.46	1.53	15.4	10.11	0.18	1.8
C-C′	24.43	28.32	3.88	15.9	24.26	–0.17	–0.7
Total	34.37	39.78	5.41	15.7	34.37	0.00	0.0
Regional Areas Outside the Mine Site Boundary							
K-K′	3.31	4.06	0.75	22.7	3.66	0.35	10.6
L-L′	89.36	92.05	2.68	3.0	88.97	–0.39	–0.4
Total	92.68	96.11	3.43	3.7	92.636	–0.04	0.0
Transects for Evaluating Seepage[b]	**Baseline (MGD)**	**Alternative**					
		7			**8**		
		MGD	**Difference from Baseline (MGD)**	**Percent Change from Baseline**	**MGD**	**Difference from Baseline (MGD)**	**Percent Change from Baseline**
Mine-Out Areas within Mine Site Boundary							
(E-E′+F-F′+H-H′)	9.94	10.15	0.21	2.1	11.53	1.59	16.0
C-C′	24.43	24.12	–0.32	–1.3	25.86	1.42	5.9
Total	34.37	34.27	–0.11	-0.3	37.388	3.01	8.8
Regional Areas Outside the Mine Site Boundary							
K-K′	3.31	3.62	0.31	9.4	4.00	0.69	20.8
L-L′	89.36	88.98	–0.38	–0.4	90.58	1.21	1.4
Total	92.68	92.61	–0.07	–0.1	94.576	1.90	2.0

[a] See Figure D–9 and Section D.5.1 for the location and description of the transects.

[b] Seepage rates for 5-year average represent the predicted average of 2004 through 2008 (i.e., the period of simulation excluding the initial period of CY 2003).

Key: MGD=million gallons per day.

Table D–15. Predicted Dry Period (Calendar Year 2007) Average Seepage Rates[a] Toward the Gulf of Mexico and Lake Rousseau for Multiple Scenarios

Transects for Evaluating Seepage[b]	Baseline (MGD)	Alternative 2			Alternative 3		
		MGD	Difference from Baseline (MGD)	Percent Change from Baseline	MGD	Difference from Baseline (MGD)	Percent Change from Baseline
Mine-Out Areas within Mine Site Boundary							
(E-E′+F-F′+H-H′)	9.46	11.16	1.70	18.0	9.68	0.22	2.3
C-C′	23.4	27.93	4.53	19.4	23.38	–0.02	–0.1
Total	32.86	39.09	6.23	19.0	33.06	0.20	0.6
Regional Areas Outside the Mine Site Boundary							
K-K′	2.04	2.93	0.89	43.6	2.5	0.46	22.5
L-L′	86.31	89.3	2.99	3.5	86.15	–0.16	–0.2
Total	88.35	92.23	3.88	4.4	88.65	0.30	0.3

Transects for Evaluating Seepage[b]	Baseline (MGD)	Alternative 7			Alternative 8		
		MGD	Difference from Baseline (MGD)	Percent Change from Baseline	MGD	Difference from Baseline (MGD)	Percent Change from Baseline
Mine-Out Areas within Mine Site Boundary							
(E-E′+F-F′+H-H′)	9.46	9.71	0.25	2.6	11.04	1.58	16.7
C-C′	23.4	23.19	–0.21	–0.9	24.82	1.42	6.1
Total	32.86	32.9	0.04	0.1	35.86	3.00	9.1
Regional Areas Outside the Mine Site Boundary							
K-K′	2.04	2.39	0.35	17.2	2.75	0.71	34.8
L-L′	86.31	86.08	–0.23	–0.3	87.53	1.22	1.4
Total	88.35	88.47	0.12	0.1	90.28	1.93	2.2

[a] See Figure D–9 and Section D.5.1 for the location and description of the transects.
[b] Seepage rates for dry period represent the predicted average of January through December 2007.
Key: MGD=million gallons per day.

Table D–16. Predicted Wet Period (Calendar Year 2004) Average Seepage Rates[a] Toward the Gulf of Mexico and Lake Rousseau for Multiple Scenarios

Transects for Evaluating Seepage[b]	Baseline (MGD)	Alternative					
		2			3		
		MGD	Difference from Baseline (MGD)	Percent Change from Baseline	MGD	Difference from Baseline (MGD)	Percent Change from Baseline
Mine-Out Areas within Mine Site Boundary							
(E-E′+F-F′+H-H′)	10.88	12.32	1.44	13.2	10.99	0.11	1.0
C-C′	26.11	30.16	4.05	15.5	25.85	–0.26	–1.0
Total	36.99	42.48	5.49	14.8	36.84	–0.15	–0.4
Regional Areas Outside the Mine Site Boundary							
K-K′	5.5	6.14	0.64	11.6	5.78	0.28	5.1
L-L′	94	96.79	2.79	3.0	93.4	–0.60	–0.6
Total	99.5	102.93	3.43	3.4	99.18	0.32	0.3
Transects for Evaluating Seepage[b]	**Baseline (MGD)**	**Alternative**					
		7			**8**		
		MGD	**Difference from Baseline (MGD)**	**Percent Change from Baseline**	**MGD**	**Difference from Baseline (MGD)**	**Percent Change from Baseline**
Mine-Out Areas within Mine Site Boundary							
(E-E′+F-F′+H-H′)	10.88	11.1	0.22	2.0	12.57	1.69	15.5
C-C′	26.11	25.71	–0.40	–1.5	27.71	1.60	6.1
Total	36.99	36.81	–0.18	-0.5	40.28	3.29	8.9
Regional Areas Outside the Mine Site Boundary							
K-K′	5.5	5.8	0.30	5.5	6.18	0.68	12.4
L-L′	94	93.45	–0.55	–0.6	95.33	1.33	1.4
Total	99.5	99.25	–0.25	–0.3	101.51	2.01	2.0

[a] See Figure D–9 and Section D.5.1 for the location and description of the transects.
[b] Seepage rates for wet period represent the predicted average of January through December 2004.
Key: MGD=million gallons per day.

D.5.4 Mitigation Effectiveness Analysis

As described in this appendix, the completed flow modeling has evaluated the potential impacts on seepage, specifically the net change in the volume of groundwater moving within the subsurface aquifer due to creation of the quarry lakes. With the minimal impacts on groundwater seepage predicted by modeling, specific actions to mitigate seepage change are not anticipated. Therefore, the modeling of mitigation effectiveness is not required.

D.5.5 Cumulative Impact Analysis

A modeling analysis of additional incremental impact(s) (beyond planned mining) to groundwater seepage was not completed as foreseeable future actions exterior to the mine area and within the model domain are not anticipated. This conclusion requires that no cumulative impact modeling be completed.

D.6 SENSITIVITY ANALYSIS

After completion of the model calibration, a sensitivity analysis was performed to determine which input parameters have the greatest influence on the calibration. Typically, a sensitivity analysis is conducted by individually adjusting input parameters and evaluating how the manipulation changes the calibration

statistics derived from matching observed water level elevations. This analysis provides an assessment of how input parameter adjustment influences predicted water levels. For this model, the sensitivity analysis evaluated how individual parameter adjustment affects the seepage rates across multiple transects. Parameters investigated for this calibrated flow model were recharge and *K* values for different zones, including the backfill material to be deposited in the mine-out areas within the King Road Limestone Mine site for implementing the mining alternatives. Due to the simulation time of the model runs, steady state models were used for the backfill material *K* sensitivity analysis.

D.6.1 Sensitivity to Recharge Variation

The net recharge value(s) (calculated by the HELP model) was determined to be a sensitive model parameter during the calibration process (i.e., altering the amount of net recharge in the model produced different results). Therefore, a sensitivity analysis was performed on the recharge zones. This was performed by the auto sensitivity option within Groundwater Vistas. The model chosen for the sensitivity analysis was Alternative 2, based on the maximum mine-out area, and CY 2006, based on average precipitation values for the simulation period.

Two zones of recharge exist in the King Road Limestone Mine site model: Zone 1 in the eastern portion of the model and Zone 2 in the western portion of the model (see Attachment A, Figure A–2). Multipliers for the recharge sensitivity analysis were 0.6, 0.8, 0.9, 1.0, 1.1, 1.2, and 1.4. Therefore, the calibrated values for Zone 1 recharge were multiplied by these factors (e.g., 0.6, 0.8) to revise the Zone 1 recharge values for the sensitivity runs while keeping the Zone 2 recharge fixed with the calibrated values. Once all the simulations were completed with the Zone 1 revised sets of recharge, Zone 1 recharge was set back to the calibrated values, the calibrated Zone 2 recharge values were revised for sensitivity runs similar to Zone 1 recharge, and simulations were performed for each set of revised Zone 2 recharge. After each run, the sum of squared residuals value was recorded. The sum of squared residuals value for each model run was plotted versus the multiplier. Figure D–14 shows the graph produced by the recharge sensitivity analysis for the King Road Limestone Mine site model. According to the recharge sensitivity analysis, Zone 2 recharge was more sensitive to the King Road Limestone Mine site model than Zone 1 recharge. Furthermore, increasing Zone 2 recharge had a greater effect than decreasing Zone 2 recharge.

Also note that sensitivity analyses can be used for calibration purposes. For instance, in Figure D–15, it can be seen that increasing Zone 1 recharge actually reduces the sum of squared residuals for the model. This infers that a higher recharge rate in the eastern portion of the model would result in less error. However, while this implies a more reasonable model numerically, it was determined to be unrepresentative of the conceptual model and not within the acceptable range of recharge values typical of the area.

D.6.2 Sensitivity to Backfill Hydraulic Conductivity *(K)* Variation

The backfilling of the quarry lakes is planned to occur via the pumping of waste material (e.g., unused rock particles) from the central processing plant to each lake using a pipeline. The end of the pipe will be placed in the quarry and moved as necessary when a delta of material has accumulated. It is expected that a delta will prograde into the lake at the point of discharge with segregation of rock sizes due to differences in settling velocities. As such, the larger particles (e.g., coarse sand size) will be deposited first, and the finer particles (fine sands and silts) will settle slower and may be transported further from the discharge pipe. As the pipe is moved within the quarry area, overlapping deltas of sediment will be built from the base and sides of the quarry upward. The layers will consist of unconsolidated sediment with non-cemented grains. As the actual backfill geometry is unknown and will be difficult to predict, a backfill geometry was assumed that consists of thick, coarse sand at the base, fine sand in the middle, and silt size near the surface. As discussed, these layers were assigned conductivity values.

A sensitivity analysis was performed on the hydraulic conductivity of the unconsolidated backfill material. Due to the lengthy simulation time, this sensitivity analysis was performed using steady state models that were converted from the transient simulations. Sieve analysis data of similar material have produced a backfill *K* value of 0.85 feet per day. Therefore, an isotropic *K* value of 0.85 feet per day was used for the backfill material in Layers 2 and 3 of the King Road Limestone Mine site model and was assigned to

K Zone 6. The backfill material in Layer 1 was assigned to *K* Zone 5 with the same virtual *K* value for Layer 1 that is used to simulate the wetlands. The backfill material is within the mine site boundary. Similar to the recharge sensitivity analysis, Alternative 2, CY 2006 was used for the backfill *K* sensitivity analysis.

An initial sensitivity analysis was conducted using the auto sensitivity option in Groundwater Vistas to determine the sensitivity of *K* Zones 5 and 6 in both the horizontal and vertical direction. The results of this sensitivity analysis (shown in Figure D–15) indicate that altering the horizontal *K* in Zone 5 has the greatest effect on the King Road Limestone Mine site model simulations for Alternative 2 under average conditions (CY 2006). However, this sensitivity analysis could not produce the effects on drawdown/mounding due to mining as compared with the baseline *K* value for the backfill material. Therefore, a manual sensitivity analysis was performed to show the sensitivity of *K* Zone 6 (i.e., hydraulic conductivity of the backfill material) on the drawdown/mounding due to mining. This analysis was performed by simulating Alternative 2 under average conditions (CY 2006) and varying the *K* values for Zone 6. The multipliers for the backfill *K* sensitivity analysis are 0.01, 0.1, 1.0, 10, 100, and 1,000. Therefore, the corresponding *K* values are 0.0085, 0.085, 8.5, 85, and 850 feet per day, whereas 0.85 feet per day is the baseline *K* value. Simulations were performed for each set of new *K* values, and each simulation was compared with the baseline under average conditions to determine the head difference from baseline. For this analysis, eight mine site monitoring wells (MW-1, MW-3, MW-4, MW-5, T-1snk, T-8snk, T-9snk, and T-10snk) and two arbitrary monitoring wells (where higher drawdown/mounding effects were predicted with the baseline *K* value; WLW-7a and WLW-7b) were selected. T-1snk in the baseline simulation was replaced by Lake 16 in Alternative 2. These monitoring wells in relation to the mine site boundary and Alternative 2 lakes are shown in Figure D–16. The results of this analysis are presented in Table D–17. As can be seen from this table, by decreasing the backfill *K* value, there would be slight increases of mounding (e.g., less than 0.05 feet on average if the *K* value is decreased by an order of magnitude), but no effect on the drawdown. However, by increasing the backfill *K* value, there would be significant decreases of mounding (e.g., approximately 0.13 feet, or a 50 percent decrease on average, if the *K* value is increased by an order of magnitude) and increases of drawdown (e.g., approximately 0.17 feet, or a 39 percent increase on average, if the *K* value is increased by two orders of magnitude).

D.6.3 Sensitivity to Hydraulic Conductivity *(K)* Variation

A sensitivity analysis was performed on the calibrated hydraulic conductivities of different *K* zones within the model area. This analysis was performed for the baseline (i.e., No Action Alternative), as well for Alternative 2 (i.e., mine-out alternative). First, the hydraulic conductivity of *K* Zone 2 (i.e., Layer 1, representing the wetland area) was increased by 20 percent (i.e., from 8,950 feet per day to 10,800 feet per day), keeping all other *K* zones at the calibrated values. Second, the hydraulic conductivities of all the *K* zones except *K* Zone 2 were increased by 100 percent.

Results of these analyses were summarized through seepage analysis and are presented in Table D–18. As indicated, seepage volume increases with higher hydraulic conductivity values (approximately 20 percent is the maximum increase in one of the transects) the maximum percent change in seepage between Alternative 2 and baseline is less than 3 percent. Therefore, it may be concluded that the results of the model are quite accurate in terms of a relative comparison of alternatives.

Table D–17. Results of Backfill Material *K* Sensitivity on Predicted Drawdown/Mounding Based on Simulation of Alternative 2

	Baseline	Zone 6 K_h & K_v = 0.0085 feet per day		Zone 6 K_h & K_v = 0.085 feet per day		Zone 6 K_h & K_v = 0.85 feet per day	
Monitoring Well	**Head Elevation (feet)**	**Head Elevation (feet)**	**Head Difference from Baseline**	**Head Elevation (feet)**	**Head Difference from Baseline**	**Head Elevation (feet)**	**Head Difference from Baseline**
MW-1	4.04	3.77	0.27	3.77	0.27	3.77	0.27
MW-3	12.51	13	–0.49	13	–0.49	12.94	–0.43
MW-4	9.99	10.43	–0.44	10.43	–0.44	10.4	–0.41
MW-5	6.93	7.18	–0.25	7.17	–0.24	7.11	–0.18
T-1snk (Lake 16)	3.18	2.98	0.2	2.98	0.2	2.99	0.19
T-8snk	5.89	5.84	0.05	5.83	0.06	5.77	0.12
T-9snk	10.23	10.77	–0.54	10.76	–0.53	10.65	–0.42
T-10snk	10.96	11.59	–0.63	11.58	–0.62	11.49	–0.53
WLW-7a	11.45	12.14	–0.69	12.13	–0.68	12.07	–0.62
WLW-7b	13.98	14.42	–0.44	14.41	–0.43	14.37	–0.39

	Baseline	Zone 6 K_h & K_v = 8.5 feet per day		Zone 6 K_h & K_v = 85 feet per day		Zone 6 K_h & K_v = 850 feet per day	
Monitoring Well	**Head Elevation (feet)**	**Head Elevation (feet)**	**Head Difference from Baseline**	**Head Elevation (feet)**	**Head Difference from Baseline**	**Head Elevation (feet)**	**Head Difference from Baseline**
MW-1	4.04	3.78	0.26	3.74	0.3	3.73	0.31
MW-3	12.51	12.77	–0.26	12.47	0.04	11.27	1.24
MW-4	9.99	10.3	–0.31	10.15	–0.16	9.7	0.29
MW-5	6.93	6.95	–0.02	6.76	0.17	6.66	0.27
T-1snk (Lake 16)	3.18	2.99	0.19	2.97	0.21	2.97	0.21
T-8snk	5.89	5.61	0.28	5.45	0.44	5.43	0.46
T-9snk	10.23	10.43	–0.2	10.18	0.05	9.54	0.69
T-10snk	10.96	11.28	–0.32	10.98	–0.02	10.13	0.83
WLW-7a	11.45	11.89	–0.44	11.58	–0.13	10.51	0.94
WLW-7b	13.98	14.25	–0.27	14.04	–0.06	13.36	0.62

Notes: Negative values (shown in red) indicate a rise in the water table from baseline conditions. Positive values (shown in blue) indicate a drop in the water table from baseline conditions. Values representing backfill *K* of 0.85 feet per day (final value used in the model) are shaded gray. Head elevations are in feet above mean sea level (amsl).
Key: *K*=hydraulic conductivity; K_h=horizontal hydraulic conductivity; K_v=vertical hydraulic conductivity.

Table D–18. Results of *K* Sensitivity on Seepage Rates[a] for King Road Limestone Mine Site Groundwater Flow Model *K* Zones

Transects for Evaluating Seepage[b]	Seepage Flow Direction	Baseline Condition - Run 1 (MGD)	Baseline Condition - Run 2 (MGD)	Baseline Condition - Run 3 (MGD)	Alternative 2 - Run 1		Alternative 2 - Run 2		Alternative 2 - Run 3	
					MGD	Percent Change from Baseline - Run 1	MGD	Percent Change from Baseline - Run 2	MGD	Percent Change from Baseline - Run 3
Within and at the Mine Site Boundary										
(G-G+D-D)	North to South	23.37	24.3	24.59	27.82	19.0	28.95	19.1	29.41	19.6
(E-E+F-F+ H-H)	North to South	9.96	10.54	11.67	11.33	13.8	11.96	13.5	13.22	13.3
A-A-E2W	East to West	7.41	7.84	10.06	7.21	–2.7	7.43	–5.2	9.89	–1.7
B-B-E2W	East to West	16.62	17.39	18.76	17.44	4.9	18.02	3.6	19.88	6.0
C-C-E2W	East to West	24.51	25.36	26.55	28.11	14.7	28.87	13.8	30.33	14.2
Outside the Mine Site Boundary										
I-I-E2W	East to West	131.15	133.91	141.3	131.13	0.0	133.87	0.0	141.31	0.0
J-J-N2S	North to South	93.99	96.19	96.34	95.91	2.0	98.18	2.1	98.46	2.2
K-K-N2S	North to South	3.42	3.67	3.85	4.04	18.1	4.39	19.6	4.51	17.1
L-L-E2W	East to West	89.66	92.1	94.67	92.08	2.7	94.37	2.5	97.15	2.6

a Seepage rates represent the predicted average of January through December 2006.

b See Figure D–9 and Section D.5.1 for the location and description of the transects.

Key: MGD=million gallons per day.

D.7 MODEL ASSUMPTIONS/LIMITATIONS AND APPLICABILITY

A numerical groundwater model is the quantitative transformation of a physical system representing complex hydrogeologic conditions of a site. Therefore, it represents a modeler's understanding of the subsurface flow system, which may deviate from the actual system. For example, the King Road Limestone Mine Site Groundwater Flow Model assumes a six-layer configuration for the subsurface geology with several layers assigned uniform thicknesses and similar properties. It is understood that this simplification of the subsurface geology represents a limitation in the model. In spite of these limitations, the King Road Limestone Mine Site Groundwater Flow Model is verified to reasonably capture regional flow patterns, and the model was considered applicable for the present study.

D.7.1 Constraining Limitations/Assumptions

The groundwater flow model used in this EIS is a mathematical representation of groundwater flow within a complex hydrogeologic setting. The model itself is complex, yet is limited in its ability to replicate flow within the model domain. However, the King Road Limestone Mine Site Groundwater Flow Model is a valuable decisionmaking aid if the key limitations and assumptions are considered. The model is calibrated and can simulate the hydrologic effects caused by mining to the extent necessary to allow comparative analysis of the different mining alternatives.

The key limitations/assumptions of the King Road Limestone Mine Site Groundwater Flow Model are presented below.

- The model is only calibrated to a comprehensive set of water level data without considering calibration of stages or hydraulic gradients.
- No data were available for drainages (Spring Run Creek, Demory Creek) that may have produced limitations within the model.
- The observed groundwater levels used for model calibration represent the daily maximum values (the only groundwater levels published by the USGS) compared with water levels at the end of each time step (i.e., day) computed by the model.
- Because MODFLOW is a finite-difference model, it cannot reproduce groundwater levels observed in the immediate vicinity of a pumping well due to limitations imposed by the spatial resolution of the model. This is not considered a significant limitation as pumping wells are far removed from the mine site.
- The model is not a precise representation of the complex heterogeneous flow system of the aquifer because the rock properties (e.g., porosity and permeability) vary both laterally and vertically throughout the area.
- The model will not accommodate turbulent flow or a conduit flow network. It is recognized that conduit flow is likely in the mine site and vicinity, yet recent work by Dr. Kincaid indicates a portion of the groundwater basin is not dominated by karstic flow (Tarmac 2009).
- The model has a "square" footprint at the base of lake cells with vertical walls projected throughout all layers. It does not account for rock left in place for littoral shelves, sloped quarry walls, or rock remaining at the base of the quarry lake.
- Simulations are performed based on 1 year (CY 2006) of hydrologic data, assuming these data to be repeated continuously over a longer period of time (e.g., for up to 100 years).
- Instead of gradual completion of the mining alternatives, each simulation assumes completion of an alternative at one time (i.e., the simulation does not account for time-varying changes in the lake footprints).

- All the lake bottoms are assigned a depth of approximately 120 feet (i.e., projected into layer 3 of the model). The backfilling of the quarry lakes is projected as three layers of differing hydraulic conductivity yet the internal stratigraphy will be more complex.

Notwithstanding these limitations, the model is calibrated and can reasonably simulate the hydrologic effects caused by mining to allow for decisionmaking. In addition, the model simulates regional flow patterns quite reasonably. The model is considered adequate for comparative analyses and the calculated seepage quantities are usable (with limitations considered) for a comparative assessment of the proposed mining alternatives.

D.7.2 Usefulness of the Model

For this EIS, the usefulness and applicability of the King Road Limestone Mine Site Groundwater Flow Model is in its ability to assess relative changes to baseline conditions of groundwater flow with addition of mining footprints. To be useful for this EIS, the model must produce consistent results in each model run reflective of the proportional changes in baseline conditions as rock is mined. The ability of the model to be reconfigured to predict different mining scenarios is critical in allowing comparative analyses of the proposed mining alternatives. By the use of a fixed set of measurement points at well-placed locations (i.e., the transects), the changes in flow can be assessed over time. The positioning of transects at locations likely impacted by changes in groundwater flow, such as the eastern and western edge of the proposed mining area, result in modeling results that are considered useful for decisionmakers. The comparative analyses of seepage presented in Chapter 4 (without mitigation) and Chapter 5 (with mitigation) of this EIS allow quantification of the modeled change in groundwater flow, but most importantly, give indications of areas within the model domain of predicted greater or lesser impact from the proposed mining. With this information, decisions can be made and plans designed to monitor for those predicted changes as mining progresses if mining is permitted. At the appropriate time, the model could be revised to incorporate the actual changes to groundwater flow (e.g., observed changes in water levels due to initial mining), thus improving the usefulness of the model.

D.8 REFERENCES

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APPENDIX D – Figures

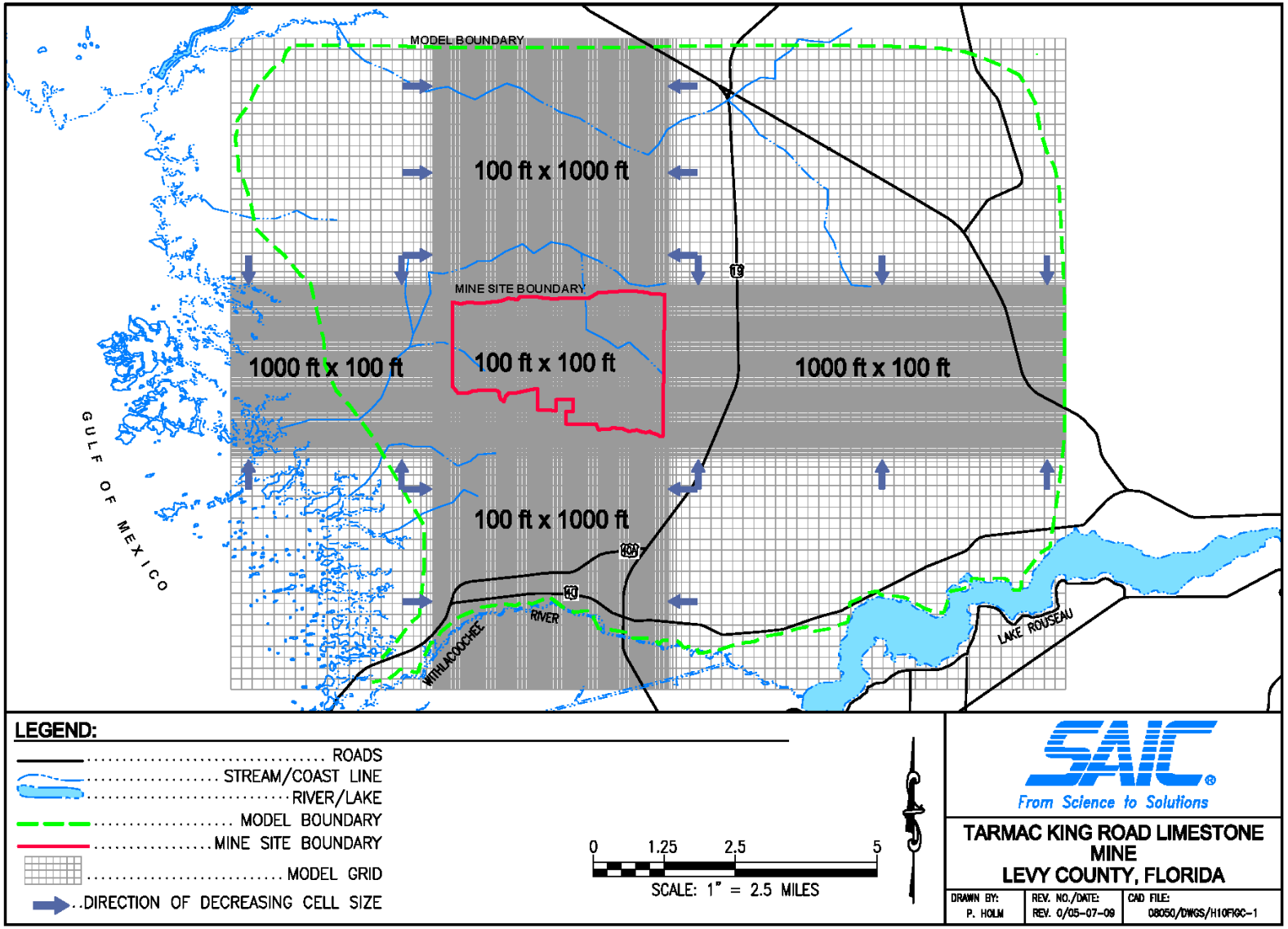

Figure D–1. Model Boundary and Grid

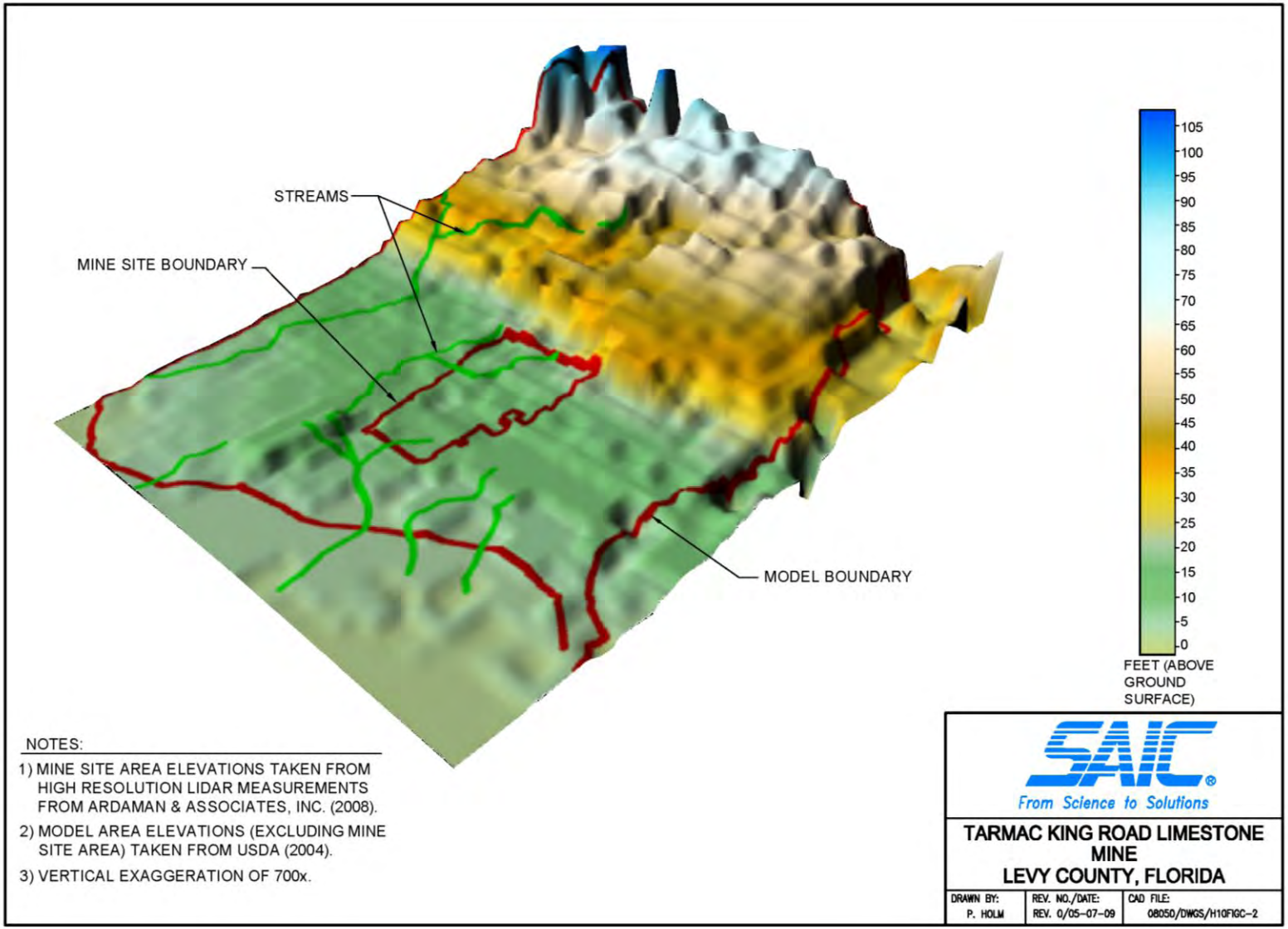

Figure D–2. Topography (Top of Layer 1)

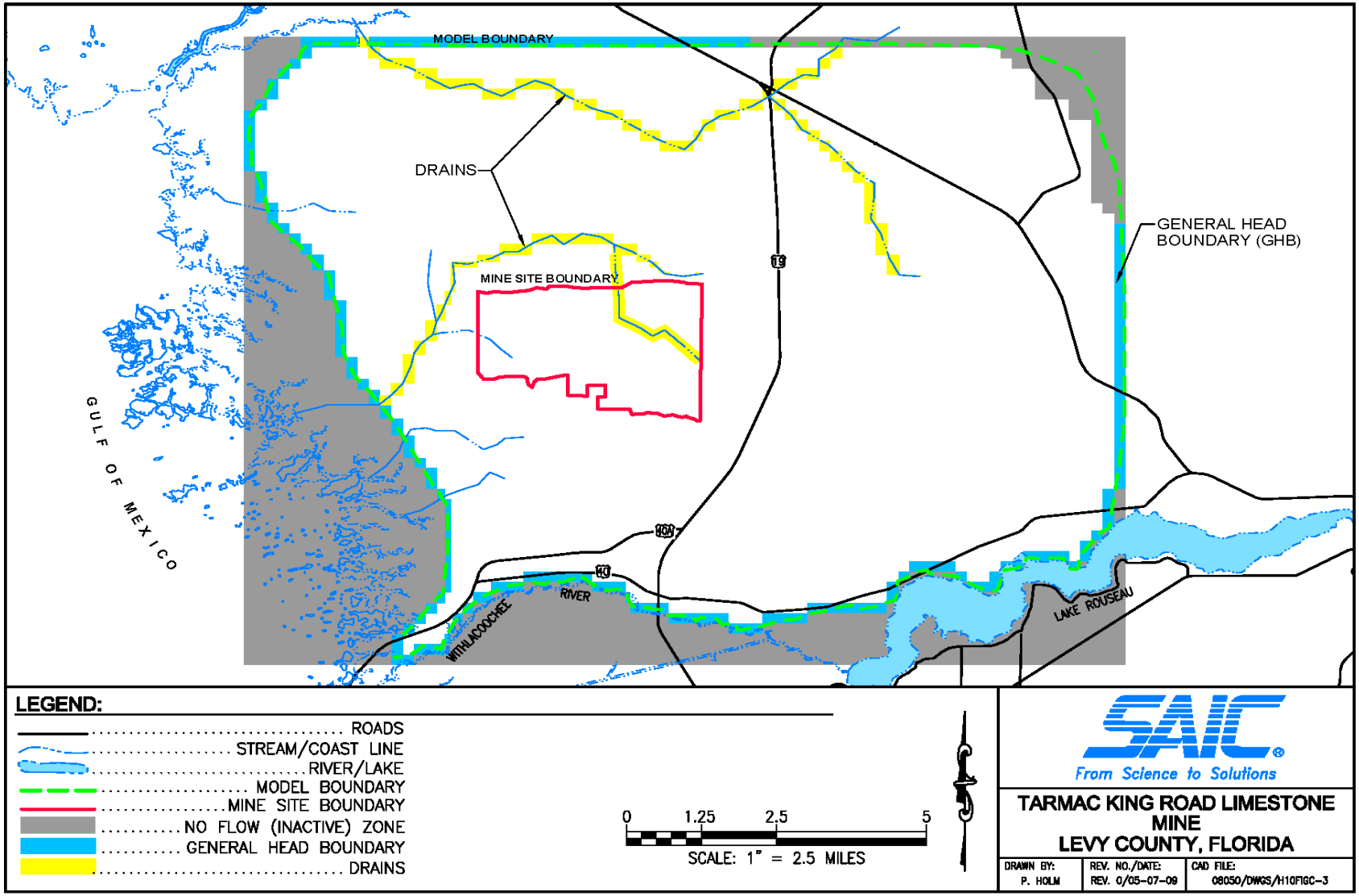

Figure D–3. Boundary Conditions for Layer 1

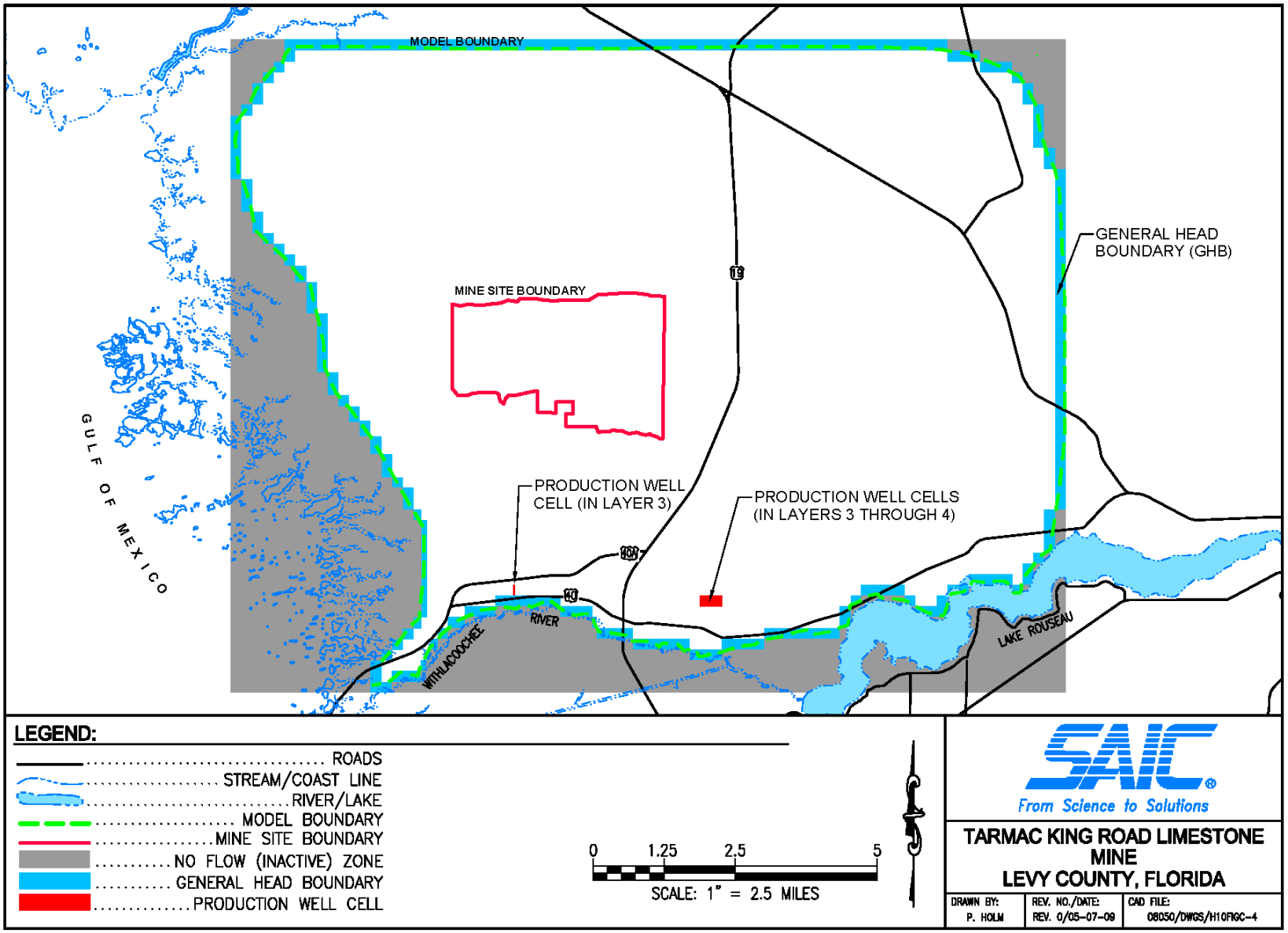

Figure D–4. Boundary Conditions for Layers 2 through 6

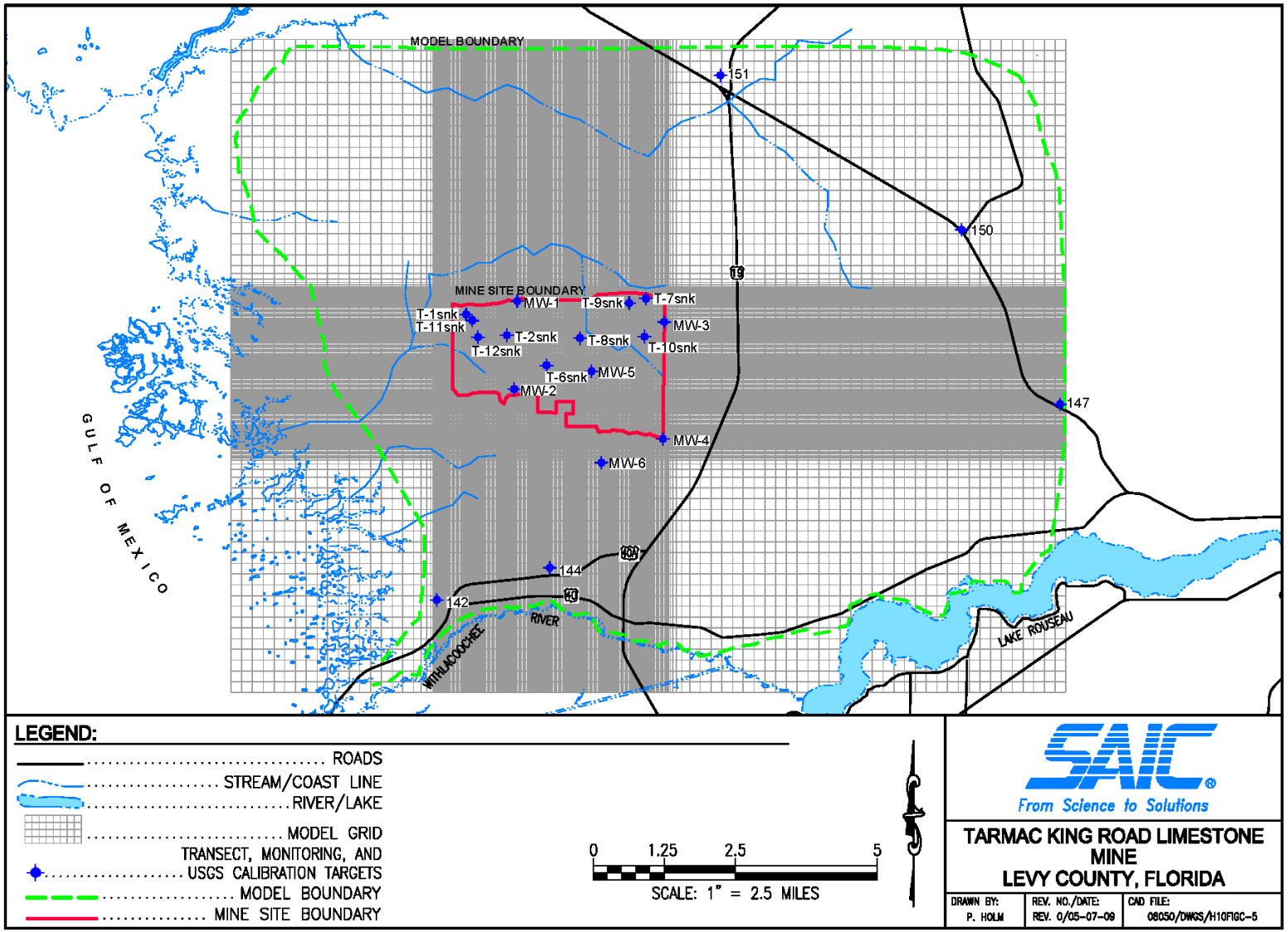

Figure D–5. Transect, Monitoring, and USGS Calibration Targets

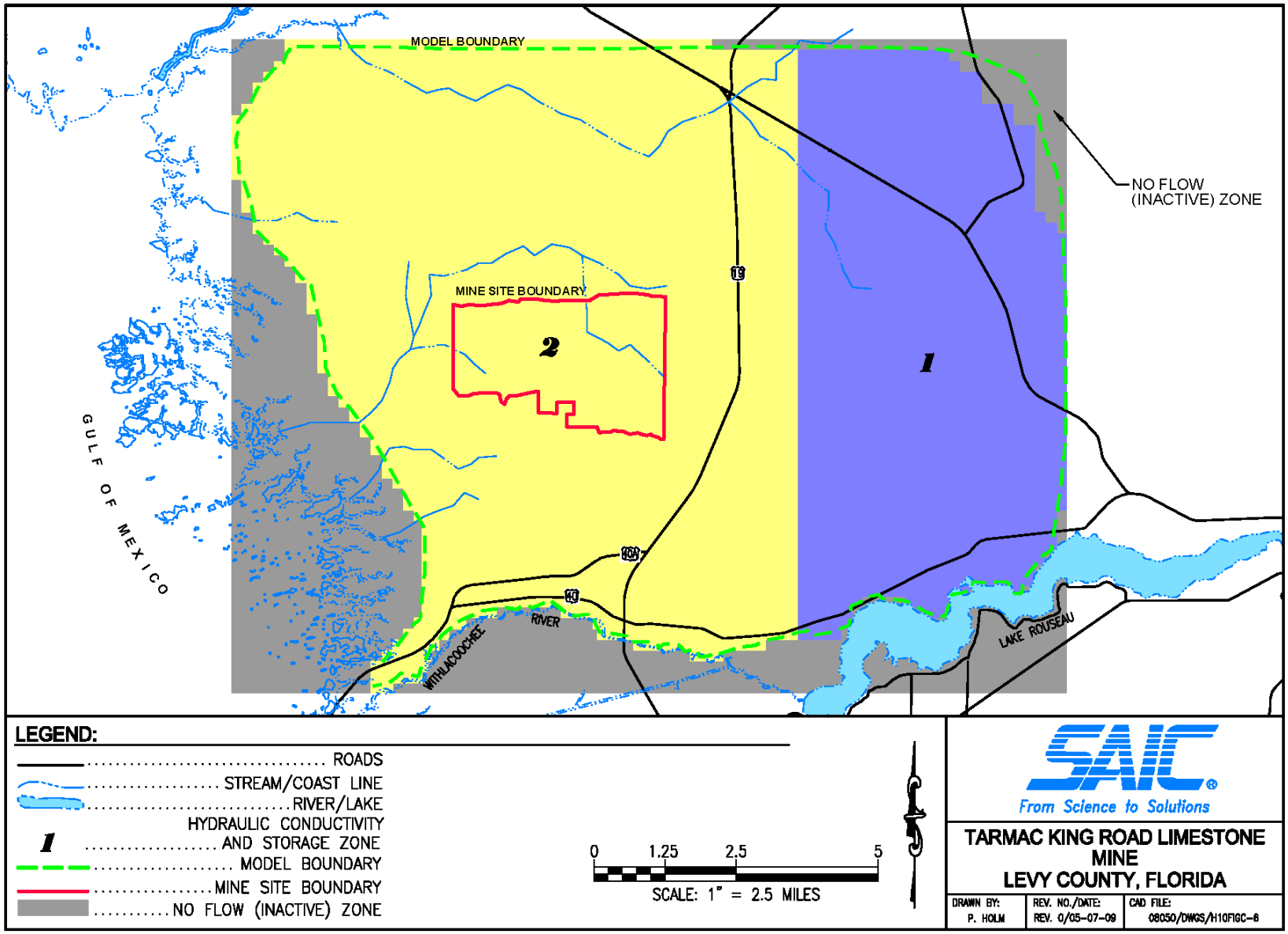

Figure D–6. Hydraulic Conductivity and Storage Zones for Layer 1

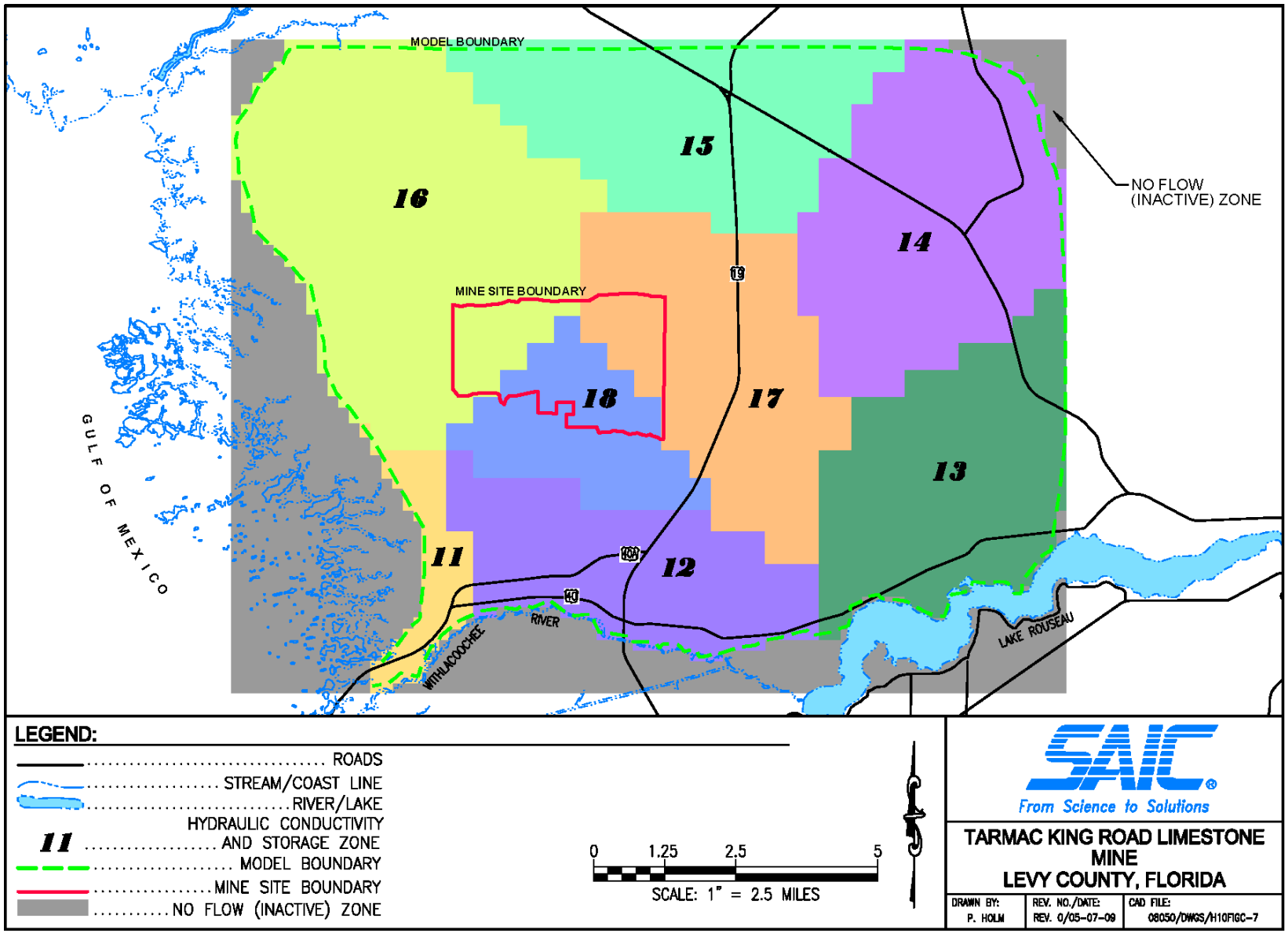

Figure D–7. Hydraulic Conductivity and Storage Zones for Layers 2 through 6

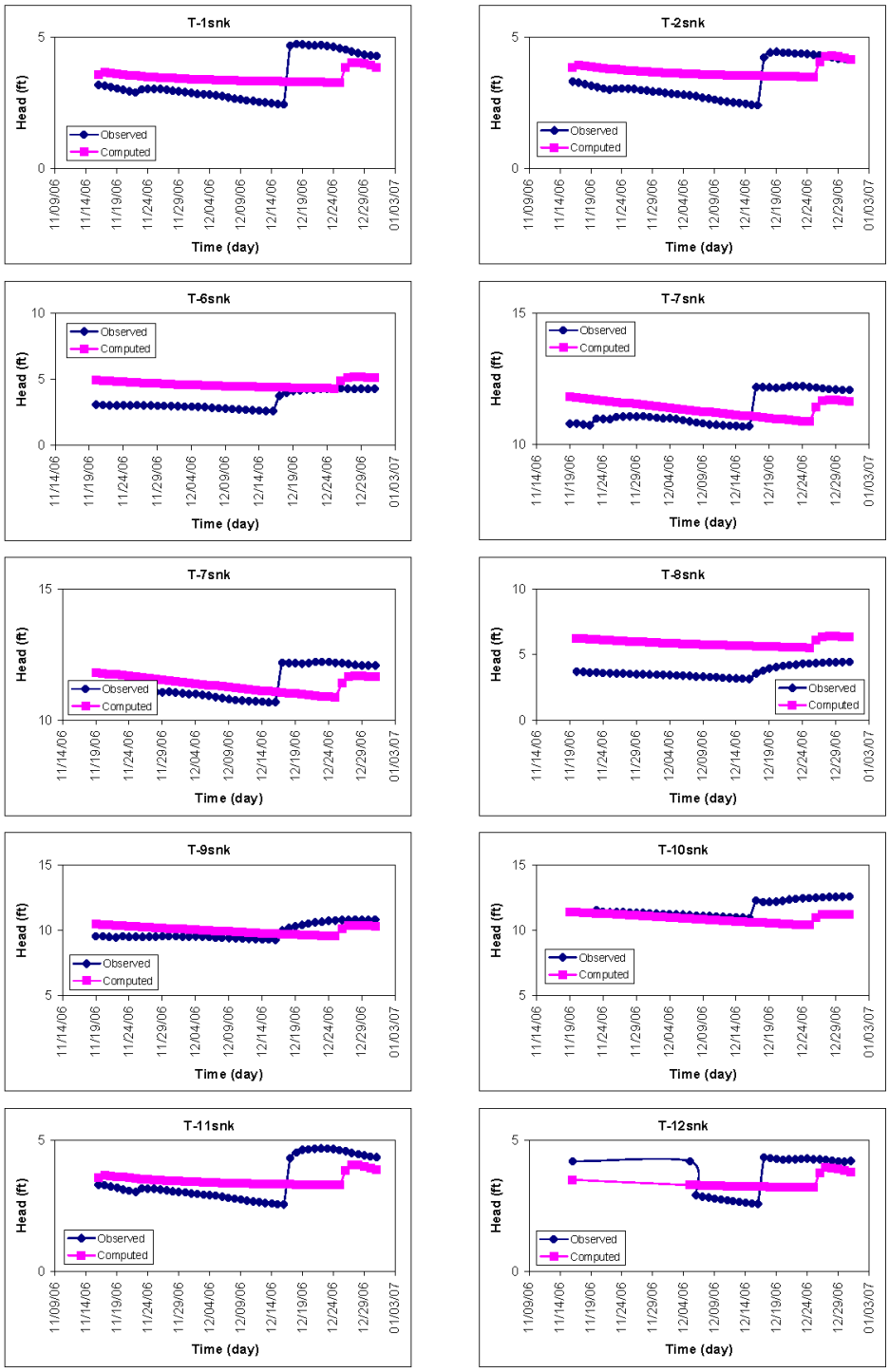

Figure D–8a. Plot of Observed Versus Simulated Water Level (Head) Results for Mine Site Transect Wells

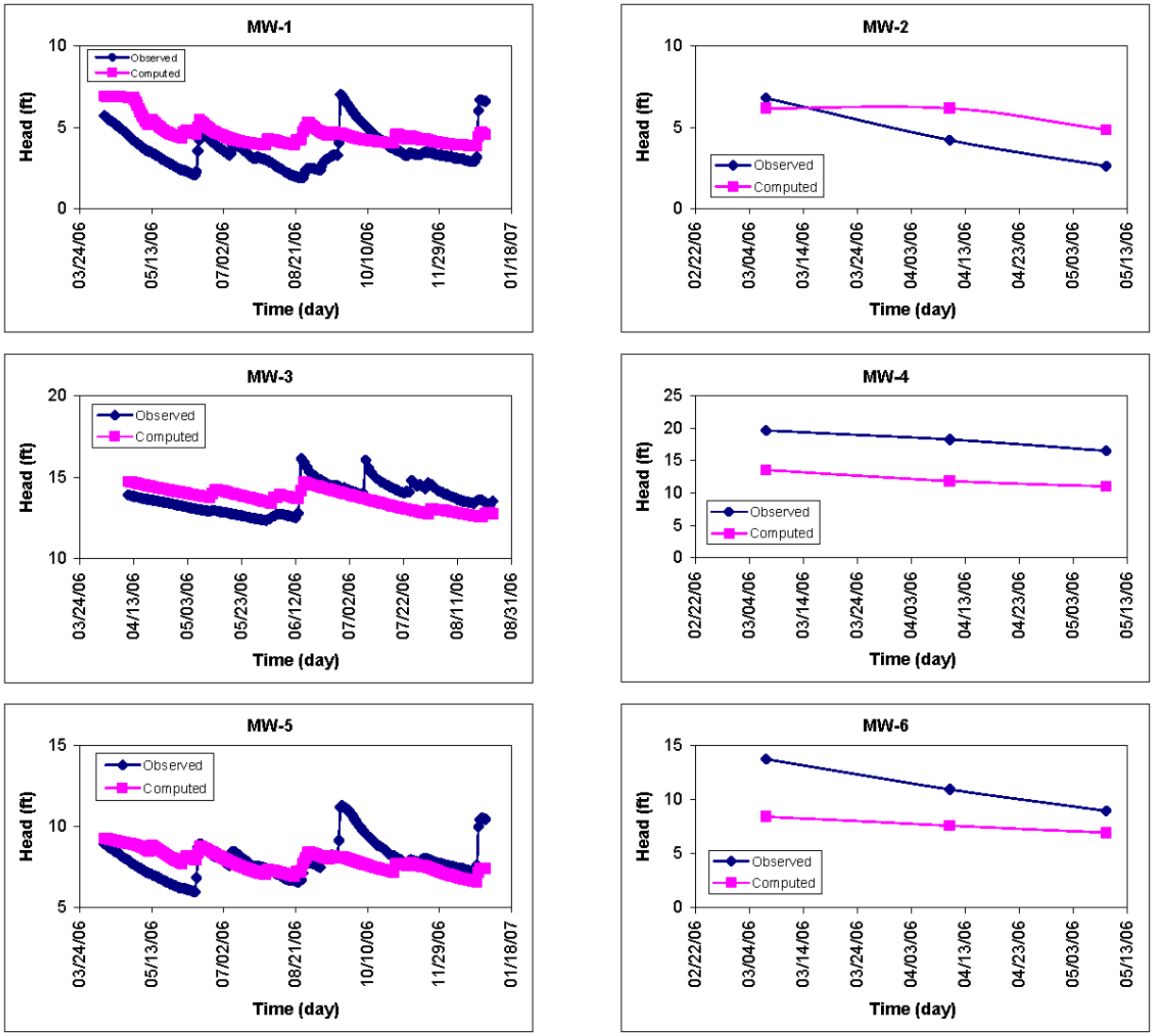

Figure D–8b. Plot of Observed Versus Simulated Water Level (Head) Results for Mine Site Monitoring Wells

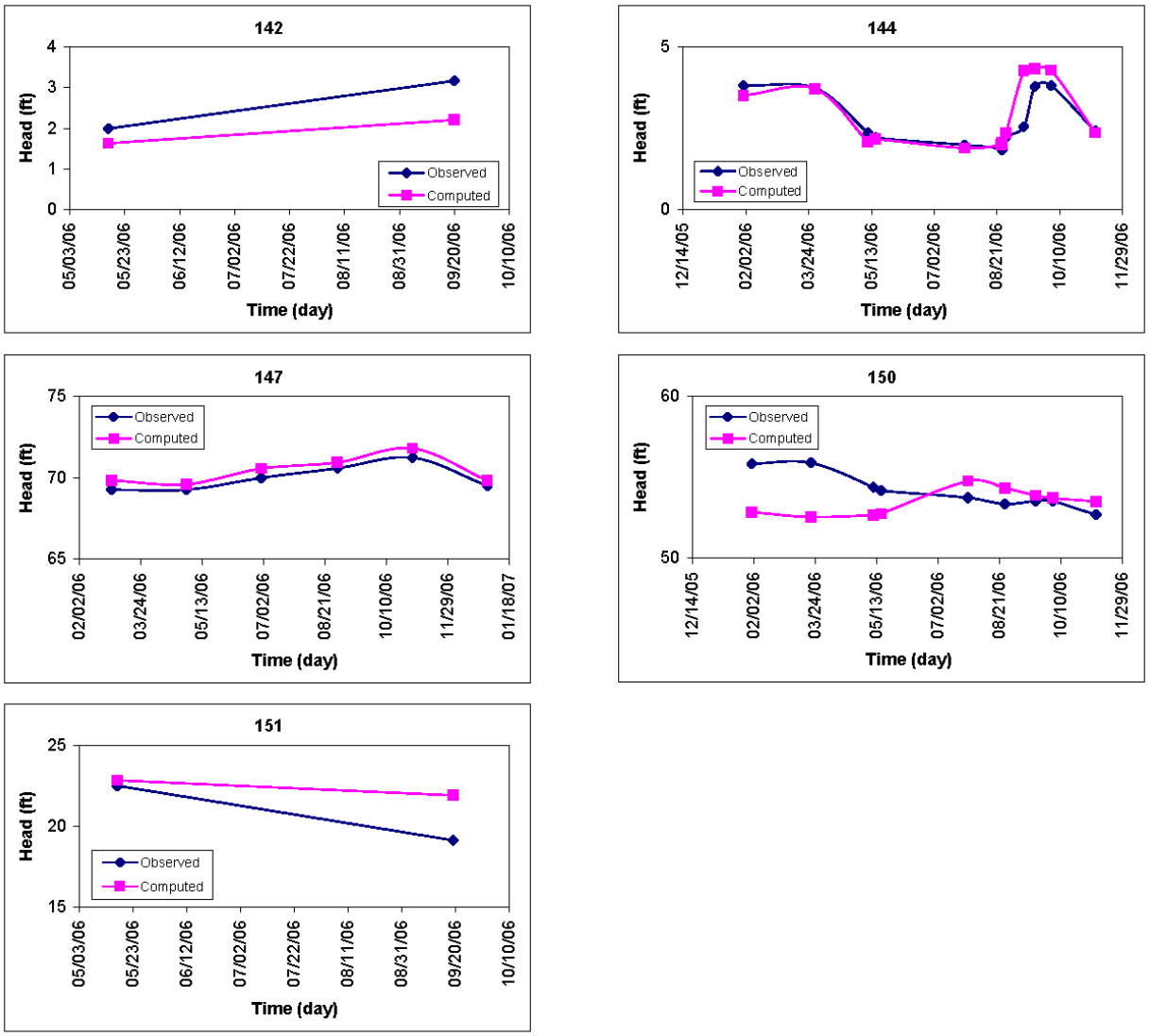

Figure D–8c. Plot of Observed Versus Simulated Water Level (Head) Results for Regional USGS Monitoring Wells

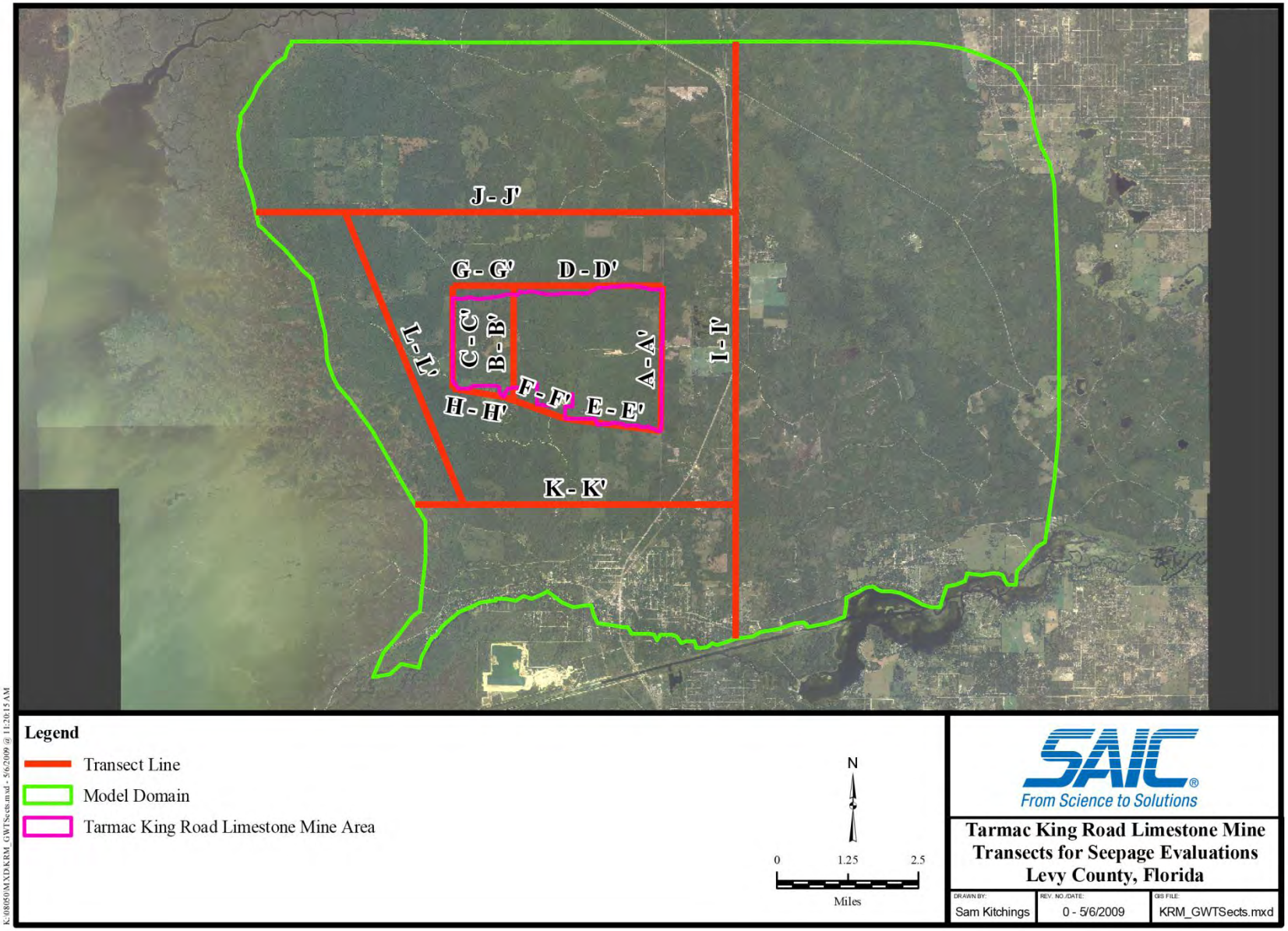

Figure D–9. Selected Transects for Seepage Analysis

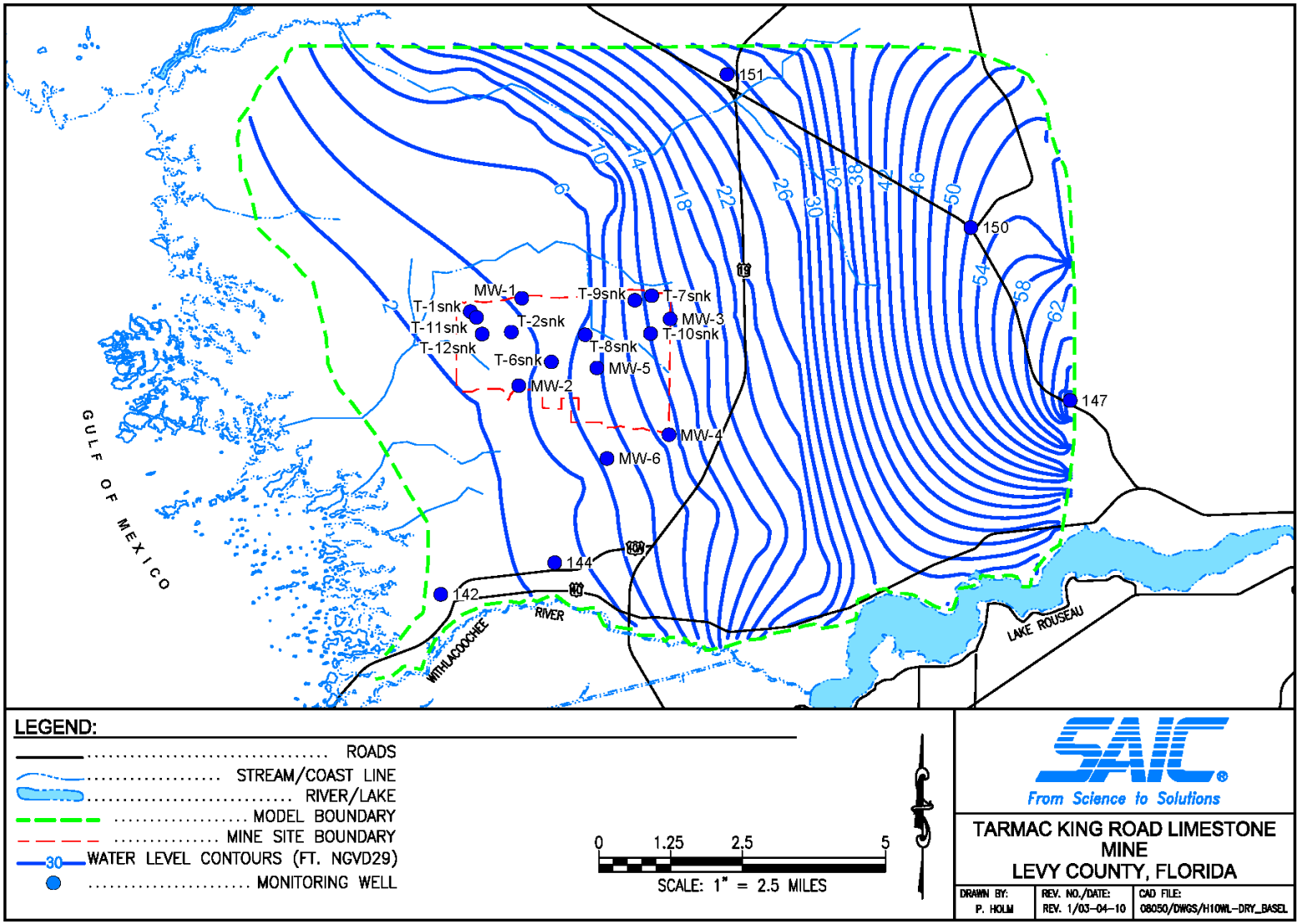

Figure D–10. Baseline (Alternative 1) Water Level Contours During Dry Season

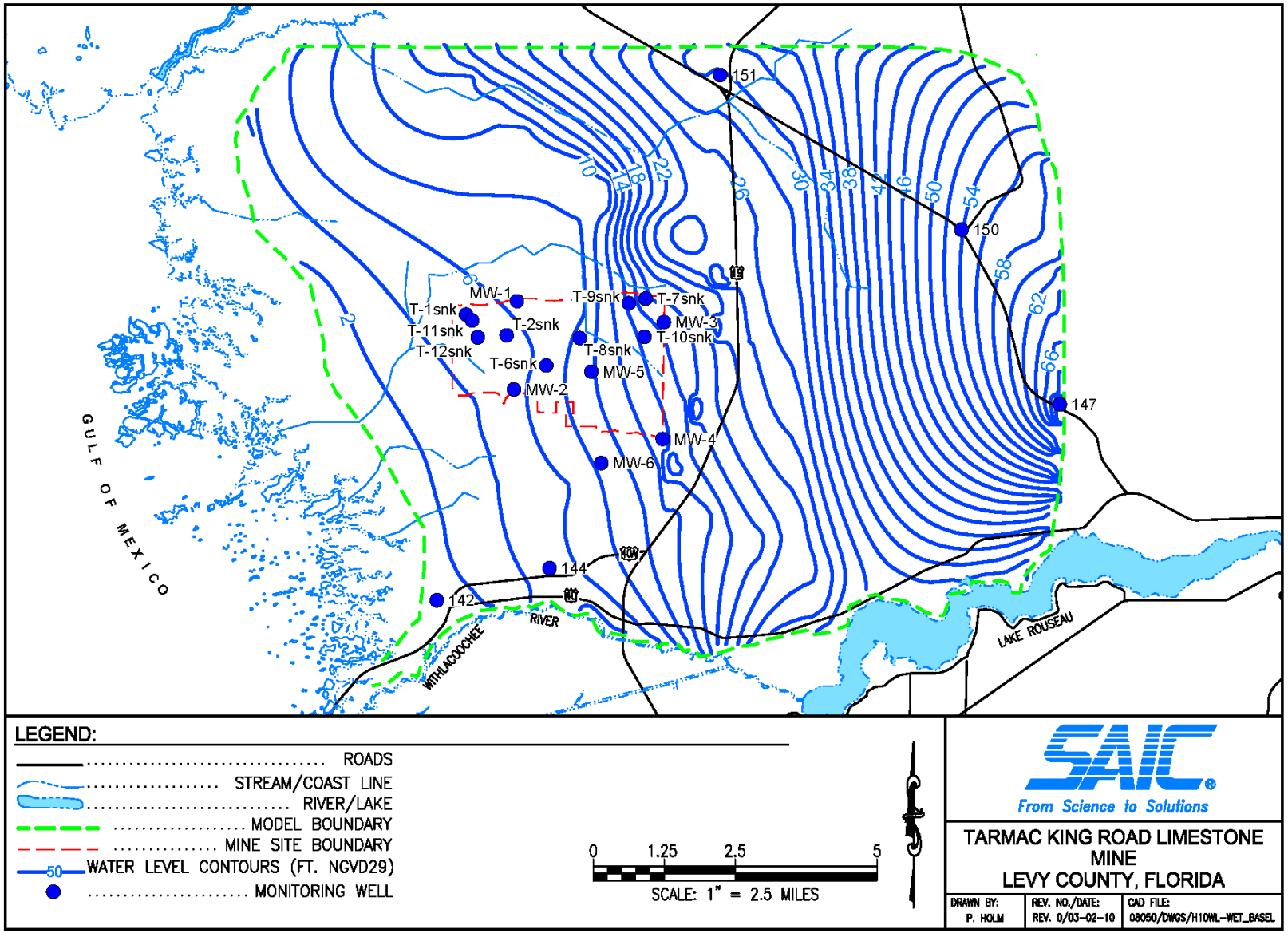

Figure D–11. Baseline (Alternative 1) Water Level Contours During Wet Season

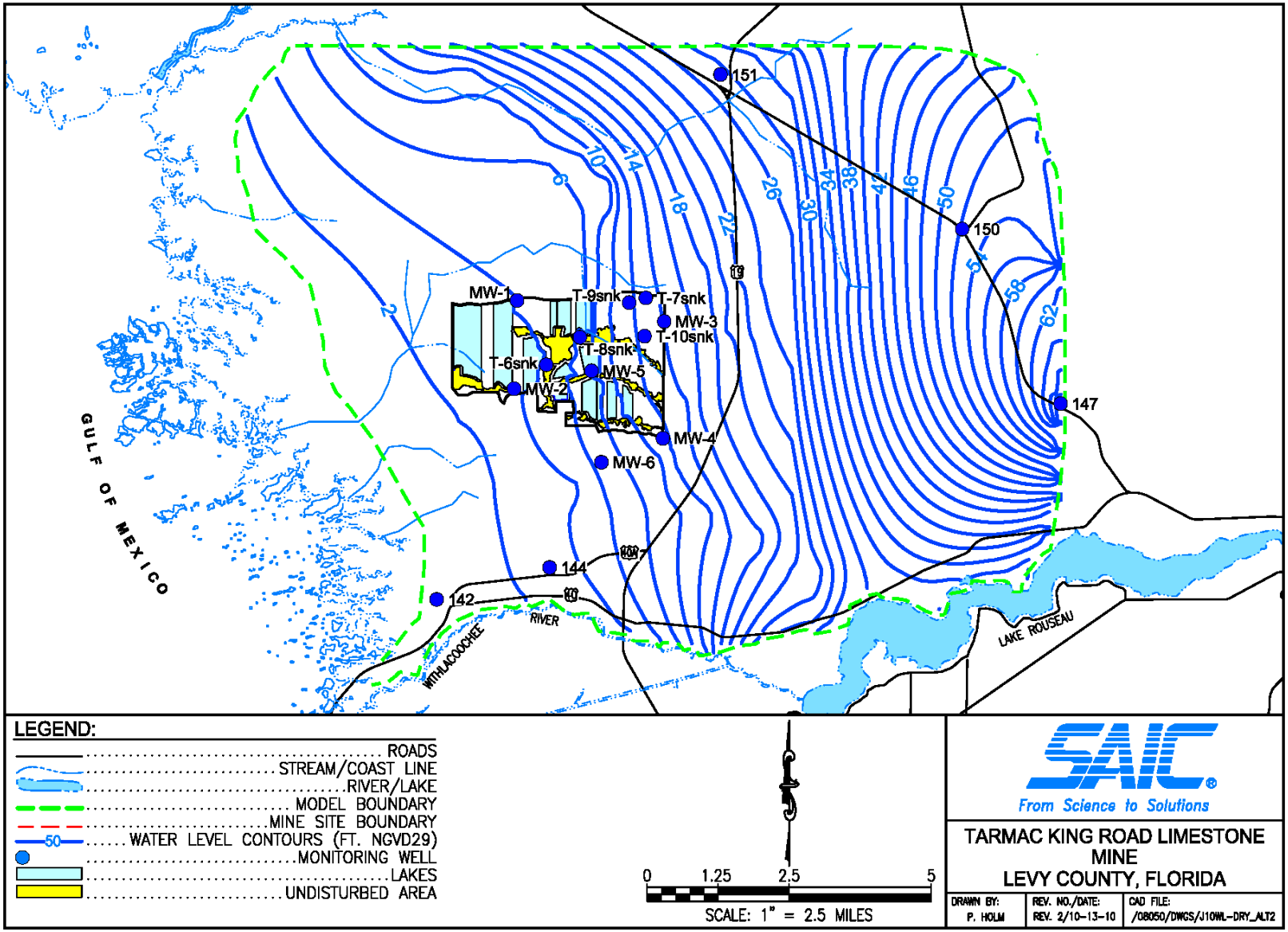

Figure D–12. Alternative 2 Water Level Contours During Dry Season

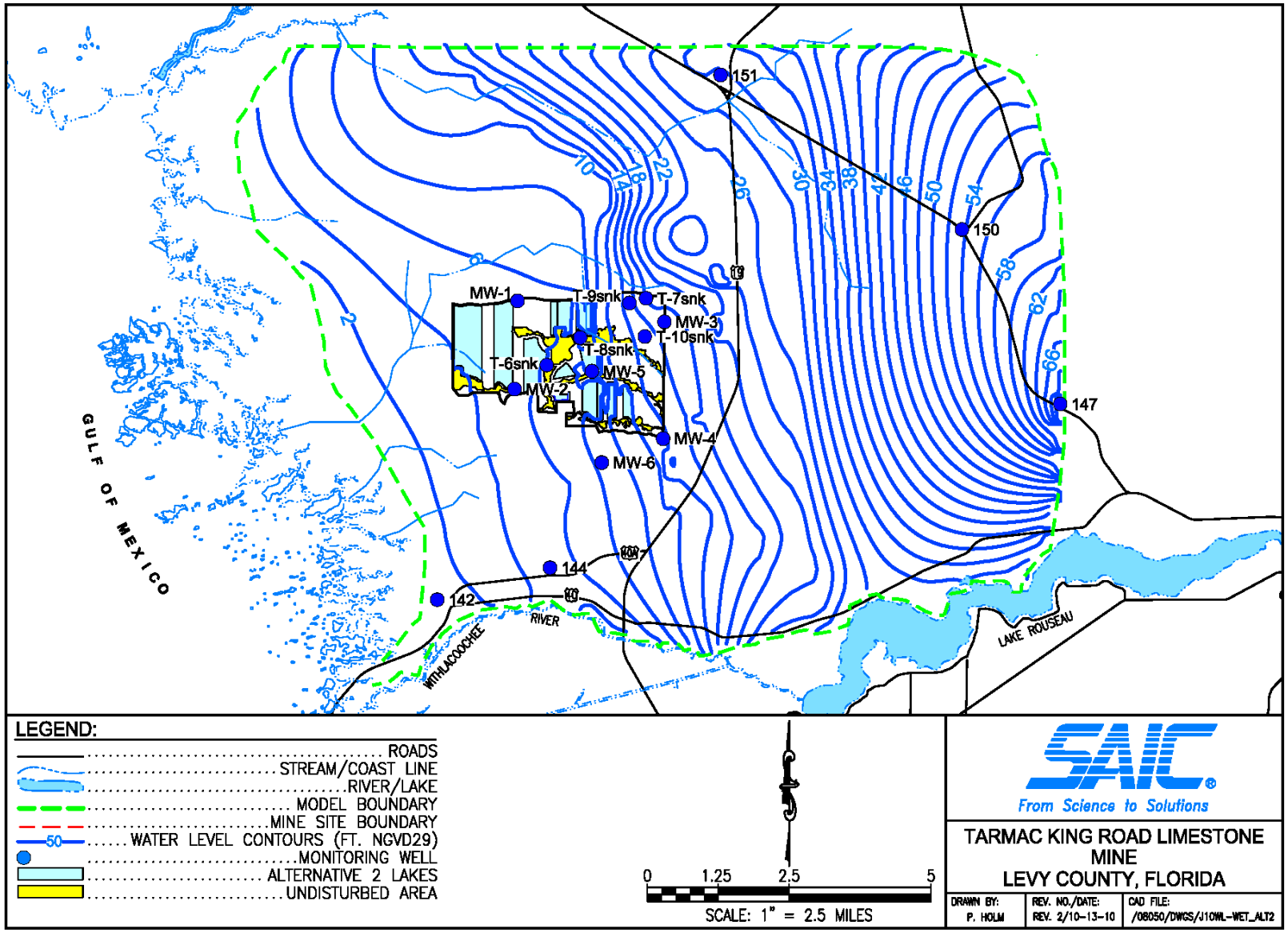

Figure D–13. Alternative 2 Water Level Contours During Wet Season

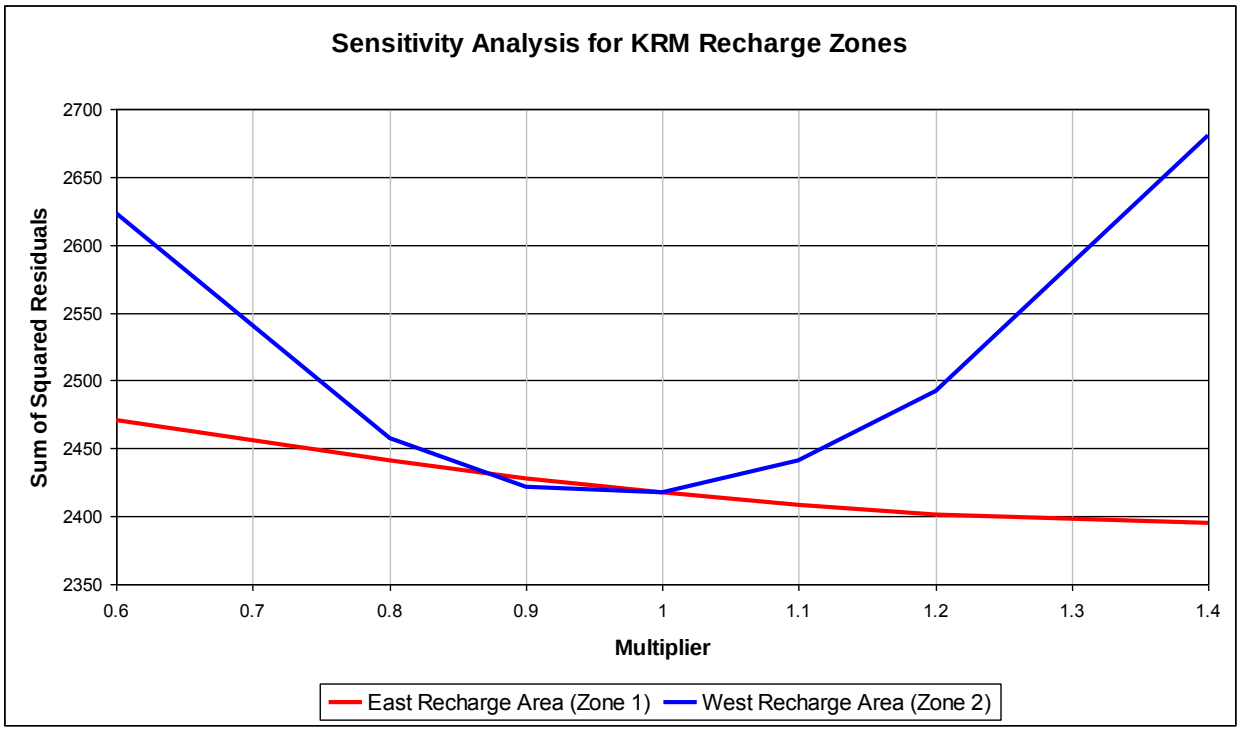

Figure D–14. Results of Recharge Sensitivity Analysis for King Road Limestone Mine Site Groundwater Flow Model

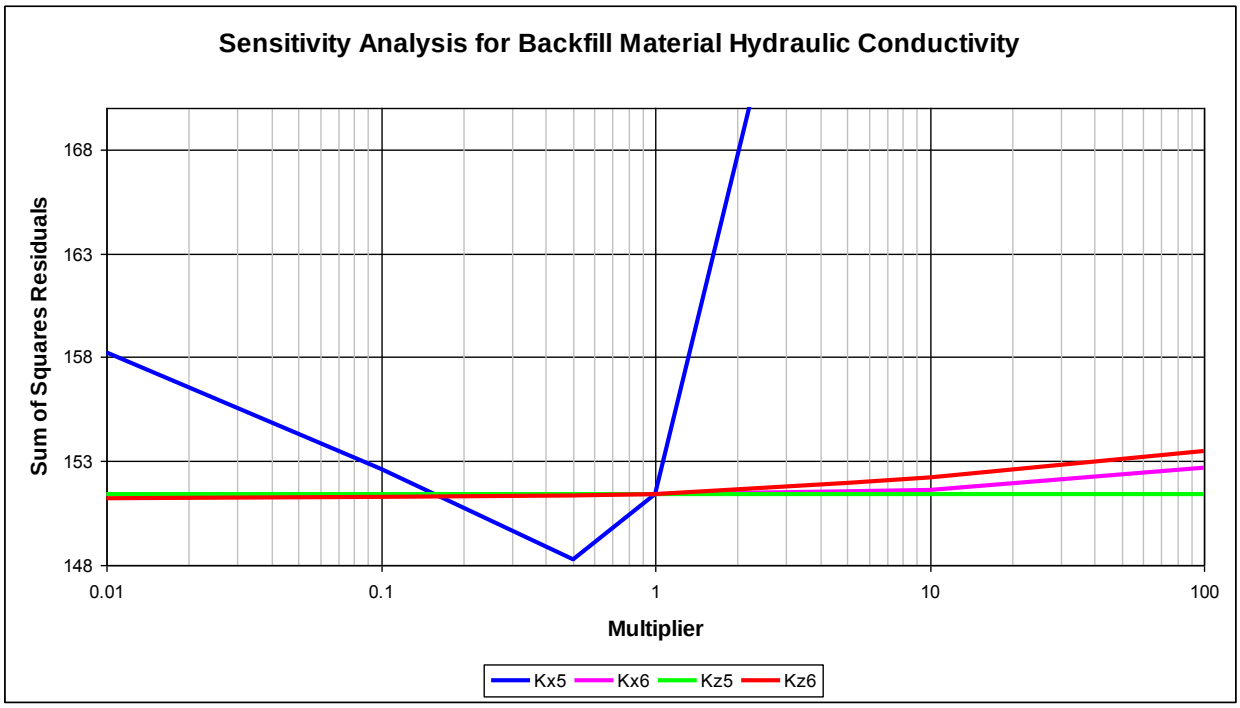

Figure D–15. Results of Backfill Material Hydraulic Conductivity Sensitivity Analysis for King Road Limestone Mine Site Groundwater Flow Model

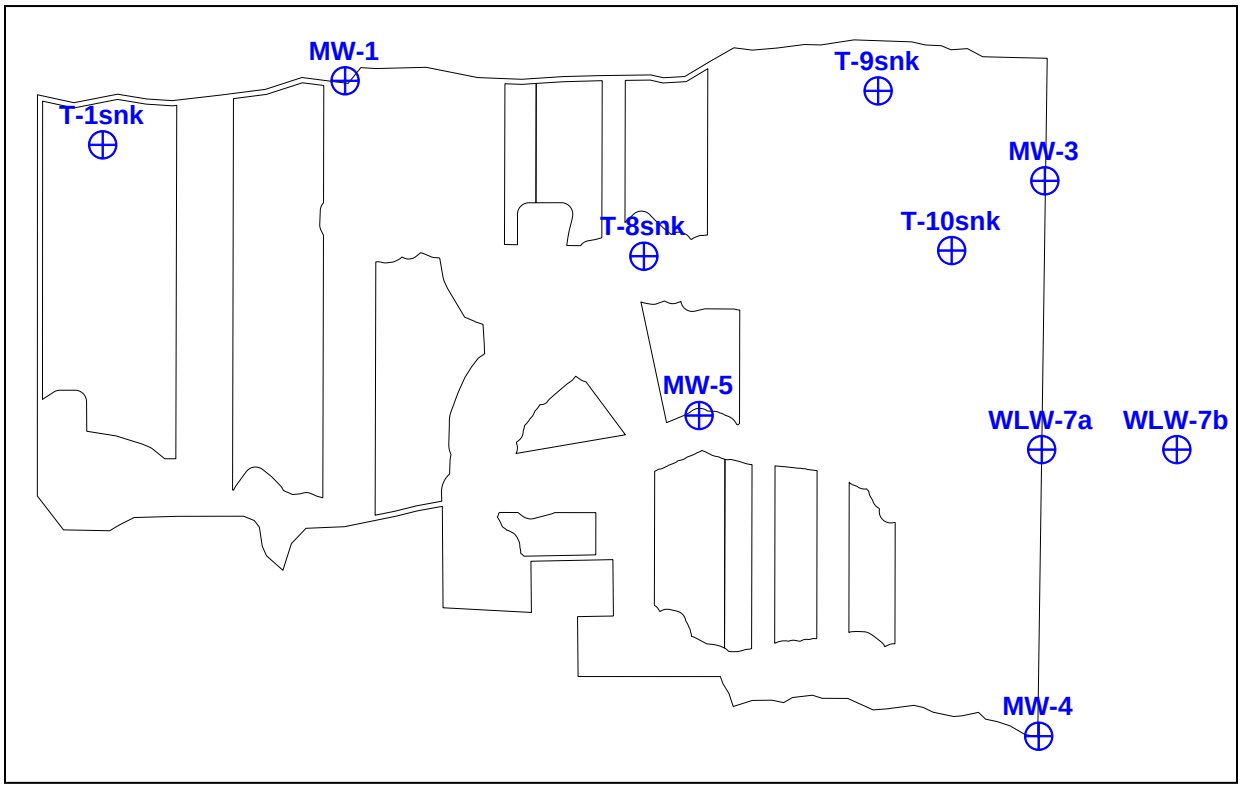

Figure D–16. Monitoring Wells for Manually Evaluating *K* Sensitivity of the Backfill Materials

Attachment A – Additional Tables and Figures

Table A–1. King Road Limestone Mine Site Groundwater Flow Model Zone 1 (Eastern Model Area) Recharge Values

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
1-Jan-03	1.77E-03	1-Jan-04	1.80E-03	1-Jan-05	1.87E-03	1-Jan-06	1.89E-03	1-Jan-07	2.03E-03	1-Jan-08	1.63E-03
2-Jan-03	1.77E-03	2-Jan-04	1.80E-03	2-Jan-05	1.87E-03	2-Jan-06	1.89E-03	2-Jan-07	2.07E-03	2-Jan-08	1.63E-03
3-Jan-03	1.77E-03	3-Jan-04	1.80E-03	3-Jan-05	1.87E-03	3-Jan-06	1.88E-03	3-Jan-07	2.07E-03	3-Jan-08	1.62E-03
4-Jan-03	1.76E-03	4-Jan-04	1.79E-03	4-Jan-05	1.87E-03	4-Jan-06	1.89E-03	4-Jan-07	2.07E-03	4-Jan-08	1.62E-03
5-Jan-03	1.76E-03	5-Jan-04	1.79E-03	5-Jan-05	1.86E-03	5-Jan-06	1.89E-03	5-Jan-07	2.07E-03	5-Jan-08	1.62E-03
6-Jan-03	1.77E-03	6-Jan-04	1.79E-03	6-Jan-05	1.86E-03	6-Jan-06	1.89E-03	6-Jan-07	2.07E-03	6-Jan-08	1.62E-03
7-Jan-03	1.78E-03	7-Jan-04	1.79E-03	7-Jan-05	1.86E-03	7-Jan-06	1.89E-03	7-Jan-07	2.07E-03	7-Jan-08	1.62E-03
8-Jan-03	1.78E-03	8-Jan-04	1.79E-03	8-Jan-05	1.85E-03	8-Jan-06	1.89E-03	8-Jan-07	2.05E-03	8-Jan-08	1.61E-03
9-Jan-03	1.78E-03	9-Jan-04	1.78E-03	9-Jan-05	1.85E-03	9-Jan-06	1.89E-03	9-Jan-07	2.05E-03	9-Jan-08	1.61E-03
10-Jan-03	1.78E-03	10-Jan-04	1.78E-03	10-Jan-05	1.85E-03	10-Jan-06	1.88E-03	10-Jan-07	2.03E-03	10-Jan-08	1.61E-03
11-Jan-03	1.77E-03	11-Jan-04	1.78E-03	11-Jan-05	1.85E-03	11-Jan-06	1.88E-03	11-Jan-07	2.02E-03	11-Jan-08	1.61E-03
12-Jan-03	1.77E-03	12-Jan-04	1.78E-03	12-Jan-05	1.86E-03	12-Jan-06	1.88E-03	12-Jan-07	2.01E-03	12-Jan-08	1.61E-03
13-Jan-03	1.77E-03	13-Jan-04	1.78E-03	13-Jan-05	1.88E-03	13-Jan-06	1.88E-03	13-Jan-07	1.99E-03	13-Jan-08	1.61E-03
14-Jan-03	1.78E-03	14-Jan-04	1.77E-03	14-Jan-05	1.88E-03	14-Jan-06	1.87E-03	14-Jan-07	1.98E-03	14-Jan-08	1.61E-03
15-Jan-03	1.78E-03	15-Jan-04	1.77E-03	15-Jan-05	1.87E-03	15-Jan-06	1.87E-03	15-Jan-07	1.97E-03	15-Jan-08	1.61E-03
16-Jan-03	1.78E-03	16-Jan-04	1.77E-03	16-Jan-05	1.87E-03	16-Jan-06	1.87E-03	16-Jan-07	1.96E-03	16-Jan-08	1.61E-03
17-Jan-03	1.77E-03	17-Jan-04	1.77E-03	17-Jan-05	1.87E-03	17-Jan-06	1.86E-03	17-Jan-07	1.95E-03	17-Jan-08	1.60E-03
18-Jan-03	1.77E-03	18-Jan-04	1.76E-03	18-Jan-05	1.87E-03	18-Jan-06	1.86E-03	18-Jan-07	1.94E-03	18-Jan-08	1.60E-03
19-Jan-03	1.77E-03	19-Jan-04	1.76E-03	19-Jan-05	1.87E-03	19-Jan-06	1.86E-03	19-Jan-07	1.93E-03	19-Jan-08	1.60E-03
20-Jan-03	1.77E-03	20-Jan-04	1.76E-03	20-Jan-05	1.86E-03	20-Jan-06	1.86E-03	20-Jan-07	1.93E-03	20-Jan-08	1.60E-03
21-Jan-03	1.77E-03	21-Jan-04	1.76E-03	21-Jan-05	1.86E-03	21-Jan-06	1.85E-03	21-Jan-07	1.92E-03	21-Jan-08	1.60E-03
22-Jan-03	1.77E-03	22-Jan-04	1.76E-03	22-Jan-05	1.86E-03	22-Jan-06	1.85E-03	22-Jan-07	1.95E-03	22-Jan-08	1.60E-03
23-Jan-03	1.77E-03	23-Jan-04	1.75E-03	23-Jan-05	1.86E-03	23-Jan-06	1.86E-03	23-Jan-07	1.98E-03	23-Jan-08	1.59E-03
24-Jan-03	1.77E-03	24-Jan-04	1.75E-03	24-Jan-05	1.85E-03	24-Jan-06	1.86E-03	24-Jan-07	1.98E-03	24-Jan-08	1.60E-03
25-Jan-03	1.76E-03	25-Jan-04	1.75E-03	25-Jan-05	1.85E-03	25-Jan-06	1.86E-03	25-Jan-07	1.98E-03	25-Jan-08	1.60E-03
26-Jan-03	1.76E-03	26-Jan-04	1.75E-03	26-Jan-05	1.85E-03	26-Jan-06	1.86E-03	26-Jan-07	2.00E-03	26-Jan-08	1.61E-03
27-Jan-03	1.76E-03	27-Jan-04	1.75E-03	27-Jan-05	1.85E-03	27-Jan-06	1.86E-03	27-Jan-07	2.00E-03	27-Jan-08	1.62E-03
28-Jan-03	1.76E-03	28-Jan-04	1.74E-03	28-Jan-05	1.85E-03	28-Jan-06	1.85E-03	28-Jan-07	2.00E-03	28-Jan-08	1.63E-03
29-Jan-03	1.76E-03	29-Jan-04	1.74E-03	29-Jan-05	1.85E-03	29-Jan-06	1.85E-03	29-Jan-07	1.99E-03	29-Jan-08	1.64E-03
30-Jan-03	1.76E-03	30-Jan-04	1.76E-03	30-Jan-05	1.84E-03	30-Jan-06	1.85E-03	30-Jan-07	1.99E-03	30-Jan-08	1.65E-03
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1-Feb-03	1.75E-03	1-Feb-04	1.76E-03	1-Feb-05	1.84E-03	1-Feb-06	1.84E-03	1-Feb-07	2.02E-03	1-Feb-08	1.66E-03
2-Feb-03	1.75E-03	2-Feb-04	1.76E-03	2-Feb-05	1.84E-03	2-Feb-06	1.84E-03	2-Feb-07	2.07E-03	2-Feb-08	1.66E-03
3-Feb-03	1.75E-03	3-Feb-04	1.76E-03	3-Feb-05	1.84E-03	3-Feb-06	1.84E-03	3-Feb-07	2.05E-03	3-Feb-08	1.66E-03
4-Feb-03	1.75E-03	4-Feb-04	1.76E-03	4-Feb-05	1.84E-03	4-Feb-06	1.94E-03	4-Feb-07	2.04E-03	4-Feb-08	1.66E-03
5-Feb-03	1.75E-03	5-Feb-04	1.76E-03	5-Feb-05	1.84E-03	5-Feb-06	2.03E-03	5-Feb-07	2.02E-03	5-Feb-08	1.65E-03
6-Feb-03	1.75E-03	6-Feb-04	1.76E-03	6-Feb-05	1.84E-03	6-Feb-06	2.03E-03	6-Feb-07	2.01E-03	6-Feb-08	1.65E-03
7-Feb-03	1.74E-03	7-Feb-04	1.76E-03	7-Feb-05	1.84E-03	7-Feb-06	2.03E-03	7-Feb-07	2.00E-03	7-Feb-08	1.65E-03
8-Feb-03	1.74E-03	8-Feb-04	1.76E-03	8-Feb-05	1.84E-03	8-Feb-06	2.02E-03	8-Feb-07	1.98E-03	8-Feb-08	1.65E-03
9-Feb-03	1.74E-03	9-Feb-04	1.76E-03	9-Feb-05	1.84E-03	9-Feb-06	2.01E-03	9-Feb-07	1.97E-03	9-Feb-08	1.65E-03
10-Feb-03	1.74E-03	10-Feb-04	1.75E-03	10-Feb-05	1.84E-03	10-Feb-06	2.00E-03	10-Feb-07	1.96E-03	10-Feb-08	1.65E-03
11-Feb-03	1.74E-03	11-Feb-04	1.75E-03	11-Feb-05	1.84E-03	11-Feb-06	1.99E-03	11-Feb-07	1.95E-03	11-Feb-08	1.64E-03
12-Feb-03	1.73E-03	12-Feb-04	1.75E-03	12-Feb-05	1.84E-03	12-Feb-06	1.98E-03	12-Feb-07	1.94E-03	12-Feb-08	1.64E-03

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
13-Feb-03	1.73E-03	13-Feb-04	1.75E-03	13-Feb-05	1.84E-03	13-Feb-06	1.98E-03	13-Feb-07	1.93E-03	13-Feb-08	1.64E-03
14-Feb-03	1.74E-03	14-Feb-04	1.75E-03	14-Feb-05	1.84E-03	14-Feb-06	1.98E-03	14-Feb-07	1.93E-03	14-Feb-08	1.64E-03
15-Feb-03	1.75E-03	15-Feb-04	1.74E-03	15-Feb-05	1.84E-03	15-Feb-06	1.98E-03	15-Feb-07	1.95E-03	15-Feb-08	1.64E-03
16-Feb-03	1.75E-03	16-Feb-04	1.74E-03	16-Feb-05	1.84E-03	16-Feb-06	1.98E-03	16-Feb-07	1.96E-03	16-Feb-08	1.63E-03
17-Feb-03	1.75E-03	17-Feb-04	1.74E-03	17-Feb-05	1.84E-03	17-Feb-06	1.97E-03	17-Feb-07	1.96E-03	17-Feb-08	1.63E-03
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19-Feb-03	1.78E-03	19-Feb-04	1.74E-03	19-Feb-05	1.84E-03	19-Feb-06	1.96E-03	19-Feb-07	1.95E-03	19-Feb-08	1.63E-03
20-Feb-03	1.78E-03	20-Feb-04	1.74E-03	20-Feb-05	1.84E-03	20-Feb-06	1.95E-03	20-Feb-07	1.95E-03	20-Feb-08	1.63E-03
21-Feb-03	1.77E-03	21-Feb-04	1.73E-03	21-Feb-05	1.84E-03	21-Feb-06	1.94E-03	21-Feb-07	1.95E-03	21-Feb-08	1.62E-03
22-Feb-03	1.77E-03	22-Feb-04	1.73E-03	22-Feb-05	1.84E-03	22-Feb-06	1.93E-03	22-Feb-07	1.94E-03	22-Feb-08	1.62E-03
23-Feb-03	1.79E-03	23-Feb-04	1.73E-03	23-Feb-05	1.84E-03	23-Feb-06	1.93E-03	23-Feb-07	1.94E-03	23-Feb-08	1.62E-03
24-Feb-03	1.81E-03	24-Feb-04	1.73E-03	24-Feb-05	1.84E-03	24-Feb-06	1.92E-03	24-Feb-07	1.93E-03	24-Feb-08	1.62E-03
25-Feb-03	1.82E-03	25-Feb-04	1.79E-03	25-Feb-05	1.84E-03	25-Feb-06	1.92E-03	25-Feb-07	1.93E-03	25-Feb-08	1.62E-03
26-Feb-03	1.82E-03	26-Feb-04	1.84E-03	26-Feb-05	1.84E-03	26-Feb-06	1.91E-03	26-Feb-07	1.92E-03	26-Feb-08	1.62E-03
27-Feb-03	1.82E-03	27-Feb-04	1.84E-03	27-Feb-05	1.83E-03	27-Feb-06	1.91E-03	27-Feb-07	1.92E-03	27-Feb-08	1.62E-03
28-Feb-03	1.83E-03	28-Feb-04	1.84E-03	28-Feb-05	1.83E-03	28-Feb-06	1.91E-03	28-Feb-07	1.91E-03	28-Feb-08	1.62E-03
1-Mar-03	1.83E-03	29-Feb-04	1.84E-03	1-Mar-05	1.83E-03	1-Mar-06	1.94E-03	1-Mar-07	1.94E-03	29-Feb-08	1.63E-03
2-Mar-03	1.83E-03	1-Mar-04	1.83E-03	2-Mar-05	1.83E-03	2-Mar-06	1.94E-03	2-Mar-07	1.94E-03	1-Mar-08	1.63E-03
3-Mar-03	1.85E-03	2-Mar-04	1.83E-03	3-Mar-05	1.83E-03	3-Mar-06	1.94E-03	3-Mar-07	1.95E-03	2-Mar-08	1.62E-03
4-Mar-03	1.91E-03	3-Mar-04	1.83E-03	4-Mar-05	1.83E-03	4-Mar-06	1.94E-03	4-Mar-07	1.96E-03	3-Mar-08	1.62E-03
5-Mar-03	1.95E-03	4-Mar-04	1.83E-03	5-Mar-05	1.83E-03	5-Mar-06	1.94E-03	5-Mar-07	1.95E-03	4-Mar-08	1.62E-03
6-Mar-03	1.96E-03	5-Mar-04	1.82E-03	6-Mar-05	1.83E-03	6-Mar-06	1.94E-03	6-Mar-07	1.94E-03	5-Mar-08	1.62E-03
7-Mar-03	1.95E-03	6-Mar-04	1.82E-03	7-Mar-05	1.83E-03	7-Mar-06	1.94E-03	7-Mar-07	1.94E-03	6-Mar-08	1.62E-03
8-Mar-03	1.95E-03	7-Mar-04	1.82E-03	8-Mar-05	1.83E-03	8-Mar-06	1.94E-03	8-Mar-07	1.93E-03	7-Mar-08	1.62E-03
9-Mar-03	1.97E-03	8-Mar-04	1.82E-03	9-Mar-05	1.83E-03	9-Mar-06	1.94E-03	9-Mar-07	1.92E-03	8-Mar-08	1.70E-03
10-Mar-03	1.98E-03	9-Mar-04	1.81E-03	10-Mar-05	1.83E-03	10-Mar-06	1.94E-03	10-Mar-07	1.91E-03	9-Mar-08	1.78E-03
11-Mar-03	1.97E-03	10-Mar-04	1.81E-03	11-Mar-05	1.83E-03	11-Mar-06	1.94E-03	11-Mar-07	1.91E-03	10-Mar-08	1.80E-03
12-Mar-03	1.96E-03	11-Mar-04	1.81E-03	12-Mar-05	1.83E-03	12-Mar-06	1.94E-03	12-Mar-07	1.90E-03	11-Mar-08	1.80E-03
13-Mar-03	1.95E-03	12-Mar-04	1.81E-03	13-Mar-05	1.83E-03	13-Mar-06	1.94E-03	13-Mar-07	1.90E-03	12-Mar-08	1.79E-03
14-Mar-03	1.94E-03	13-Mar-04	1.82E-03	14-Mar-05	1.83E-03	14-Mar-06	1.94E-03	14-Mar-07	1.89E-03	13-Mar-08	1.79E-03
15-Mar-03	1.93E-03	14-Mar-04	1.83E-03	15-Mar-05	1.83E-03	15-Mar-06	1.93E-03	15-Mar-07	1.92E-03	14-Mar-08	1.79E-03
16-Mar-03	1.93E-03	15-Mar-04	1.83E-03	16-Mar-05	1.83E-03	16-Mar-06	1.93E-03	16-Mar-07	1.95E-03	15-Mar-08	1.79E-03
17-Mar-03	1.93E-03	16-Mar-04	1.83E-03	17-Mar-05	1.82E-03	17-Mar-06	1.93E-03	17-Mar-07	2.01E-03	16-Mar-08	1.80E-03
18-Mar-03	1.92E-03	17-Mar-04	1.87E-03	18-Mar-05	1.82E-03	18-Mar-06	1.93E-03	18-Mar-07	2.01E-03	17-Mar-08	1.79E-03
19-Mar-03	1.91E-03	18-Mar-04	1.89E-03	19-Mar-05	1.82E-03	19-Mar-06	1.93E-03	19-Mar-07	2.00E-03	18-Mar-08	1.79E-03
20-Mar-03	1.91E-03	19-Mar-04	1.89E-03	20-Mar-05	1.82E-03	20-Mar-06	1.92E-03	20-Mar-07	1.99E-03	19-Mar-08	1.79E-03
21-Mar-03	1.90E-03	20-Mar-04	1.89E-03	21-Mar-05	1.81E-03	21-Mar-06	1.92E-03	21-Mar-07	1.98E-03	20-Mar-08	1.79E-03
22-Mar-03	1.89E-03	21-Mar-04	1.89E-03	22-Mar-05	1.81E-03	22-Mar-06	1.92E-03	22-Mar-07	1.97E-03	21-Mar-08	1.79E-03
23-Mar-03	1.89E-03	22-Mar-04	1.89E-03	23-Mar-05	1.81E-03	23-Mar-06	1.91E-03	23-Mar-07	1.96E-03	22-Mar-08	1.79E-03
24-Mar-03	1.89E-03	23-Mar-04	1.88E-03	24-Mar-05	1.81E-03	24-Mar-06	1.91E-03	24-Mar-07	1.94E-03	23-Mar-08	1.79E-03
25-Mar-03	1.91E-03	24-Mar-04	1.88E-03	25-Mar-05	1.80E-03	25-Mar-06	1.91E-03	25-Mar-07	1.93E-03	24-Mar-08	1.79E-03
26-Mar-03	1.92E-03	25-Mar-04	1.88E-03	26-Mar-05	1.84E-03	26-Mar-06	1.90E-03	26-Mar-07	1.93E-03	25-Mar-08	1.79E-03
27-Mar-03	1.92E-03	26-Mar-04	1.87E-03	27-Mar-05	1.89E-03	27-Mar-06	1.90E-03	27-Mar-07	1.92E-03	26-Mar-08	1.78E-03
28-Mar-03	1.91E-03	27-Mar-04	1.87E-03	28-Mar-05	1.91E-03	28-Mar-06	1.89E-03	28-Mar-07	1.91E-03	27-Mar-08	1.78E-03
29-Mar-03	1.91E-03	28-Mar-04	1.87E-03	29-Mar-05	1.92E-03	29-Mar-06	1.89E-03	29-Mar-07	1.91E-03	28-Mar-08	1.78E-03

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
30-Mar-03	1.90E-03	29-Mar-04	1.87E-03	30-Mar-05	1.93E-03	30-Mar-06	1.89E-03	30-Mar-07	1.90E-03	29-Mar-08	1.78E-03
31-Mar-03	1.90E-03	30-Mar-04	1.87E-03	31-Mar-05	1.92E-03	31-Mar-06	1.89E-03	31-Mar-07	1.90E-03	30-Mar-08	1.77E-03
1-Apr-03	1.89E-03	31-Mar-04	1.87E-03	1-Apr-05	1.92E-03	1-Apr-06	1.88E-03	1-Apr-07	1.89E-03	31-Mar-08	1.77E-03
2-Apr-03	1.89E-03	1-Apr-04	1.86E-03	2-Apr-05	1.92E-03	2-Apr-06	1.88E-03	2-Apr-07	1.89E-03	1-Apr-08	1.77E-03
3-Apr-03	1.89E-03	2-Apr-04	1.86E-03	3-Apr-05	1.98E-03	3-Apr-06	1.88E-03	3-Apr-07	1.89E-03	2-Apr-08	1.77E-03
4-Apr-03	1.88E-03	3-Apr-04	1.86E-03	4-Apr-05	1.98E-03	4-Apr-06	1.88E-03	4-Apr-07	1.88E-03	3-Apr-08	1.77E-03
5-Apr-03	1.88E-03	4-Apr-04	1.86E-03	5-Apr-05	1.98E-03	5-Apr-06	1.89E-03	5-Apr-07	1.88E-03	4-Apr-08	1.77E-03
6-Apr-03	1.88E-03	5-Apr-04	1.85E-03	6-Apr-05	1.98E-03	6-Apr-06	1.89E-03	6-Apr-07	1.88E-03	5-Apr-08	1.77E-03
7-Apr-03	1.87E-03	6-Apr-04	1.85E-03	7-Apr-05	1.98E-03	7-Apr-06	1.89E-03	7-Apr-07	1.88E-03	6-Apr-08	1.77E-03
8-Apr-03	1.87E-03	7-Apr-04	1.85E-03	8-Apr-05	2.01E-03	8-Apr-06	1.89E-03	8-Apr-07	1.87E-03	7-Apr-08	1.77E-03
9-Apr-03	1.87E-03	8-Apr-04	1.85E-03	9-Apr-05	2.00E-03	9-Apr-06	1.88E-03	9-Apr-07	1.87E-03	8-Apr-08	1.77E-03
10-Apr-03	1.89E-03	9-Apr-04	1.84E-03	10-Apr-05	1.98E-03	10-Apr-06	1.88E-03	10-Apr-07	1.87E-03	9-Apr-08	1.77E-03
11-Apr-03	1.89E-03	10-Apr-04	1.84E-03	11-Apr-05	1.97E-03	11-Apr-06	1.88E-03	11-Apr-07	1.88E-03	10-Apr-08	1.76E-03
12-Apr-03	1.89E-03	11-Apr-04	1.84E-03	12-Apr-05	1.95E-03	12-Apr-06	1.88E-03	12-Apr-07	1.91E-03	11-Apr-08	1.76E-03
13-Apr-03	1.89E-03	12-Apr-04	1.84E-03	13-Apr-05	1.94E-03	13-Apr-06	1.87E-03	13-Apr-07	1.90E-03	12-Apr-08	1.76E-03
14-Apr-03	1.89E-03	13-Apr-04	1.83E-03	14-Apr-05	1.96E-03	14-Apr-06	1.87E-03	14-Apr-07	1.90E-03	13-Apr-08	1.76E-03
15-Apr-03	1.89E-03	14-Apr-04	1.83E-03	15-Apr-05	1.97E-03	15-Apr-06	1.87E-03	15-Apr-07	1.89E-03	14-Apr-08	1.75E-03
16-Apr-03	1.89E-03	15-Apr-04	1.83E-03	16-Apr-05	1.97E-03	16-Apr-06	1.87E-03	16-Apr-07	1.88E-03	15-Apr-08	1.75E-03
17-Apr-03	1.89E-03	16-Apr-04	1.83E-03	17-Apr-05	1.95E-03	17-Apr-06	1.86E-03	17-Apr-07	1.89E-03	16-Apr-08	1.75E-03
18-Apr-03	1.89E-03	17-Apr-04	1.82E-03	18-Apr-05	1.95E-03	18-Apr-06	1.86E-03	18-Apr-07	1.90E-03	17-Apr-08	1.75E-03
19-Apr-03	1.89E-03	18-Apr-04	1.82E-03	19-Apr-05	1.94E-03	19-Apr-06	1.86E-03	19-Apr-07	1.90E-03	18-Apr-08	1.75E-03
20-Apr-03	1.89E-03	19-Apr-04	1.82E-03	20-Apr-05	1.93E-03	20-Apr-06	1.86E-03	20-Apr-07	1.90E-03	19-Apr-08	1.74E-03
21-Apr-03	1.89E-03	20-Apr-04	1.82E-03	21-Apr-05	1.93E-03	21-Apr-06	1.85E-03	21-Apr-07	1.90E-03	20-Apr-08	1.74E-03
22-Apr-03	1.88E-03	21-Apr-04	1.81E-03	22-Apr-05	1.92E-03	22-Apr-06	1.85E-03	22-Apr-07	1.89E-03	21-Apr-08	1.74E-03
23-Apr-03	1.88E-03	22-Apr-04	1.81E-03	23-Apr-05	1.92E-03	23-Apr-06	1.87E-03	23-Apr-07	1.89E-03	22-Apr-08	1.74E-03
24-Apr-03	1.88E-03	23-Apr-04	1.81E-03	24-Apr-05	1.91E-03	24-Apr-06	1.88E-03	24-Apr-07	1.89E-03	23-Apr-08	1.74E-03
25-Apr-03	1.88E-03	24-Apr-04	1.81E-03	25-Apr-05	1.90E-03	25-Apr-06	1.88E-03	25-Apr-07	1.89E-03	24-Apr-08	1.73E-03
26-Apr-03	1.87E-03	25-Apr-04	1.80E-03	26-Apr-05	1.89E-03	26-Apr-06	1.88E-03	26-Apr-07	1.88E-03	25-Apr-08	1.73E-03
27-Apr-03	1.87E-03	26-Apr-04	1.80E-03	27-Apr-05	1.90E-03	27-Apr-06	1.87E-03	27-Apr-07	1.88E-03	26-Apr-08	1.73E-03
28-Apr-03	1.87E-03	27-Apr-04	1.80E-03	28-Apr-05	1.92E-03	28-Apr-06	1.87E-03	28-Apr-07	1.88E-03	27-Apr-08	1.73E-03
29-Apr-03	1.87E-03	28-Apr-04	1.80E-03	29-Apr-05	1.91E-03	29-Apr-06	1.87E-03	29-Apr-07	1.88E-03	28-Apr-08	1.73E-03
30-Apr-03	1.87E-03	29-Apr-04	1.79E-03	30-Apr-05	1.90E-03	30-Apr-06	1.86E-03	30-Apr-07	1.87E-03	29-Apr-08	1.72E-03
1-May-03	1.86E-03	30-Apr-04	1.79E-03	1-May-05	1.89E-03	1-May-06	1.86E-03	1-May-07	1.87E-03	30-Apr-08	1.72E-03
2-May-03	1.86E-03	1-May-04	1.79E-03	2-May-05	1.89E-03	2-May-06	1.84E-03	2-May-07	1.87E-03	1-May-08	1.72E-03
3-May-03	1.86E-03	2-May-04	1.79E-03	3-May-05	1.89E-03	3-May-06	1.84E-03	3-May-07	1.86E-03	2-May-08	1.72E-03
4-May-03	1.85E-03	3-May-04	1.79E-03	4-May-05	1.88E-03	4-May-06	1.84E-03	4-May-07	1.86E-03	3-May-08	1.72E-03
5-May-03	1.85E-03	4-May-04	1.78E-03	5-May-05	1.90E-03	5-May-06	1.83E-03	5-May-07	1.86E-03	4-May-08	1.71E-03
6-May-03	1.85E-03	5-May-04	1.78E-03	6-May-05	1.94E-03	6-May-06	1.82E-03	6-May-07	1.85E-03	5-May-08	1.71E-03
7-May-03	1.84E-03	6-May-04	1.78E-03	7-May-05	1.94E-03	7-May-06	1.80E-03	7-May-07	1.85E-03	6-May-08	1.71E-03
8-May-03	1.84E-03	7-May-04	1.78E-03	8-May-05	1.94E-03	8-May-06	1.79E-03	8-May-07	1.84E-03	7-May-08	1.71E-03
9-May-03	1.83E-03	8-May-04	1.77E-03	9-May-05	1.94E-03	9-May-06	1.79E-03	9-May-07	1.84E-03	8-May-08	1.71E-03
10-May-03	1.82E-03	9-May-04	1.77E-03	10-May-05	1.93E-03	10-May-06	1.79E-03	10-May-07	1.84E-03	9-May-08	1.70E-03
11-May-03	1.82E-03	10-May-04	1.77E-03	11-May-05	1.92E-03	11-May-06	1.79E-03	11-May-07	1.84E-03	10-May-08	1.70E-03
12-May-03	1.80E-03	11-May-04	1.77E-03	12-May-05	1.93E-03	12-May-06	1.78E-03	12-May-07	1.84E-03	11-May-08	1.70E-03
13-May-03	1.79E-03	12-May-04	1.77E-03	13-May-05	1.93E-03	13-May-06	1.78E-03	13-May-07	1.83E-03	12-May-08	1.70E-03

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
14-May-03	1.79E-03	13-May-04	1.76E-03	14-May-05	1.92E-03	14-May-06	1.78E-03	14-May-07	1.82E-03	13-May-08	1.70E-03
15-May-03	1.79E-03	14-May-04	1.76E-03	15-May-05	1.90E-03	15-May-06	1.78E-03	15-May-07	1.80E-03	14-May-08	1.69E-03
16-May-03	1.79E-03	15-May-04	1.76E-03	16-May-05	1.89E-03	16-May-06	1.78E-03	16-May-07	1.79E-03	15-May-08	1.69E-03
17-May-03	1.79E-03	16-May-04	1.76E-03	17-May-05	1.88E-03	17-May-06	1.77E-03	17-May-07	1.79E-03	16-May-08	1.69E-03
18-May-03	1.78E-03	17-May-04	1.76E-03	18-May-05	1.88E-03	18-May-06	1.77E-03	18-May-07	1.79E-03	17-May-08	1.69E-03
19-May-03	1.78E-03	18-May-04	1.75E-03	19-May-05	1.87E-03	19-May-06	1.77E-03	19-May-07	1.79E-03	18-May-08	1.69E-03
20-May-03	1.78E-03	19-May-04	1.75E-03	20-May-05	1.86E-03	20-May-06	1.77E-03	20-May-07	1.79E-03	19-May-08	1.68E-03
21-May-03	1.78E-03	20-May-04	1.75E-03	21-May-05	1.84E-03	21-May-06	1.77E-03	21-May-07	1.78E-03	20-May-08	1.68E-03
22-May-03	1.77E-03	21-May-04	1.75E-03	22-May-05	1.84E-03	22-May-06	1.76E-03	22-May-07	1.78E-03	21-May-08	1.68E-03
23-May-03	1.77E-03	22-May-04	1.75E-03	23-May-05	1.84E-03	23-May-06	1.76E-03	23-May-07	1.78E-03	22-May-08	1.68E-03
24-May-03	1.77E-03	23-May-04	1.74E-03	24-May-05	1.83E-03	24-May-06	1.76E-03	24-May-07	1.78E-03	23-May-08	1.68E-03
25-May-03	1.77E-03	24-May-04	1.74E-03	25-May-05	1.83E-03	25-May-06	1.76E-03	25-May-07	1.77E-03	24-May-08	1.67E-03
26-May-03	1.77E-03	25-May-04	1.74E-03	26-May-05	1.81E-03	26-May-06	1.76E-03	26-May-07	1.77E-03	25-May-08	1.67E-03
27-May-03	1.76E-03	26-May-04	1.74E-03	27-May-05	1.80E-03	27-May-06	1.75E-03	27-May-07	1.77E-03	26-May-08	1.67E-03
28-May-03	1.76E-03	27-May-04	1.74E-03	28-May-05	1.79E-03	28-May-06	1.75E-03	28-May-07	1.77E-03	27-May-08	1.67E-03
29-May-03	1.76E-03	28-May-04	1.73E-03	29-May-05	1.79E-03	29-May-06	1.75E-03	29-May-07	1.77E-03	28-May-08	1.67E-03
30-May-03	1.76E-03	29-May-04	1.73E-03	30-May-05	1.79E-03	30-May-06	1.75E-03	30-May-07	1.76E-03	29-May-08	1.66E-03
31-May-03	1.76E-03	30-May-04	1.73E-03	31-May-05	1.79E-03	31-May-06	1.75E-03	31-May-07	1.76E-03	30-May-08	1.66E-03
1-Jun-03	1.75E-03	31-May-04	1.73E-03	1-Jun-05	1.78E-03	1-Jun-06	1.74E-03	1-Jun-07	1.76E-03	31-May-08	1.66E-03
2-Jun-03	1.75E-03	1-Jun-04	1.73E-03	2-Jun-05	1.78E-03	2-Jun-06	1.74E-03	2-Jun-07	1.76E-03	1-Jun-08	1.66E-03
3-Jun-03	1.75E-03	2-Jun-04	1.72E-03	3-Jun-05	1.78E-03	3-Jun-06	1.74E-03	3-Jun-07	1.76E-03	2-Jun-08	1.66E-03
4-Jun-03	1.75E-03	3-Jun-04	1.72E-03	4-Jun-05	1.78E-03	4-Jun-06	1.74E-03	4-Jun-07	1.75E-03	3-Jun-08	1.65E-03
5-Jun-03	1.75E-03	4-Jun-04	1.72E-03	5-Jun-05	1.78E-03	5-Jun-06	1.73E-03	5-Jun-07	1.75E-03	4-Jun-08	1.65E-03
6-Jun-03	1.75E-03	5-Jun-04	1.72E-03	6-Jun-05	1.77E-03	6-Jun-06	1.73E-03	6-Jun-07	1.75E-03	5-Jun-08	1.65E-03
7-Jun-03	1.77E-03	6-Jun-04	1.71E-03	7-Jun-05	1.77E-03	7-Jun-06	1.73E-03	7-Jun-07	1.75E-03	6-Jun-08	1.65E-03
8-Jun-03	1.78E-03	7-Jun-04	1.71E-03	8-Jun-05	1.77E-03	8-Jun-06	1.73E-03	8-Jun-07	1.75E-03	7-Jun-08	1.65E-03
9-Jun-03	1.79E-03	8-Jun-04	1.71E-03	9-Jun-05	1.77E-03	9-Jun-06	1.73E-03	9-Jun-07	1.74E-03	8-Jun-08	1.64E-03
10-Jun-03	1.81E-03	9-Jun-04	1.71E-03	10-Jun-05	1.77E-03	10-Jun-06	1.72E-03	10-Jun-07	1.74E-03	9-Jun-08	1.64E-03
11-Jun-03	1.82E-03	10-Jun-04	1.71E-03	11-Jun-05	1.76E-03	11-Jun-06	1.72E-03	11-Jun-07	1.74E-03	10-Jun-08	1.64E-03
12-Jun-03	1.83E-03	11-Jun-04	1.70E-03	12-Jun-05	1.76E-03	12-Jun-06	1.72E-03	12-Jun-07	1.74E-03	11-Jun-08	1.64E-03
13-Jun-03	1.83E-03	12-Jun-04	1.70E-03	13-Jun-05	1.76E-03	13-Jun-06	1.72E-03	13-Jun-07	1.74E-03	12-Jun-08	1.64E-03
14-Jun-03	1.83E-03	13-Jun-04	1.70E-03	14-Jun-05	1.76E-03	14-Jun-06	1.75E-03	14-Jun-07	1.73E-03	13-Jun-08	1.63E-03
15-Jun-03	1.83E-03	14-Jun-04	1.70E-03	15-Jun-05	1.76E-03	15-Jun-06	1.79E-03	15-Jun-07	1.73E-03	14-Jun-08	1.63E-03
16-Jun-03	1.82E-03	15-Jun-04	1.70E-03	16-Jun-05	1.75E-03	16-Jun-06	1.79E-03	16-Jun-07	1.73E-03	15-Jun-08	1.63E-03
17-Jun-03	1.82E-03	16-Jun-04	1.69E-03	17-Jun-05	1.75E-03	17-Jun-06	1.79E-03	17-Jun-07	1.73E-03	16-Jun-08	1.63E-03
18-Jun-03	1.82E-03	17-Jun-04	1.69E-03	18-Jun-05	1.75E-03	18-Jun-06	1.79E-03	18-Jun-07	1.73E-03	17-Jun-08	1.63E-03
19-Jun-03	1.83E-03	18-Jun-04	1.69E-03	19-Jun-05	1.75E-03	19-Jun-06	1.78E-03	19-Jun-07	1.72E-03	18-Jun-08	1.62E-03
20-Jun-03	1.94E-03	19-Jun-04	1.69E-03	20-Jun-05	1.75E-03	20-Jun-06	1.78E-03	20-Jun-07	1.72E-03	19-Jun-08	1.62E-03
21-Jun-03	1.98E-03	20-Jun-04	1.69E-03	21-Jun-05	1.75E-03	21-Jun-06	1.78E-03	21-Jun-07	1.72E-03	20-Jun-08	1.62E-03
22-Jun-03	1.98E-03	21-Jun-04	1.68E-03	22-Jun-05	1.75E-03	22-Jun-06	1.78E-03	22-Jun-07	1.72E-03	21-Jun-08	1.62E-03
23-Jun-03	1.98E-03	22-Jun-04	1.68E-03	23-Jun-05	1.77E-03	23-Jun-06	1.77E-03	23-Jun-07	1.72E-03	22-Jun-08	1.62E-03
24-Jun-03	1.98E-03	23-Jun-04	1.68E-03	24-Jun-05	1.79E-03	24-Jun-06	1.77E-03	24-Jun-07	1.71E-03	23-Jun-08	1.62E-03
25-Jun-03	1.96E-03	24-Jun-04	1.68E-03	25-Jun-05	1.79E-03	25-Jun-06	1.77E-03	25-Jun-07	1.71E-03	24-Jun-08	1.61E-03
26-Jun-03	1.94E-03	25-Jun-04	1.68E-03	26-Jun-05	1.79E-03	26-Jun-06	1.77E-03	26-Jun-07	1.71E-03	25-Jun-08	1.61E-03
27-Jun-03	1.93E-03	26-Jun-04	1.68E-03	27-Jun-05	1.79E-03	27-Jun-06	1.77E-03	27-Jun-07	1.71E-03	26-Jun-08	1.61E-03

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
28-Jun-03	1.92E-03	27-Jun-04	1.67E-03	28-Jun-05	1.79E-03	28-Jun-06	1.76E-03	28-Jun-07	1.71E-03	27-Jun-08	1.61E-03
29-Jun-03	1.91E-03	28-Jun-04	1.67E-03	29-Jun-05	1.79E-03	29-Jun-06	1.76E-03	29-Jun-07	1.70E-03	28-Jun-08	1.61E-03
30-Jun-03	1.90E-03	29-Jun-04	1.74E-03	30-Jun-05	1.79E-03	30-Jun-06	1.76E-03	30-Jun-07	1.70E-03	29-Jun-08	1.60E-03
1-Jul-03	1.89E-03	30-Jun-04	1.82E-03	1-Jul-05	1.79E-03	1-Jul-06	1.76E-03	1-Jul-07	1.70E-03	30-Jun-08	1.60E-03
2-Jul-03	1.88E-03	1-Jul-04	1.82E-03	2-Jul-05	1.80E-03	2-Jul-06	1.78E-03	2-Jul-07	1.70E-03	1-Jul-08	1.60E-03
3-Jul-03	1.91E-03	2-Jul-04	1.82E-03	3-Jul-05	1.83E-03	3-Jul-06	1.79E-03	3-Jul-07	1.70E-03	2-Jul-08	1.60E-03
4-Jul-03	1.94E-03	3-Jul-04	1.81E-03	4-Jul-05	1.84E-03	4-Jul-06	1.79E-03	4-Jul-07	1.69E-03	3-Jul-08	1.60E-03
5-Jul-03	1.93E-03	4-Jul-04	1.81E-03	5-Jul-05	1.84E-03	5-Jul-06	1.80E-03	5-Jul-07	1.69E-03	4-Jul-08	1.59E-03
6-Jul-03	1.92E-03	5-Jul-04	1.81E-03	6-Jul-05	1.83E-03	6-Jul-06	1.79E-03	6-Jul-07	1.69E-03	5-Jul-08	1.59E-03
7-Jul-03	1.91E-03	6-Jul-04	1.81E-03	7-Jul-05	1.83E-03	7-Jul-06	1.79E-03	7-Jul-07	1.69E-03	6-Jul-08	1.59E-03
8-Jul-03	1.90E-03	7-Jul-04	1.80E-03	8-Jul-05	1.83E-03	8-Jul-06	1.79E-03	8-Jul-07	1.69E-03	7-Jul-08	1.59E-03
9-Jul-03	1.89E-03	8-Jul-04	1.80E-03	9-Jul-05	1.82E-03	9-Jul-06	1.80E-03	9-Jul-07	1.68E-03	8-Jul-08	1.59E-03
10-Jul-03	1.89E-03	9-Jul-04	1.80E-03	10-Jul-05	1.85E-03	10-Jul-06	1.79E-03	10-Jul-07	1.68E-03	9-Jul-08	1.59E-03
11-Jul-03	1.88E-03	10-Jul-04	1.80E-03	11-Jul-05	1.89E-03	11-Jul-06	1.79E-03	11-Jul-07	1.68E-03	10-Jul-08	1.58E-03
12-Jul-03	1.88E-03	11-Jul-04	1.80E-03	12-Jul-05	1.90E-03	12-Jul-06	1.79E-03	12-Jul-07	1.68E-03	11-Jul-08	1.58E-03
13-Jul-03	1.87E-03	12-Jul-04	1.80E-03	13-Jul-05	1.90E-03	13-Jul-06	1.79E-03	13-Jul-07	1.68E-03	12-Jul-08	1.58E-03
14-Jul-03	1.87E-03	13-Jul-04	1.80E-03	14-Jul-05	1.90E-03	14-Jul-06	1.79E-03	14-Jul-07	1.67E-03	13-Jul-08	1.58E-03
15-Jul-03	1.87E-03	14-Jul-04	1.80E-03	15-Jul-05	1.89E-03	15-Jul-06	1.78E-03	15-Jul-07	1.67E-03	14-Jul-08	1.58E-03
16-Jul-03	1.86E-03	15-Jul-04	1.80E-03	16-Jul-05	1.89E-03	16-Jul-06	1.78E-03	16-Jul-07	1.67E-03	15-Jul-08	1.57E-03
17-Jul-03	1.86E-03	16-Jul-04	1.81E-03	17-Jul-05	1.89E-03	17-Jul-06	1.78E-03	17-Jul-07	1.67E-03	16-Jul-08	1.57E-03
18-Jul-03	1.85E-03	17-Jul-04	1.81E-03	18-Jul-05	1.88E-03	18-Jul-06	1.78E-03	18-Jul-07	1.67E-03	17-Jul-08	1.57E-03
19-Jul-03	1.84E-03	18-Jul-04	1.86E-03	19-Jul-05	1.88E-03	19-Jul-06	1.78E-03	19-Jul-07	1.66E-03	18-Jul-08	1.57E-03
20-Jul-03	1.84E-03	19-Jul-04	1.96E-03	20-Jul-05	1.88E-03	20-Jul-06	1.77E-03	20-Jul-07	1.66E-03	19-Jul-08	1.57E-03
21-Jul-03	1.84E-03	20-Jul-04	2.02E-03	21-Jul-05	1.89E-03	21-Jul-06	1.77E-03	21-Jul-07	1.66E-03	20-Jul-08	1.57E-03
22-Jul-03	1.83E-03	21-Jul-04	1.99E-03	22-Jul-05	1.88E-03	22-Jul-06	1.77E-03	22-Jul-07	1.66E-03	21-Jul-08	1.57E-03
23-Jul-03	1.82E-03	22-Jul-04	1.97E-03	23-Jul-05	1.88E-03	23-Jul-06	1.77E-03	23-Jul-07	1.66E-03	22-Jul-08	1.57E-03
24-Jul-03	1.80E-03	23-Jul-04	2.01E-03	24-Jul-05	1.89E-03	24-Jul-06	1.77E-03	24-Jul-07	1.65E-03	23-Jul-08	1.56E-03
25-Jul-03	1.79E-03	24-Jul-04	2.07E-03	25-Jul-05	1.88E-03	25-Jul-06	1.76E-03	25-Jul-07	1.65E-03	24-Jul-08	1.56E-03
26-Jul-03	1.79E-03	25-Jul-04	2.05E-03	26-Jul-05	1.88E-03	26-Jul-06	1.76E-03	26-Jul-07	1.65E-03	25-Jul-08	1.57E-03
27-Jul-03	1.79E-03	26-Jul-04	2.04E-03	27-Jul-05	1.87E-03	27-Jul-06	1.76E-03	27-Jul-07	1.65E-03	26-Jul-08	1.57E-03
28-Jul-03	1.79E-03	27-Jul-04	2.04E-03	28-Jul-05	1.87E-03	28-Jul-06	1.76E-03	28-Jul-07	1.65E-03	27-Jul-08	1.56E-03
29-Jul-03	1.79E-03	28-Jul-04	2.03E-03	29-Jul-05	1.87E-03	29-Jul-06	1.75E-03	29-Jul-07	1.64E-03	28-Jul-08	1.56E-03
30-Jul-03	1.78E-03	29-Jul-04	2.03E-03	30-Jul-05	1.86E-03	30-Jul-06	1.75E-03	30-Jul-07	1.64E-03	29-Jul-08	1.56E-03
31-Jul-03	1.78E-03	30-Jul-04	2.02E-03	31-Jul-05	1.87E-03	31-Jul-06	1.75E-03	31-Jul-07	1.64E-03	30-Jul-08	1.56E-03
1-Aug-03	1.78E-03	31-Jul-04	2.00E-03	1-Aug-05	1.87E-03	1-Aug-06	1.75E-03	1-Aug-07	1.64E-03	31-Jul-08	1.57E-03
2-Aug-03	1.78E-03	1-Aug-04	1.99E-03	2-Aug-05	1.87E-03	2-Aug-06	1.75E-03	2-Aug-07	1.64E-03	1-Aug-08	1.61E-03
3-Aug-03	1.77E-03	2-Aug-04	1.97E-03	3-Aug-05	1.87E-03	3-Aug-06	1.75E-03	3-Aug-07	1.75E-03	2-Aug-08	1.65E-03
4-Aug-03	1.77E-03	3-Aug-04	1.98E-03	4-Aug-05	1.87E-03	4-Aug-06	1.75E-03	4-Aug-07	1.81E-03	3-Aug-08	1.79E-03
5-Aug-03	1.77E-03	4-Aug-04	1.98E-03	5-Aug-05	1.87E-03	5-Aug-06	1.74E-03	5-Aug-07	1.82E-03	4-Aug-08	1.83E-03
6-Aug-03	1.77E-03	5-Aug-04	1.98E-03	6-Aug-05	1.86E-03	6-Aug-06	1.74E-03	6-Aug-07	1.81E-03	5-Aug-08	1.83E-03
7-Aug-03	1.77E-03	6-Aug-04	1.96E-03	7-Aug-05	1.86E-03	7-Aug-06	1.74E-03	7-Aug-07	1.81E-03	6-Aug-08	1.82E-03
8-Aug-03	1.76E-03	7-Aug-04	1.95E-03	8-Aug-05	1.85E-03	8-Aug-06	1.74E-03	8-Aug-07	1.81E-03	7-Aug-08	1.82E-03
9-Aug-03	1.76E-03	8-Aug-04	1.94E-03	9-Aug-05	1.85E-03	9-Aug-06	1.74E-03	9-Aug-07	1.80E-03	8-Aug-08	1.82E-03
10-Aug-03	1.76E-03	9-Aug-04	1.94E-03	10-Aug-05	1.85E-03	10-Aug-06	1.73E-03	10-Aug-07	1.80E-03	9-Aug-08	1.82E-03
11-Aug-03	1.76E-03	10-Aug-04	1.94E-03	11-Aug-05	1.84E-03	11-Aug-06	1.73E-03	11-Aug-07	1.80E-03	10-Aug-08	1.82E-03

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
12-Aug-03	1.76E-03	11-Aug-04	1.93E-03	12-Aug-05	1.84E-03	12-Aug-06	1.73E-03	12-Aug-07	1.80E-03	11-Aug-08	1.81E-03
13-Aug-03	1.75E-03	12-Aug-04	1.92E-03	13-Aug-05	1.84E-03	13-Aug-06	1.73E-03	13-Aug-07	1.80E-03	12-Aug-08	1.81E-03
14-Aug-03	1.75E-03	13-Aug-04	1.92E-03	14-Aug-05	1.83E-03	14-Aug-06	1.73E-03	14-Aug-07	1.79E-03	13-Aug-08	1.81E-03
15-Aug-03	1.75E-03	14-Aug-04	1.91E-03	15-Aug-05	1.83E-03	15-Aug-06	1.72E-03	15-Aug-07	1.79E-03	14-Aug-08	1.80E-03
16-Aug-03	1.75E-03	15-Aug-04	1.92E-03	16-Aug-05	1.83E-03	16-Aug-06	1.72E-03	16-Aug-07	1.79E-03	15-Aug-08	1.80E-03
17-Aug-03	1.75E-03	16-Aug-04	1.93E-03	17-Aug-05	1.83E-03	17-Aug-06	1.72E-03	17-Aug-07	1.79E-03	16-Aug-08	1.80E-03
18-Aug-03	1.74E-03	17-Aug-04	1.92E-03	18-Aug-05	1.82E-03	18-Aug-06	1.72E-03	18-Aug-07	1.79E-03	17-Aug-08	1.80E-03
19-Aug-03	1.74E-03	18-Aug-04	1.91E-03	19-Aug-05	1.83E-03	19-Aug-06	1.72E-03	19-Aug-07	1.78E-03	18-Aug-08	1.80E-03
20-Aug-03	1.74E-03	19-Aug-04	1.90E-03	20-Aug-05	1.83E-03	20-Aug-06	1.71E-03	20-Aug-07	1.78E-03	19-Aug-08	1.80E-03
21-Aug-03	1.74E-03	20-Aug-04	1.89E-03	21-Aug-05	1.82E-03	21-Aug-06	1.71E-03	21-Aug-07	1.78E-03	20-Aug-08	1.81E-03
22-Aug-03	1.76E-03	21-Aug-04	1.89E-03	22-Aug-05	1.82E-03	22-Aug-06	1.71E-03	22-Aug-07	1.78E-03	21-Aug-08	1.81E-03
23-Aug-03	1.80E-03	22-Aug-04	1.88E-03	23-Aug-05	1.82E-03	23-Aug-06	1.71E-03	23-Aug-07	1.77E-03	22-Aug-08	1.81E-03
24-Aug-03	1.79E-03	23-Aug-04	1.88E-03	24-Aug-05	1.81E-03	24-Aug-06	1.71E-03	24-Aug-07	1.77E-03	23-Aug-08	1.99E-03
25-Aug-03	1.80E-03	24-Aug-04	1.88E-03	25-Aug-05	1.81E-03	25-Aug-06	1.70E-03	25-Aug-07	1.77E-03	24-Aug-08	2.04E-03
26-Aug-03	1.80E-03	25-Aug-04	1.89E-03	26-Aug-05	1.81E-03	26-Aug-06	1.70E-03	26-Aug-07	1.77E-03	25-Aug-08	2.02E-03
27-Aug-03	1.80E-03	26-Aug-04	1.89E-03	27-Aug-05	1.81E-03	27-Aug-06	1.71E-03	27-Aug-07	1.77E-03	26-Aug-08	2.00E-03
28-Aug-03	1.80E-03	27-Aug-04	1.88E-03	28-Aug-05	1.83E-03	28-Aug-06	1.73E-03	28-Aug-07	1.76E-03	27-Aug-08	1.98E-03
29-Aug-03	1.79E-03	28-Aug-04	1.88E-03	29-Aug-05	1.89E-03	29-Aug-06	1.73E-03	29-Aug-07	1.76E-03	28-Aug-08	1.96E-03
30-Aug-03	1.79E-03	29-Aug-04	1.87E-03	30-Aug-05	1.89E-03	30-Aug-06	1.73E-03	30-Aug-07	1.76E-03	29-Aug-08	1.95E-03
31-Aug-03	1.79E-03	30-Aug-04	1.87E-03	31-Aug-05	1.90E-03	31-Aug-06	1.74E-03	31-Aug-07	1.76E-03	30-Aug-08	1.93E-03
1-Sep-03	1.79E-03	31-Aug-04	1.87E-03	1-Sep-05	1.96E-03	1-Sep-06	1.74E-03	1-Sep-07	1.76E-03	31-Aug-08	1.92E-03
2-Sep-03	1.79E-03	1-Sep-04	1.86E-03	2-Sep-05	1.98E-03	2-Sep-06	1.74E-03	2-Sep-07	1.75E-03	1-Sep-08	1.91E-03
3-Sep-03	1.80E-03	2-Sep-04	1.86E-03	3-Sep-05	1.96E-03	3-Sep-06	1.74E-03	3-Sep-07	1.75E-03	2-Sep-08	1.90E-03
4-Sep-03	1.80E-03	3-Sep-04	1.89E-03	4-Sep-05	1.95E-03	4-Sep-06	1.74E-03	4-Sep-07	1.75E-03	3-Sep-08	1.89E-03
5-Sep-03	1.82E-03	4-Sep-04	1.89E-03	5-Sep-05	1.94E-03	5-Sep-06	1.74E-03	5-Sep-07	1.75E-03	4-Sep-08	1.89E-03
6-Sep-03	1.83E-03	5-Sep-04	1.90E-03	6-Sep-05	1.93E-03	6-Sep-06	1.74E-03	6-Sep-07	1.75E-03	5-Sep-08	1.88E-03
7-Sep-03	1.84E-03	6-Sep-04	2.06E-03	7-Sep-05	1.94E-03	7-Sep-06	1.75E-03	7-Sep-07	1.74E-03	6-Sep-08	1.88E-03
8-Sep-03	1.83E-03	7-Sep-04	2.07E-03	8-Sep-05	1.93E-03	8-Sep-06	1.78E-03	8-Sep-07	1.74E-03	7-Sep-08	1.88E-03
9-Sep-03	1.83E-03	8-Sep-04	2.06E-03	9-Sep-05	1.93E-03	9-Sep-06	1.80E-03	9-Sep-07	1.74E-03	8-Sep-08	1.87E-03
10-Sep-03	1.83E-03	9-Sep-04	2.04E-03	10-Sep-05	1.92E-03	10-Sep-06	1.79E-03	10-Sep-07	1.74E-03	9-Sep-08	1.88E-03
11-Sep-03	1.82E-03	10-Sep-04	2.02E-03	11-Sep-05	1.91E-03	11-Sep-06	1.79E-03	11-Sep-07	1.74E-03	10-Sep-08	1.89E-03
12-Sep-03	1.82E-03	11-Sep-04	2.00E-03	12-Sep-05	1.90E-03	12-Sep-06	1.79E-03	12-Sep-07	1.73E-03	11-Sep-08	1.88E-03
13-Sep-03	1.82E-03	12-Sep-04	1.99E-03	13-Sep-05	1.89E-03	13-Sep-06	1.79E-03	13-Sep-07	1.73E-03	12-Sep-08	1.88E-03
14-Sep-03	1.82E-03	13-Sep-04	2.01E-03	14-Sep-05	1.89E-03	14-Sep-06	1.80E-03	14-Sep-07	1.73E-03	13-Sep-08	1.88E-03
15-Sep-03	1.84E-03	14-Sep-04	2.03E-03	15-Sep-05	1.88E-03	15-Sep-06	1.81E-03	15-Sep-07	1.73E-03	14-Sep-08	1.87E-03
16-Sep-03	1.84E-03	15-Sep-04	2.03E-03	16-Sep-05	1.88E-03	16-Sep-06	1.81E-03	16-Sep-07	1.73E-03	15-Sep-08	1.87E-03
17-Sep-03	1.84E-03	16-Sep-04	2.03E-03	17-Sep-05	1.89E-03	17-Sep-06	1.81E-03	17-Sep-07	1.72E-03	16-Sep-08	1.87E-03
18-Sep-03	1.84E-03	17-Sep-04	2.01E-03	18-Sep-05	1.89E-03	18-Sep-06	1.82E-03	18-Sep-07	1.72E-03	17-Sep-08	1.86E-03
19-Sep-03	1.84E-03	18-Sep-04	2.00E-03	19-Sep-05	1.88E-03	19-Sep-06	1.95E-03	19-Sep-07	1.72E-03	18-Sep-08	1.86E-03
20-Sep-03	1.84E-03	19-Sep-04	1.99E-03	20-Sep-05	1.88E-03	20-Sep-06	2.07E-03	20-Sep-07	1.72E-03	19-Sep-08	1.86E-03
21-Sep-03	1.83E-03	20-Sep-04	1.99E-03	21-Sep-05	1.88E-03	21-Sep-06	2.08E-03	21-Sep-07	1.71E-03	20-Sep-08	1.86E-03
22-Sep-03	1.83E-03	21-Sep-04	1.99E-03	22-Sep-05	1.87E-03	22-Sep-06	2.07E-03	22-Sep-07	1.72E-03	21-Sep-08	1.85E-03
23-Sep-03	1.83E-03	22-Sep-04	1.98E-03	23-Sep-05	1.87E-03	23-Sep-06	2.05E-03	23-Sep-07	1.73E-03	22-Sep-08	1.85E-03
24-Sep-03	1.83E-03	23-Sep-04	1.97E-03	24-Sep-05	1.87E-03	24-Sep-06	2.04E-03	24-Sep-07	1.74E-03	23-Sep-08	1.85E-03
25-Sep-03	1.82E-03	24-Sep-04	1.97E-03	25-Sep-05	1.87E-03	25-Sep-06	2.03E-03	25-Sep-07	1.75E-03	24-Sep-08	1.85E-03

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
26-Sep-03	1.84E-03	25-Sep-04	1.98E-03	26-Sep-05	1.86E-03	26-Sep-06	2.02E-03	26-Sep-07	1.75E-03	25-Sep-08	1.84E-03
27-Sep-03	1.85E-03	26-Sep-04	2.03E-03	27-Sep-05	1.86E-03	27-Sep-06	2.01E-03	27-Sep-07	1.75E-03	26-Sep-08	1.84E-03
28-Sep-03	1.86E-03	27-Sep-04	2.08E-03	28-Sep-05	1.86E-03	28-Sep-06	2.00E-03	28-Sep-07	1.74E-03	27-Sep-08	1.84E-03
29-Sep-03	1.87E-03	28-Sep-04	2.06E-03	29-Sep-05	1.86E-03	29-Sep-06	1.99E-03	29-Sep-07	1.74E-03	28-Sep-08	1.84E-03
30-Sep-03	1.87E-03	29-Sep-04	2.04E-03	30-Sep-05	1.85E-03	30-Sep-06	1.98E-03	30-Sep-07	1.74E-03	29-Sep-08	1.83E-03
1-Oct-03	1.87E-03	30-Sep-04	2.03E-03	1-Oct-05	1.85E-03	1-Oct-06	2.02E-03	1-Oct-07	1.74E-03	30-Sep-08	1.83E-03
2-Oct-03	1.87E-03	1-Oct-04	2.02E-03	2-Oct-05	1.85E-03	2-Oct-06	2.03E-03	2-Oct-07	1.74E-03	1-Oct-08	1.83E-03
3-Oct-03	1.87E-03	2-Oct-04	2.02E-03	3-Oct-05	1.85E-03	3-Oct-06	2.02E-03	3-Oct-07	1.74E-03	2-Oct-08	1.83E-03
4-Oct-03	1.87E-03	3-Oct-04	2.01E-03	4-Oct-05	1.84E-03	4-Oct-06	2.01E-03	4-Oct-07	1.74E-03	3-Oct-08	1.82E-03
5-Oct-03	1.87E-03	4-Oct-04	1.99E-03	5-Oct-05	1.84E-03	5-Oct-06	2.00E-03	5-Oct-07	1.74E-03	4-Oct-08	1.82E-03
6-Oct-03	1.87E-03	5-Oct-04	1.98E-03	6-Oct-05	1.84E-03	6-Oct-06	1.99E-03	6-Oct-07	1.74E-03	5-Oct-08	1.82E-03
7-Oct-03	1.87E-03	6-Oct-04	1.97E-03	7-Oct-05	1.84E-03	7-Oct-06	1.98E-03	7-Oct-07	1.74E-03	6-Oct-08	1.82E-03
8-Oct-03	1.87E-03	7-Oct-04	1.97E-03	8-Oct-05	1.84E-03	8-Oct-06	1.98E-03	8-Oct-07	1.75E-03	7-Oct-08	1.82E-03
9-Oct-03	1.87E-03	8-Oct-04	1.96E-03	9-Oct-05	1.85E-03	9-Oct-06	1.97E-03	9-Oct-07	1.75E-03	8-Oct-08	1.81E-03
10-Oct-03	1.87E-03	9-Oct-04	1.95E-03	10-Oct-05	1.85E-03	10-Oct-06	1.96E-03	10-Oct-07	1.75E-03	9-Oct-08	1.81E-03
11-Oct-03	1.86E-03	10-Oct-04	1.94E-03	11-Oct-05	1.85E-03	11-Oct-06	1.95E-03	11-Oct-07	1.75E-03	10-Oct-08	1.81E-03
12-Oct-03	1.86E-03	11-Oct-04	1.97E-03	12-Oct-05	1.84E-03	12-Oct-06	1.95E-03	12-Oct-07	1.75E-03	11-Oct-08	1.81E-03
13-Oct-03	1.86E-03	12-Oct-04	1.98E-03	13-Oct-05	1.84E-03	13-Oct-06	1.94E-03	13-Oct-07	1.74E-03	12-Oct-08	1.80E-03
14-Oct-03	1.87E-03	13-Oct-04	1.98E-03	14-Oct-05	1.84E-03	14-Oct-06	1.93E-03	14-Oct-07	1.74E-03	13-Oct-08	1.82E-03
15-Oct-03	1.88E-03	14-Oct-04	1.97E-03	15-Oct-05	1.84E-03	15-Oct-06	1.92E-03	15-Oct-07	1.74E-03	14-Oct-08	1.83E-03
16-Oct-03	1.89E-03	15-Oct-04	1.98E-03	16-Oct-05	1.83E-03	16-Oct-06	1.92E-03	16-Oct-07	1.74E-03	15-Oct-08	1.84E-03
17-Oct-03	1.89E-03	16-Oct-04	1.98E-03	17-Oct-05	1.83E-03	17-Oct-06	1.91E-03	17-Oct-07	1.74E-03	16-Oct-08	1.84E-03
18-Oct-03	1.89E-03	17-Oct-04	1.98E-03	18-Oct-05	1.83E-03	18-Oct-06	1.91E-03	18-Oct-07	1.73E-03	17-Oct-08	1.84E-03
19-Oct-03	1.89E-03	18-Oct-04	1.97E-03	19-Oct-05	1.83E-03	19-Oct-06	1.90E-03	19-Oct-07	1.73E-03	18-Oct-08	1.83E-03
20-Oct-03	1.89E-03	19-Oct-04	1.96E-03	20-Oct-05	1.82E-03	20-Oct-06	1.90E-03	20-Oct-07	1.73E-03	19-Oct-08	1.83E-03
21-Oct-03	1.89E-03	20-Oct-04	1.95E-03	21-Oct-05	1.82E-03	21-Oct-06	1.90E-03	21-Oct-07	1.73E-03	20-Oct-08	1.83E-03
22-Oct-03	1.88E-03	21-Oct-04	1.95E-03	22-Oct-05	1.82E-03	22-Oct-06	1.89E-03	22-Oct-07	1.73E-03	21-Oct-08	1.83E-03
23-Oct-03	1.88E-03	22-Oct-04	1.95E-03	23-Oct-05	1.82E-03	23-Oct-06	1.89E-03	23-Oct-07	1.73E-03	22-Oct-08	1.82E-03
24-Oct-03	1.88E-03	23-Oct-04	1.95E-03	24-Oct-05	1.81E-03	24-Oct-06	1.89E-03	24-Oct-07	1.73E-03	23-Oct-08	1.82E-03
25-Oct-03	1.87E-03	24-Oct-04	1.95E-03	25-Oct-05	1.81E-03	25-Oct-06	1.90E-03	25-Oct-07	1.72E-03	24-Oct-08	1.82E-03
26-Oct-03	1.87E-03	25-Oct-04	1.95E-03	26-Oct-05	1.81E-03	26-Oct-06	1.94E-03	26-Oct-07	1.72E-03	25-Oct-08	1.82E-03
27-Oct-03	1.87E-03	26-Oct-04	1.95E-03	27-Oct-05	1.81E-03	27-Oct-06	1.94E-03	27-Oct-07	1.72E-03	26-Oct-08	1.82E-03
28-Oct-03	1.87E-03	27-Oct-04	1.94E-03	28-Oct-05	1.84E-03	28-Oct-06	1.93E-03	28-Oct-07	1.72E-03	27-Oct-08	1.81E-03
29-Oct-03	1.86E-03	28-Oct-04	1.94E-03	29-Oct-05	1.84E-03	29-Oct-06	1.97E-03	29-Oct-07	1.72E-03	28-Oct-08	1.81E-03
30-Oct-03	1.88E-03	29-Oct-04	1.94E-03	30-Oct-05	1.84E-03	30-Oct-06	1.98E-03	30-Oct-07	1.72E-03	29-Oct-08	1.81E-03
31-Oct-03	1.89E-03	30-Oct-04	1.94E-03	31-Oct-05	1.84E-03	31-Oct-06	1.98E-03	31-Oct-07	1.71E-03	30-Oct-08	1.81E-03
1-Nov-03	1.89E-03	31-Oct-04	1.94E-03	1-Nov-05	1.84E-03	1-Nov-06	1.98E-03	1-Nov-07	1.71E-03	31-Oct-08	1.81E-03
2-Nov-03	1.89E-03	1-Nov-04	1.94E-03	2-Nov-05	1.84E-03	2-Nov-06	1.98E-03	2-Nov-07	1.71E-03	1-Nov-08	1.80E-03
3-Nov-03	1.89E-03	2-Nov-04	1.93E-03	3-Nov-05	1.84E-03	3-Nov-06	1.98E-03	3-Nov-07	1.71E-03	2-Nov-08	1.80E-03
4-Nov-03	1.89E-03	3-Nov-04	1.93E-03	4-Nov-05	1.84E-03	4-Nov-06	1.98E-03	4-Nov-07	1.71E-03	3-Nov-08	1.80E-03
5-Nov-03	1.89E-03	4-Nov-04	1.92E-03	5-Nov-05	1.84E-03	5-Nov-06	1.97E-03	5-Nov-07	1.70E-03	4-Nov-08	1.80E-03
6-Nov-03	1.89E-03	5-Nov-04	1.92E-03	6-Nov-05	1.83E-03	6-Nov-06	1.97E-03	6-Nov-07	1.70E-03	5-Nov-08	1.79E-03
7-Nov-03	1.88E-03	6-Nov-04	1.92E-03	7-Nov-05	1.83E-03	7-Nov-06	1.96E-03	7-Nov-07	1.70E-03	6-Nov-08	1.79E-03
8-Nov-03	1.89E-03	7-Nov-04	1.91E-03	8-Nov-05	1.83E-03	8-Nov-06	1.98E-03	8-Nov-07	1.70E-03	7-Nov-08	1.79E-03
9-Nov-03	1.88E-03	8-Nov-04	1.91E-03	9-Nov-05	1.83E-03	9-Nov-06	1.98E-03	9-Nov-07	1.70E-03	8-Nov-08	1.79E-03

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
10-Nov-03	1.88E-03	9-Nov-04	1.90E-03	10-Nov-05	1.83E-03	10-Nov-06	1.98E-03	10-Nov-07	1.69E-03	9-Nov-08	1.79E-03
11-Nov-03	1.88E-03	10-Nov-04	1.93E-03	11-Nov-05	1.82E-03	11-Nov-06	1.98E-03	11-Nov-07	1.69E-03	10-Nov-08	1.79E-03
12-Nov-03	1.87E-03	11-Nov-04	1.93E-03	12-Nov-05	1.82E-03	12-Nov-06	1.98E-03	12-Nov-07	1.69E-03	11-Nov-08	1.80E-03
13-Nov-03	1.87E-03	12-Nov-04	1.93E-03	13-Nov-05	1.82E-03	13-Nov-06	1.97E-03	13-Nov-07	1.69E-03	12-Nov-08	1.80E-03
14-Nov-03	1.87E-03	13-Nov-04	1.93E-03	14-Nov-05	1.82E-03	14-Nov-06	1.97E-03	14-Nov-07	1.69E-03	13-Nov-08	1.80E-03
15-Nov-03	1.87E-03	14-Nov-04	1.93E-03	15-Nov-05	1.81E-03	15-Nov-06	1.96E-03	15-Nov-07	1.68E-03	14-Nov-08	1.80E-03
16-Nov-03	1.86E-03	15-Nov-04	1.94E-03	16-Nov-05	1.81E-03	16-Nov-06	1.95E-03	16-Nov-07	1.68E-03	15-Nov-08	1.79E-03
17-Nov-03	1.86E-03	16-Nov-04	1.93E-03	17-Nov-05	1.81E-03	17-Nov-06	1.98E-03	17-Nov-07	1.68E-03	16-Nov-08	1.79E-03
18-Nov-03	1.86E-03	17-Nov-04	1.93E-03	18-Nov-05	1.81E-03	18-Nov-06	1.98E-03	18-Nov-07	1.68E-03	17-Nov-08	1.79E-03
19-Nov-03	1.86E-03	18-Nov-04	1.93E-03	19-Nov-05	1.80E-03	19-Nov-06	1.98E-03	19-Nov-07	1.68E-03	18-Nov-08	1.79E-03
20-Nov-03	1.85E-03	19-Nov-04	1.92E-03	20-Nov-05	1.80E-03	20-Nov-06	1.98E-03	20-Nov-07	1.67E-03	19-Nov-08	1.79E-03
21-Nov-03	1.85E-03	20-Nov-04	1.92E-03	21-Nov-05	1.80E-03	21-Nov-06	1.98E-03	21-Nov-07	1.67E-03	20-Nov-08	1.80E-03
22-Nov-03	1.85E-03	21-Nov-04	1.91E-03	22-Nov-05	1.80E-03	22-Nov-06	1.98E-03	22-Nov-07	1.67E-03	21-Nov-08	1.79E-03
23-Nov-03	1.85E-03	22-Nov-04	1.91E-03	23-Nov-05	1.80E-03	23-Nov-06	1.98E-03	23-Nov-07	1.67E-03	22-Nov-08	1.80E-03
24-Nov-03	1.84E-03	23-Nov-04	1.90E-03	24-Nov-05	1.79E-03	24-Nov-06	1.98E-03	24-Nov-07	1.67E-03	23-Nov-08	1.80E-03
25-Nov-03	1.84E-03	24-Nov-04	1.90E-03	25-Nov-05	1.79E-03	25-Nov-06	1.98E-03	25-Nov-07	1.66E-03	24-Nov-08	1.80E-03
26-Nov-03	1.84E-03	25-Nov-04	1.90E-03	26-Nov-05	1.79E-03	26-Nov-06	1.97E-03	26-Nov-07	1.66E-03	25-Nov-08	1.80E-03
27-Nov-03	1.84E-03	26-Nov-04	1.93E-03	27-Nov-05	1.79E-03	27-Nov-06	1.96E-03	27-Nov-07	1.66E-03	26-Nov-08	1.80E-03
28-Nov-03	1.83E-03	27-Nov-04	1.94E-03	28-Nov-05	1.79E-03	28-Nov-06	1.95E-03	28-Nov-07	1.66E-03	27-Nov-08	1.80E-03
29-Nov-03	1.83E-03	28-Nov-04	1.94E-03	29-Nov-05	1.79E-03	29-Nov-06	1.94E-03	29-Nov-07	1.66E-03	28-Nov-08	1.80E-03
30-Nov-03	1.83E-03	29-Nov-04	1.94E-03	30-Nov-05	1.84E-03	30-Nov-06	1.94E-03	30-Nov-07	1.66E-03	29-Nov-08	1.80E-03
1-Dec-03	1.83E-03	30-Nov-04	1.93E-03	1-Dec-05	1.86E-03	1-Dec-06	1.93E-03	1-Dec-07	1.65E-03	30-Nov-08	1.79E-03
2-Dec-03	1.83E-03	1-Dec-04	1.92E-03	2-Dec-05	1.87E-03	2-Dec-06	1.92E-03	2-Dec-07	1.65E-03	1-Dec-08	1.79E-03
3-Dec-03	1.82E-03	2-Dec-04	1.92E-03	3-Dec-05	1.88E-03	3-Dec-06	1.92E-03	3-Dec-07	1.65E-03	2-Dec-08	1.79E-03
4-Dec-03	1.82E-03	3-Dec-04	1.91E-03	4-Dec-05	1.89E-03	4-Dec-06	1.91E-03	4-Dec-07	1.65E-03	3-Dec-08	1.79E-03
5-Dec-03	1.82E-03	4-Dec-04	1.91E-03	5-Dec-05	1.89E-03	5-Dec-06	1.91E-03	5-Dec-07	1.65E-03	4-Dec-08	1.79E-03
6-Dec-03	1.82E-03	5-Dec-04	1.90E-03	6-Dec-05	1.89E-03	6-Dec-06	1.90E-03	6-Dec-07	1.64E-03	5-Dec-08	1.78E-03
7-Dec-03	1.81E-03	6-Dec-04	1.90E-03	7-Dec-05	1.88E-03	7-Dec-06	1.93E-03	7-Dec-07	1.64E-03	6-Dec-08	1.78E-03
8-Dec-03	1.81E-03	7-Dec-04	1.89E-03	8-Dec-05	1.88E-03	8-Dec-06	1.93E-03	8-Dec-07	1.64E-03	7-Dec-08	1.78E-03
9-Dec-03	1.81E-03	8-Dec-04	1.92E-03	9-Dec-05	1.89E-03	9-Dec-06	1.93E-03	9-Dec-07	1.64E-03	8-Dec-08	1.78E-03
10-Dec-03	1.81E-03	9-Dec-04	1.93E-03	10-Dec-05	1.89E-03	10-Dec-06	1.92E-03	10-Dec-07	1.64E-03	9-Dec-08	1.78E-03
11-Dec-03	1.81E-03	10-Dec-04	1.93E-03	11-Dec-05	1.89E-03	11-Dec-06	1.92E-03	11-Dec-07	1.63E-03	10-Dec-08	1.78E-03
12-Dec-03	1.80E-03	11-Dec-04	1.92E-03	12-Dec-05	1.89E-03	12-Dec-06	1.91E-03	12-Dec-07	1.63E-03	11-Dec-08	1.77E-03
13-Dec-03	1.84E-03	12-Dec-04	1.92E-03	13-Dec-05	1.89E-03	13-Dec-06	1.91E-03	13-Dec-07	1.63E-03	12-Dec-08	1.77E-03
14-Dec-03	1.84E-03	13-Dec-04	1.92E-03	14-Dec-05	1.89E-03	14-Dec-06	1.90E-03	14-Dec-07	1.63E-03	13-Dec-08	1.77E-03
15-Dec-03	1.84E-03	14-Dec-04	1.92E-03	15-Dec-05	1.88E-03	15-Dec-06	1.90E-03	15-Dec-07	1.63E-03	14-Dec-08	1.77E-03
16-Dec-03	1.83E-03	15-Dec-04	1.92E-03	16-Dec-05	1.89E-03	16-Dec-06	1.90E-03	16-Dec-07	1.62E-03	15-Dec-08	1.77E-03
17-Dec-03	1.83E-03	16-Dec-04	1.92E-03	17-Dec-05	1.89E-03	17-Dec-06	1.89E-03	17-Dec-07	1.62E-03	16-Dec-08	1.77E-03
18-Dec-03	1.83E-03	17-Dec-04	1.91E-03	18-Dec-05	1.89E-03	18-Dec-06	1.89E-03	18-Dec-07	1.62E-03	17-Dec-08	1.77E-03
19-Dec-03	1.83E-03	18-Dec-04	1.91E-03	19-Dec-05	1.89E-03	19-Dec-06	1.89E-03	19-Dec-07	1.62E-03	18-Dec-08	1.77E-03
20-Dec-03	1.82E-03	19-Dec-04	1.91E-03	20-Dec-05	1.89E-03	20-Dec-06	1.88E-03	20-Dec-07	1.62E-03	19-Dec-08	1.77E-03
21-Dec-03	1.82E-03	20-Dec-04	1.90E-03	21-Dec-05	1.89E-03	21-Dec-06	1.88E-03	21-Dec-07	1.62E-03	20-Dec-08	1.77E-03
22-Dec-03	1.82E-03	21-Dec-04	1.90E-03	22-Dec-05	1.90E-03	22-Dec-06	1.88E-03	22-Dec-07	1.61E-03	21-Dec-08	1.77E-03
23-Dec-03	1.82E-03	22-Dec-04	1.89E-03	23-Dec-05	1.89E-03	23-Dec-06	1.88E-03	23-Dec-07	1.62E-03	22-Dec-08	1.77E-03
24-Dec-03	1.81E-03	23-Dec-04	1.89E-03	24-Dec-05	1.89E-03	24-Dec-06	1.90E-03	24-Dec-07	1.62E-03	23-Dec-08	1.77E-03

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
25-Dec-03	1.81E-03	24-Dec-04	1.89E-03	25-Dec-05	1.89E-03	25-Dec-06	1.96E-03	25-Dec-07	1.63E-03	24-Dec-08	1.77E-03
26-Dec-03	1.81E-03	25-Dec-04	1.88E-03	26-Dec-05	1.89E-03	26-Dec-06	2.07E-03	26-Dec-07	1.63E-03	25-Dec-08	1.76E-03
27-Dec-03	1.81E-03	26-Dec-04	1.88E-03	27-Dec-05	1.89E-03	27-Dec-06	2.07E-03	27-Dec-07	1.63E-03	26-Dec-08	1.76E-03
28-Dec-03	1.81E-03	27-Dec-04	1.89E-03	28-Dec-05	1.90E-03	28-Dec-06	2.07E-03	28-Dec-07	1.63E-03	27-Dec-08	1.76E-03
29-Dec-03	1.81E-03	28-Dec-04	1.89E-03	29-Dec-05	1.89E-03	29-Dec-06	2.05E-03	29-Dec-07	1.63E-03	28-Dec-08	1.76E-03
30-Dec-03	1.81E-03	29-Dec-04	1.88E-03	30-Dec-05	1.89E-03	30-Dec-06	2.04E-03	30-Dec-07	1.63E-03	29-Dec-08	1.76E-03
31-Dec-03	1.80E-03	30-Dec-04	1.88E-03	31-Dec-05	1.90E-03	31-Dec-06	2.02E-03	31-Dec-07	1.63E-03	30-Dec-08	1.75E-03
		31-Dec-04	1.88E-03							31-Dec-08	1.75E-03

Key: CY=calendar year; ft/day=feet per day.

Table A–2. Tarmac King Road Limestone Mine Site Groundwater Flow Model Zone 2 (Western Model Area) Recharge Values

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
1-Jan-03	0.00E+00	1-Jan-04	0.00E+00	1-Jan-05	0.00E+00	1-Jan-06	0.00E+00	1-Jan-07	3.08E-02	1-Jan-08	0.00E+00
2-Jan-03	0.00E+00	2-Jan-04	0.00E+00	2-Jan-05	0.00E+00	2-Jan-06	0.00E+00	2-Jan-07	2.75E-02	2-Jan-08	0.00E+00
3-Jan-03	0.00E+00	3-Jan-04	0.00E+00	3-Jan-05	0.00E+00	3-Jan-06	0.00E+00	3-Jan-07	5.64E-03	3-Jan-08	0.00E+00
4-Jan-03	0.00E+00	4-Jan-04	0.00E+00	4-Jan-05	0.00E+00	4-Jan-06	1.20E-03	4-Jan-07	1.34E-02	4-Jan-08	0.00E+00
5-Jan-03	0.00E+00	5-Jan-04	0.00E+00	5-Jan-05	0.00E+00	5-Jan-06	5.45E-04	5-Jan-07	1.05E-02	5-Jan-08	0.00E+00
6-Jan-03	0.00E+00	6-Jan-04	0.00E+00	6-Jan-05	0.00E+00	6-Jan-06	0.00E+00	6-Jan-07	8.00E-03	6-Jan-08	0.00E+00
7-Jan-03	0.00E+00	7-Jan-04	0.00E+00	7-Jan-05	0.00E+00	7-Jan-06	0.00E+00	7-Jan-07	4.73E-03	7-Jan-08	0.00E+00
8-Jan-03	0.00E+00	8-Jan-04	0.00E+00	8-Jan-05	0.00E+00	8-Jan-06	0.00E+00	8-Jan-07	1.88E-03	8-Jan-08	0.00E+00
9-Jan-03	0.00E+00	9-Jan-04	0.00E+00	9-Jan-05	0.00E+00	9-Jan-06	0.00E+00	9-Jan-07	0.00E+00	9-Jan-08	0.00E+00
10-Jan-03	0.00E+00	10-Jan-04	0.00E+00	10-Jan-05	0.00E+00	10-Jan-06	0.00E+00	10-Jan-07	0.00E+00	10-Jan-08	0.00E+00
11-Jan-03	0.00E+00	11-Jan-04	0.00E+00	11-Jan-05	0.00E+00	11-Jan-06	0.00E+00	11-Jan-07	0.00E+00	11-Jan-08	0.00E+00
12-Jan-03	0.00E+00	12-Jan-04	0.00E+00	12-Jan-05	0.00E+00	12-Jan-06	0.00E+00	12-Jan-07	0.00E+00	12-Jan-08	0.00E+00
13-Jan-03	0.00E+00	13-Jan-04	0.00E+00	13-Jan-05	0.00E+00	13-Jan-06	0.00E+00	13-Jan-07	0.00E+00	13-Jan-08	0.00E+00
14-Jan-03	0.00E+00	14-Jan-04	0.00E+00	14-Jan-05	0.00E+00	14-Jan-06	0.00E+00	14-Jan-07	0.00E+00	14-Jan-08	0.00E+00
15-Jan-03	0.00E+00	15-Jan-04	0.00E+00	15-Jan-05	0.00E+00	15-Jan-06	0.00E+00	15-Jan-07	0.00E+00	15-Jan-08	0.00E+00
16-Jan-03	0.00E+00	16-Jan-04	0.00E+00	16-Jan-05	0.00E+00	16-Jan-06	0.00E+00	16-Jan-07	0.00E+00	16-Jan-08	0.00E+00
17-Jan-03	0.00E+00	17-Jan-04	0.00E+00	17-Jan-05	0.00E+00	17-Jan-06	0.00E+00	17-Jan-07	0.00E+00	17-Jan-08	0.00E+00
18-Jan-03	0.00E+00	18-Jan-04	0.00E+00	18-Jan-05	0.00E+00	18-Jan-06	0.00E+00	18-Jan-07	0.00E+00	18-Jan-08	0.00E+00
19-Jan-03	0.00E+00	19-Jan-04	0.00E+00	19-Jan-05	0.00E+00	19-Jan-06	0.00E+00	19-Jan-07	0.00E+00	19-Jan-08	0.00E+00
20-Jan-03	0.00E+00	20-Jan-04	0.00E+00	20-Jan-05	0.00E+00	20-Jan-06	0.00E+00	20-Jan-07	0.00E+00	20-Jan-08	0.00E+00
21-Jan-03	0.00E+00	21-Jan-04	0.00E+00	21-Jan-05	0.00E+00	21-Jan-06	0.00E+00	21-Jan-07	0.00E+00	21-Jan-08	0.00E+00
22-Jan-03	0.00E+00	22-Jan-04	0.00E+00	22-Jan-05	0.00E+00	22-Jan-06	0.00E+00	22-Jan-07	0.00E+00	22-Jan-08	0.00E+00
23-Jan-03	0.00E+00	23-Jan-04	0.00E+00	23-Jan-05	0.00E+00	23-Jan-06	0.00E+00	23-Jan-07	0.00E+00	23-Jan-08	0.00E+00
24-Jan-03	0.00E+00	24-Jan-04	0.00E+00	24-Jan-05	0.00E+00	24-Jan-06	0.00E+00	24-Jan-07	0.00E+00	24-Jan-08	3.35E-02
25-Jan-03	0.00E+00	25-Jan-04	0.00E+00	25-Jan-05	0.00E+00	25-Jan-06	0.00E+00	25-Jan-07	0.00E+00	25-Jan-08	6.90E-03
26-Jan-03	0.00E+00	26-Jan-04	0.00E+00	26-Jan-05	0.00E+00	26-Jan-06	0.00E+00	26-Jan-07	0.00E+00	26-Jan-08	0.00E+00
27-Jan-03	0.00E+00	27-Jan-04	0.00E+00	27-Jan-05	0.00E+00	27-Jan-06	0.00E+00	27-Jan-07	0.00E+00	27-Jan-08	1.30E-03
28-Jan-03	0.00E+00	28-Jan-04	0.00E+00	28-Jan-05	0.00E+00	28-Jan-06	0.00E+00	28-Jan-07	0.00E+00	28-Jan-08	0.00E+00
29-Jan-03	0.00E+00	29-Jan-04	0.00E+00	29-Jan-05	0.00E+00	29-Jan-06	0.00E+00	29-Jan-07	0.00E+00	29-Jan-08	0.00E+00
30-Jan-03	0.00E+00	30-Jan-04	0.00E+00	30-Jan-05	0.00E+00	30-Jan-06	0.00E+00	30-Jan-07	0.00E+00	30-Jan-08	1.20E-02
31-Jan-03	0.00E+00	31-Jan-04	0.00E+00	31-Jan-05	0.00E+00	31-Jan-06	0.00E+00	31-Jan-07	0.00E+00	31-Jan-08	8.86E-03
1-Feb-03	0.00E+00	1-Feb-04	0.00E+00	1-Feb-05	0.00E+00	1-Feb-06	0.00E+00	1-Feb-07	0.00E+00	1-Feb-08	0.00E+00

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
2-Feb-03	0.00E+00	2-Feb-04	0.00E+00	2-Feb-05	0.00E+00	2-Feb-06	0.00E+00	2-Feb-07	5.39E-02	2-Feb-08	1.12E-03
3-Feb-03	0.00E+00	3-Feb-04	0.00E+00	3-Feb-05	0.00E+00	3-Feb-06	0.00E+00	3-Feb-07	2.18E-02	3-Feb-08	9.98E-04
4-Feb-03	0.00E+00	4-Feb-04	0.00E+00	4-Feb-05	0.00E+00	4-Feb-06	0.00E+00	4-Feb-07	0.00E+00	4-Feb-08	0.00E+00
5-Feb-03	0.00E+00	5-Feb-04	0.00E+00	5-Feb-05	0.00E+00	5-Feb-06	9.35E-02	5-Feb-07	0.00E+00	5-Feb-08	0.00E+00
6-Feb-03	0.00E+00	6-Feb-04	0.00E+00	6-Feb-05	0.00E+00	6-Feb-06	3.30E-02	6-Feb-07	0.00E+00	6-Feb-08	0.00E+00
7-Feb-03	0.00E+00	7-Feb-04	0.00E+00	7-Feb-05	0.00E+00	7-Feb-06	4.64E-03	7-Feb-07	0.00E+00	7-Feb-08	0.00E+00
8-Feb-03	0.00E+00	8-Feb-04	0.00E+00	8-Feb-05	0.00E+00	8-Feb-06	5.82E-03	8-Feb-07	0.00E+00	8-Feb-08	0.00E+00
9-Feb-03	0.00E+00	9-Feb-04	0.00E+00	9-Feb-05	0.00E+00	9-Feb-06	9.40E-03	9-Feb-07	0.00E+00	9-Feb-08	0.00E+00
10-Feb-03	0.00E+00	10-Feb-04	0.00E+00	10-Feb-05	0.00E+00	10-Feb-06	5.76E-03	10-Feb-07	0.00E+00	10-Feb-08	0.00E+00
11-Feb-03	0.00E+00	11-Feb-04	0.00E+00	11-Feb-05	0.00E+00	11-Feb-06	1.53E-03	11-Feb-07	0.00E+00	11-Feb-08	0.00E+00
12-Feb-03	1.10E-02	12-Feb-04	0.00E+00	12-Feb-05	0.00E+00	12-Feb-06	4.16E-03	12-Feb-07	0.00E+00	12-Feb-08	0.00E+00
13-Feb-03	0.00E+00	13-Feb-04	0.00E+00	13-Feb-05	0.00E+00	13-Feb-06	2.40E-03	13-Feb-07	0.00E+00	13-Feb-08	0.00E+00
14-Feb-03	0.00E+00	14-Feb-04	0.00E+00	14-Feb-05	0.00E+00	14-Feb-06	1.23E-03	14-Feb-07	0.00E+00	14-Feb-08	0.00E+00
15-Feb-03	0.00E+00	15-Feb-04	0.00E+00	15-Feb-05	0.00E+00	15-Feb-06	0.00E+00	15-Feb-07	0.00E+00	15-Feb-08	0.00E+00
16-Feb-03	0.00E+00	16-Feb-04	0.00E+00	16-Feb-05	0.00E+00	16-Feb-06	0.00E+00	16-Feb-07	0.00E+00	16-Feb-08	0.00E+00
17-Feb-03	2.62E-02	17-Feb-04	0.00E+00	17-Feb-05	0.00E+00	17-Feb-06	0.00E+00	17-Feb-07	0.00E+00	17-Feb-08	0.00E+00
18-Feb-03	1.25E-02	18-Feb-04	0.00E+00	18-Feb-05	0.00E+00	18-Feb-06	0.00E+00	18-Feb-07	0.00E+00	18-Feb-08	0.00E+00
19-Feb-03	2.82E-02	19-Feb-04	0.00E+00	19-Feb-05	0.00E+00	19-Feb-06	0.00E+00	19-Feb-07	0.00E+00	19-Feb-08	0.00E+00
20-Feb-03	1.24E-02	20-Feb-04	0.00E+00	20-Feb-05	0.00E+00	20-Feb-06	0.00E+00	20-Feb-07	0.00E+00	20-Feb-08	0.00E+00
21-Feb-03	2.31E-03	21-Feb-04	0.00E+00	21-Feb-05	0.00E+00	21-Feb-06	0.00E+00	21-Feb-07	3.92E-02	21-Feb-08	0.00E+00
22-Feb-03	0.00E+00	22-Feb-04	0.00E+00	22-Feb-05	0.00E+00	22-Feb-06	0.00E+00	22-Feb-07	3.90E-03	22-Feb-08	0.00E+00
23-Feb-03	0.00E+00	23-Feb-04	0.00E+00	23-Feb-05	0.00E+00	23-Feb-06	0.00E+00	23-Feb-07	0.00E+00	23-Feb-08	0.00E+00
24-Feb-03	3.47E-02	24-Feb-04	0.00E+00	24-Feb-05	0.00E+00	24-Feb-06	0.00E+00	24-Feb-07	2.95E-03	24-Feb-08	0.00E+00
25-Feb-03	1.45E-02	25-Feb-04	8.39E-02	25-Feb-05	0.00E+00	25-Feb-06	0.00E+00	25-Feb-07	0.00E+00	25-Feb-08	2.03E-02
26-Feb-03	0.00E+00	26-Feb-04	7.05E-02	26-Feb-05	0.00E+00	26-Feb-06	0.00E+00	26-Feb-07	0.00E+00	26-Feb-08	7.97E-03
27-Feb-03	0.00E+00	27-Feb-04	1.71E-02	27-Feb-05	0.00E+00	27-Feb-06	0.00E+00	27-Feb-07	0.00E+00	27-Feb-08	0.00E+00
28-Feb-03	0.00E+00	28-Feb-04	6.72E-03	28-Feb-05	0.00E+00	28-Feb-06	0.00E+00	28-Feb-07	0.00E+00	28-Feb-08	0.00E+00
1-Mar-03	2.79E-02	29-Feb-04	1.67E-03	1-Mar-05	0.00E+00	1-Mar-06	0.00E+00	1-Mar-07	1.77E-03	29-Feb-08	0.00E+00
2-Mar-03	8.37E-03	1-Mar-04	0.00E+00	2-Mar-05	0.00E+00	2-Mar-06	0.00E+00	2-Mar-07	0.00E+00	1-Mar-08	0.00E+00
3-Mar-03	3.53E-02	2-Mar-04	0.00E+00	3-Mar-05	0.00E+00	3-Mar-06	0.00E+00	3-Mar-07	1.41E-03	2-Mar-08	0.00E+00
4-Mar-03	8.25E-02	3-Mar-04	0.00E+00	4-Mar-05	0.00E+00	4-Mar-06	0.00E+00	4-Mar-07	0.00E+00	3-Mar-08	0.00E+00
5-Mar-03	5.73E-02	4-Mar-04	0.00E+00	5-Mar-05	4.13E-03	5-Mar-06	0.00E+00	5-Mar-07	2.58E-03	4-Mar-08	0.00E+00
6-Mar-03	7.12E-03	5-Mar-04	0.00E+00	6-Mar-05	3.25E-03	6-Mar-06	0.00E+00	6-Mar-07	7.55E-03	5-Mar-08	0.00E+00
7-Mar-03	3.95E-03	6-Mar-04	0.00E+00	7-Mar-05	1.23E-03	7-Mar-06	0.00E+00	7-Mar-07	3.64E-03	6-Mar-08	0.00E+00
8-Mar-03	0.00E+00	7-Mar-04	0.00E+00	8-Mar-05	3.45E-03	8-Mar-06	0.00E+00	8-Mar-07	0.00E+00	7-Mar-08	0.00E+00
9-Mar-03	2.22E-03	8-Mar-04	0.00E+00	9-Mar-05	0.00E+00	9-Mar-06	0.00E+00	9-Mar-07	0.00E+00	8-Mar-08	5.85E-02
10-Mar-03	2.27E-02	9-Mar-04	0.00E+00	10-Mar-05	0.00E+00	10-Mar-06	0.00E+00	10-Mar-07	0.00E+00	9-Mar-08	2.20E-02
11-Mar-03	0.00E+00	10-Mar-04	0.00E+00	11-Mar-05	0.00E+00	11-Mar-06	0.00E+00	11-Mar-07	0.00E+00	10-Mar-08	1.13E-02
12-Mar-03	0.00E+00	11-Mar-04	0.00E+00	12-Mar-05	0.00E+00	12-Mar-06	0.00E+00	12-Mar-07	0.00E+00	11-Mar-08	4.63E-03
13-Mar-03	0.00E+00	12-Mar-04	0.00E+00	13-Mar-05	0.00E+00	13-Mar-06	0.00E+00	13-Mar-07	0.00E+00	12-Mar-08	0.00E+00
14-Mar-03	0.00E+00	13-Mar-04	0.00E+00	14-Mar-05	0.00E+00	14-Mar-06	0.00E+00	14-Mar-07	0.00E+00	13-Mar-08	0.00E+00
15-Mar-03	0.00E+00	14-Mar-04	0.00E+00	15-Mar-05	0.00E+00	15-Mar-06	0.00E+00	15-Mar-07	0.00E+00	14-Mar-08	1.97E-03
16-Mar-03	2.66E-03	15-Mar-04	0.00E+00	16-Mar-05	0.00E+00	16-Mar-06	0.00E+00	16-Mar-07	0.00E+00	15-Mar-08	0.00E+00
17-Mar-03	0.00E+00	16-Mar-04	0.00E+00	17-Mar-05	0.00E+00	17-Mar-06	0.00E+00	17-Mar-07	1.45E-02	16-Mar-08	1.71E-03
18-Mar-03	0.00E+00	17-Mar-04	1.99E-02	18-Mar-05	0.00E+00	18-Mar-06	0.00E+00	18-Mar-07	0.00E+00	17-Mar-08	0.00E+00

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
19-Mar-03	0.00E+00	18-Mar-04	0.00E+00	19-Mar-05	0.00E+00	19-Mar-06	0.00E+00	19-Mar-07	0.00E+00	18-Mar-08	0.00E+00
20-Mar-03	0.00E+00	19-Mar-04	0.00E+00	20-Mar-05	0.00E+00	20-Mar-06	0.00E+00	20-Mar-07	0.00E+00	19-Mar-08	0.00E+00
21-Mar-03	0.00E+00	20-Mar-04	0.00E+00	21-Mar-05	0.00E+00	21-Mar-06	0.00E+00	21-Mar-07	0.00E+00	20-Mar-08	0.00E+00
22-Mar-03	0.00E+00	21-Mar-04	0.00E+00	22-Mar-05	0.00E+00	22-Mar-06	0.00E+00	22-Mar-07	0.00E+00	21-Mar-08	0.00E+00
23-Mar-03	0.00E+00	22-Mar-04	0.00E+00	23-Mar-05	0.00E+00	23-Mar-06	0.00E+00	23-Mar-07	0.00E+00	22-Mar-08	0.00E+00
24-Mar-03	0.00E+00	23-Mar-04	0.00E+00	24-Mar-05	0.00E+00	24-Mar-06	0.00E+00	24-Mar-07	0.00E+00	23-Mar-08	1.21E-03
25-Mar-03	0.00E+00	24-Mar-04	0.00E+00	25-Mar-05	2.37E-04	25-Mar-06	0.00E+00	25-Mar-07	0.00E+00	24-Mar-08	3.04E-04
26-Mar-03	0.00E+00	25-Mar-04	0.00E+00	26-Mar-05	8.01E-02	26-Mar-06	0.00E+00	26-Mar-07	0.00E+00	25-Mar-08	4.59E-04
27-Mar-03	0.00E+00	26-Mar-04	0.00E+00	27-Mar-05	3.75E-02	27-Mar-06	0.00E+00	27-Mar-07	0.00E+00	26-Mar-08	0.00E+00
28-Mar-03	0.00E+00	27-Mar-04	0.00E+00	28-Mar-05	6.80E-03	28-Mar-06	0.00E+00	28-Mar-07	0.00E+00	27-Mar-08	0.00E+00
29-Mar-03	0.00E+00	28-Mar-04	0.00E+00	29-Mar-05	0.00E+00	29-Mar-06	0.00E+00	29-Mar-07	0.00E+00	28-Mar-08	0.00E+00
30-Mar-03	0.00E+00	29-Mar-04	0.00E+00	30-Mar-05	0.00E+00	30-Mar-06	0.00E+00	30-Mar-07	0.00E+00	29-Mar-08	0.00E+00
31-Mar-03	0.00E+00	30-Mar-04	0.00E+00	31-Mar-05	0.00E+00	31-Mar-06	0.00E+00	31-Mar-07	0.00E+00	30-Mar-08	0.00E+00
1-Apr-03	0.00E+00	31-Mar-04	0.00E+00	1-Apr-05	8.74E-04	1-Apr-06	0.00E+00	1-Apr-07	0.00E+00	31-Mar-08	0.00E+00
2-Apr-03	0.00E+00	1-Apr-04	0.00E+00	2-Apr-05	1.90E-03	2-Apr-06	0.00E+00	2-Apr-07	0.00E+00	1-Apr-08	0.00E+00
3-Apr-03	0.00E+00	2-Apr-04	0.00E+00	3-Apr-05	4.33E-02	3-Apr-06	0.00E+00	3-Apr-07	0.00E+00	2-Apr-08	0.00E+00
4-Apr-03	0.00E+00	3-Apr-04	0.00E+00	4-Apr-05	0.00E+00	4-Apr-06	0.00E+00	4-Apr-07	0.00E+00	3-Apr-08	0.00E+00
5-Apr-03	0.00E+00	4-Apr-04	0.00E+00	5-Apr-05	0.00E+00	5-Apr-06	0.00E+00	5-Apr-07	0.00E+00	4-Apr-08	0.00E+00
6-Apr-03	0.00E+00	5-Apr-04	0.00E+00	6-Apr-05	0.00E+00	6-Apr-06	0.00E+00	6-Apr-07	0.00E+00	5-Apr-08	0.00E+00
7-Apr-03	0.00E+00	6-Apr-04	0.00E+00	7-Apr-05	3.91E-02	7-Apr-06	0.00E+00	7-Apr-07	0.00E+00	6-Apr-08	0.00E+00
8-Apr-03	0.00E+00	7-Apr-04	0.00E+00	8-Apr-05	1.99E-02	8-Apr-06	0.00E+00	8-Apr-07	0.00E+00	7-Apr-08	0.00E+00
9-Apr-03	0.00E+00	8-Apr-04	0.00E+00	9-Apr-05	0.00E+00	9-Apr-06	0.00E+00	9-Apr-07	0.00E+00	8-Apr-08	1.42E-02
10-Apr-03	0.00E+00	9-Apr-04	0.00E+00	10-Apr-05	0.00E+00	10-Apr-06	0.00E+00	10-Apr-07	0.00E+00	9-Apr-08	8.50E-03
11-Apr-03	0.00E+00	10-Apr-04	0.00E+00	11-Apr-05	0.00E+00	11-Apr-06	0.00E+00	11-Apr-07	0.00E+00	10-Apr-08	0.00E+00
12-Apr-03	0.00E+00	11-Apr-04	0.00E+00	12-Apr-05	0.00E+00	12-Apr-06	0.00E+00	12-Apr-07	0.00E+00	11-Apr-08	0.00E+00
13-Apr-03	0.00E+00	12-Apr-04	0.00E+00	13-Apr-05	0.00E+00	13-Apr-06	0.00E+00	13-Apr-07	0.00E+00	12-Apr-08	0.00E+00
14-Apr-03	0.00E+00	13-Apr-04	0.00E+00	14-Apr-05	0.00E+00	14-Apr-06	0.00E+00	14-Apr-07	0.00E+00	13-Apr-08	0.00E+00
15-Apr-03	0.00E+00	14-Apr-04	0.00E+00	15-Apr-05	2.31E-02	15-Apr-06	0.00E+00	15-Apr-07	0.00E+00	14-Apr-08	0.00E+00
16-Apr-03	0.00E+00	15-Apr-04	0.00E+00	16-Apr-05	0.00E+00	16-Apr-06	0.00E+00	16-Apr-07	0.00E+00	15-Apr-08	0.00E+00
17-Apr-03	0.00E+00	16-Apr-04	0.00E+00	17-Apr-05	0.00E+00	17-Apr-06	0.00E+00	17-Apr-07	0.00E+00	16-Apr-08	0.00E+00
18-Apr-03	0.00E+00	17-Apr-04	0.00E+00	18-Apr-05	0.00E+00	18-Apr-06	0.00E+00	18-Apr-07	0.00E+00	17-Apr-08	0.00E+00
19-Apr-03	0.00E+00	18-Apr-04	0.00E+00	19-Apr-05	0.00E+00	19-Apr-06	0.00E+00	19-Apr-07	0.00E+00	18-Apr-08	0.00E+00
20-Apr-03	0.00E+00	19-Apr-04	0.00E+00	20-Apr-05	0.00E+00	20-Apr-06	0.00E+00	20-Apr-07	1.32E-03	19-Apr-08	0.00E+00
21-Apr-03	0.00E+00	20-Apr-04	0.00E+00	21-Apr-05	0.00E+00	21-Apr-06	0.00E+00	21-Apr-07	0.00E+00	20-Apr-08	0.00E+00
22-Apr-03	0.00E+00	21-Apr-04	0.00E+00	22-Apr-05	0.00E+00	22-Apr-06	0.00E+00	22-Apr-07	0.00E+00	21-Apr-08	0.00E+00
23-Apr-03	0.00E+00	22-Apr-04	0.00E+00	23-Apr-05	0.00E+00	23-Apr-06	0.00E+00	23-Apr-07	0.00E+00	22-Apr-08	0.00E+00
24-Apr-03	0.00E+00	23-Apr-04	0.00E+00	24-Apr-05	0.00E+00	24-Apr-06	0.00E+00	24-Apr-07	0.00E+00	23-Apr-08	0.00E+00
25-Apr-03	0.00E+00	24-Apr-04	0.00E+00	25-Apr-05	0.00E+00	25-Apr-06	0.00E+00	25-Apr-07	0.00E+00	24-Apr-08	0.00E+00
26-Apr-03	0.00E+00	25-Apr-04	0.00E+00	26-Apr-05	0.00E+00	26-Apr-06	0.00E+00	26-Apr-07	0.00E+00	25-Apr-08	0.00E+00
27-Apr-03	0.00E+00	26-Apr-04	0.00E+00	27-Apr-05	0.00E+00	27-Apr-06	0.00E+00	27-Apr-07	0.00E+00	26-Apr-08	0.00E+00
28-Apr-03	0.00E+00	27-Apr-04	0.00E+00	28-Apr-05	0.00E+00	28-Apr-06	0.00E+00	28-Apr-07	0.00E+00	27-Apr-08	0.00E+00
29-Apr-03	0.00E+00	28-Apr-04	0.00E+00	29-Apr-05	0.00E+00	29-Apr-06	0.00E+00	29-Apr-07	0.00E+00	28-Apr-08	0.00E+00
30-Apr-03	0.00E+00	29-Apr-04	0.00E+00	30-Apr-05	0.00E+00	30-Apr-06	0.00E+00	30-Apr-07	2.44E-04	29-Apr-08	0.00E+00
1-May-03	0.00E+00	30-Apr-04	0.00E+00	1-May-05	0.00E+00	1-May-06	0.00E+00	1-May-07	0.00E+00	30-Apr-08	0.00E+00
2-May-03	0.00E+00	1-May-04	0.00E+00	2-May-05	0.00E+00	2-May-06	0.00E+00	2-May-07	0.00E+00	1-May-08	0.00E+00

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
3-May-03	0.00E+00	2-May-04	0.00E+00	3-May-05	0.00E+00	3-May-06	0.00E+00	3-May-07	0.00E+00	2-May-08	0.00E+00
4-May-03	0.00E+00	3-May-04	0.00E+00	4-May-05	0.00E+00	4-May-06	0.00E+00	4-May-07	0.00E+00	3-May-08	0.00E+00
5-May-03	0.00E+00	4-May-04	0.00E+00	5-May-05	0.00E+00	5-May-06	0.00E+00	5-May-07	0.00E+00	4-May-08	0.00E+00
6-May-03	0.00E+00	5-May-04	0.00E+00	6-May-05	0.00E+00	6-May-06	0.00E+00	6-May-07	0.00E+00	5-May-08	0.00E+00
7-May-03	0.00E+00	6-May-04	0.00E+00	7-May-05	2.60E-03	7-May-06	0.00E+00	7-May-07	0.00E+00	6-May-08	0.00E+00
8-May-03	0.00E+00	7-May-04	0.00E+00	8-May-05	0.00E+00	8-May-06	0.00E+00	8-May-07	0.00E+00	7-May-08	0.00E+00
9-May-03	0.00E+00	8-May-04	0.00E+00	9-May-05	0.00E+00	9-May-06	0.00E+00	9-May-07	0.00E+00	8-May-08	0.00E+00
10-May-03	0.00E+00	9-May-04	0.00E+00	10-May-05	0.00E+00	10-May-06	0.00E+00	10-May-07	0.00E+00	9-May-08	0.00E+00
11-May-03	0.00E+00	10-May-04	0.00E+00	11-May-05	0.00E+00	11-May-06	0.00E+00	11-May-07	0.00E+00	10-May-08	0.00E+00
12-May-03	0.00E+00	11-May-04	0.00E+00	12-May-05	0.00E+00	12-May-06	0.00E+00	12-May-07	0.00E+00	11-May-08	0.00E+00
13-May-03	0.00E+00	12-May-04	0.00E+00	13-May-05	0.00E+00	13-May-06	0.00E+00	13-May-07	0.00E+00	12-May-08	0.00E+00
14-May-03	0.00E+00	13-May-04	0.00E+00	14-May-05	0.00E+00	14-May-06	0.00E+00	14-May-07	0.00E+00	13-May-08	0.00E+00
15-May-03	0.00E+00	14-May-04	0.00E+00	15-May-05	0.00E+00	15-May-06	0.00E+00	15-May-07	0.00E+00	14-May-08	0.00E+00
16-May-03	0.00E+00	15-May-04	0.00E+00	16-May-05	0.00E+00	16-May-06	0.00E+00	16-May-07	0.00E+00	15-May-08	0.00E+00
17-May-03	0.00E+00	16-May-04	0.00E+00	17-May-05	0.00E+00	17-May-06	0.00E+00	17-May-07	0.00E+00	16-May-08	0.00E+00
18-May-03	0.00E+00	17-May-04	0.00E+00	18-May-05	0.00E+00	18-May-06	0.00E+00	18-May-07	0.00E+00	17-May-08	0.00E+00
19-May-03	0.00E+00	18-May-04	0.00E+00	19-May-05	0.00E+00	19-May-06	0.00E+00	19-May-07	0.00E+00	18-May-08	0.00E+00
20-May-03	0.00E+00	19-May-04	0.00E+00	20-May-05	0.00E+00	20-May-06	0.00E+00	20-May-07	0.00E+00	19-May-08	0.00E+00
21-May-03	0.00E+00	20-May-04	0.00E+00	21-May-05	0.00E+00	21-May-06	0.00E+00	21-May-07	0.00E+00	20-May-08	0.00E+00
22-May-03	0.00E+00	21-May-04	0.00E+00	22-May-05	0.00E+00	22-May-06	0.00E+00	22-May-07	0.00E+00	21-May-08	0.00E+00
23-May-03	0.00E+00	22-May-04	0.00E+00	23-May-05	0.00E+00	23-May-06	0.00E+00	23-May-07	0.00E+00	22-May-08	0.00E+00
24-May-03	0.00E+00	23-May-04	0.00E+00	24-May-05	0.00E+00	24-May-06	0.00E+00	24-May-07	0.00E+00	23-May-08	0.00E+00
25-May-03	0.00E+00	24-May-04	0.00E+00	25-May-05	0.00E+00	25-May-06	0.00E+00	25-May-07	0.00E+00	24-May-08	0.00E+00
26-May-03	0.00E+00	25-May-04	0.00E+00	26-May-05	0.00E+00	26-May-06	0.00E+00	26-May-07	0.00E+00	25-May-08	0.00E+00
27-May-03	0.00E+00	26-May-04	0.00E+00	27-May-05	0.00E+00	27-May-06	0.00E+00	27-May-07	0.00E+00	26-May-08	0.00E+00
28-May-03	0.00E+00	27-May-04	0.00E+00	28-May-05	0.00E+00	28-May-06	0.00E+00	28-May-07	0.00E+00	27-May-08	0.00E+00
29-May-03	0.00E+00	28-May-04	0.00E+00	29-May-05	0.00E+00	29-May-06	0.00E+00	29-May-07	0.00E+00	28-May-08	0.00E+00
30-May-03	0.00E+00	29-May-04	0.00E+00	30-May-05	0.00E+00	30-May-06	0.00E+00	30-May-07	0.00E+00	29-May-08	0.00E+00
31-May-03	0.00E+00	30-May-04	0.00E+00	31-May-05	0.00E+00	31-May-06	0.00E+00	31-May-07	0.00E+00	30-May-08	0.00E+00
1-Jun-03	0.00E+00	31-May-04	0.00E+00	1-Jun-05	0.00E+00	1-Jun-06	0.00E+00	1-Jun-07	0.00E+00	31-May-08	0.00E+00
2-Jun-03	0.00E+00	1-Jun-04	0.00E+00	2-Jun-05	0.00E+00	2-Jun-06	0.00E+00	2-Jun-07	0.00E+00	1-Jun-08	0.00E+00
3-Jun-03	0.00E+00	2-Jun-04	0.00E+00	3-Jun-05	0.00E+00	3-Jun-06	0.00E+00	3-Jun-07	0.00E+00	2-Jun-08	0.00E+00
4-Jun-03	0.00E+00	3-Jun-04	0.00E+00	4-Jun-05	0.00E+00	4-Jun-06	0.00E+00	4-Jun-07	0.00E+00	3-Jun-08	0.00E+00
5-Jun-03	0.00E+00	4-Jun-04	0.00E+00	5-Jun-05	0.00E+00	5-Jun-06	0.00E+00	5-Jun-07	0.00E+00	4-Jun-08	0.00E+00
6-Jun-03	0.00E+00	5-Jun-04	0.00E+00	6-Jun-05	0.00E+00	6-Jun-06	0.00E+00	6-Jun-07	0.00E+00	5-Jun-08	0.00E+00
7-Jun-03	0.00E+00	6-Jun-04	0.00E+00	7-Jun-05	0.00E+00	7-Jun-06	0.00E+00	7-Jun-07	0.00E+00	6-Jun-08	0.00E+00
8-Jun-03	0.00E+00	7-Jun-04	0.00E+00	8-Jun-05	0.00E+00	8-Jun-06	0.00E+00	8-Jun-07	0.00E+00	7-Jun-08	0.00E+00
9-Jun-03	3.18E-02	8-Jun-04	0.00E+00	9-Jun-05	0.00E+00	9-Jun-06	0.00E+00	9-Jun-07	0.00E+00	8-Jun-08	0.00E+00
10-Jun-03	1.00E-02	9-Jun-04	0.00E+00	10-Jun-05	0.00E+00	10-Jun-06	0.00E+00	10-Jun-07	0.00E+00	9-Jun-08	0.00E+00
11-Jun-03	0.00E+00	10-Jun-04	0.00E+00	11-Jun-05	0.00E+00	11-Jun-06	0.00E+00	11-Jun-07	0.00E+00	10-Jun-08	0.00E+00
12-Jun-03	0.00E+00	11-Jun-04	0.00E+00	12-Jun-05	0.00E+00	12-Jun-06	0.00E+00	12-Jun-07	0.00E+00	11-Jun-08	0.00E+00
13-Jun-03	0.00E+00	12-Jun-04	0.00E+00	13-Jun-05	0.00E+00	13-Jun-06	0.00E+00	13-Jun-07	0.00E+00	12-Jun-08	0.00E+00
14-Jun-03	0.00E+00	13-Jun-04	0.00E+00	14-Jun-05	0.00E+00	14-Jun-06	0.00E+00	14-Jun-07	0.00E+00	13-Jun-08	0.00E+00
15-Jun-03	0.00E+00	14-Jun-04	0.00E+00	15-Jun-05	0.00E+00	15-Jun-06	1.25E-02	15-Jun-07	0.00E+00	14-Jun-08	0.00E+00
16-Jun-03	0.00E+00	15-Jun-04	0.00E+00	16-Jun-05	0.00E+00	16-Jun-06	0.00E+00	16-Jun-07	0.00E+00	15-Jun-08	0.00E+00

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
17-Jun-03	0.00E+00	16-Jun-04	0.00E+00	17-Jun-05	0.00E+00	17-Jun-06	0.00E+00	17-Jun-07	0.00E+00	16-Jun-08	0.00E+00
18-Jun-03	2.26E-02	17-Jun-04	0.00E+00	18-Jun-05	0.00E+00	18-Jun-06	0.00E+00	18-Jun-07	0.00E+00	17-Jun-08	0.00E+00
19-Jun-03	2.02E-02	18-Jun-04	0.00E+00	19-Jun-05	0.00E+00	19-Jun-06	0.00E+00	19-Jun-07	0.00E+00	18-Jun-08	0.00E+00
20-Jun-03	9.81E-02	19-Jun-04	0.00E+00	20-Jun-05	0.00E+00	20-Jun-06	0.00E+00	20-Jun-07	0.00E+00	19-Jun-08	0.00E+00
21-Jun-03	6.81E-02	20-Jun-04	0.00E+00	21-Jun-05	0.00E+00	21-Jun-06	0.00E+00	21-Jun-07	0.00E+00	20-Jun-08	0.00E+00
22-Jun-03	3.64E-02	21-Jun-04	0.00E+00	22-Jun-05	0.00E+00	22-Jun-06	0.00E+00	22-Jun-07	0.00E+00	21-Jun-08	0.00E+00
23-Jun-03	1.06E-02	22-Jun-04	0.00E+00	23-Jun-05	3.94E-02	23-Jun-06	7.44E-04	23-Jun-07	0.00E+00	22-Jun-08	0.00E+00
24-Jun-03	1.25E-02	23-Jun-04	0.00E+00	24-Jun-05	0.00E+00	24-Jun-06	0.00E+00	24-Jun-07	0.00E+00	23-Jun-08	0.00E+00
25-Jun-03	0.00E+00	24-Jun-04	0.00E+00	25-Jun-05	9.78E-03	25-Jun-06	0.00E+00	25-Jun-07	0.00E+00	24-Jun-08	0.00E+00
26-Jun-03	0.00E+00	25-Jun-04	0.00E+00	26-Jun-05	1.20E-02	26-Jun-06	0.00E+00	26-Jun-07	0.00E+00	25-Jun-08	0.00E+00
27-Jun-03	0.00E+00	26-Jun-04	0.00E+00	27-Jun-05	0.00E+00	27-Jun-06	0.00E+00	27-Jun-07	0.00E+00	26-Jun-08	0.00E+00
28-Jun-03	0.00E+00	27-Jun-04	0.00E+00	28-Jun-05	0.00E+00	28-Jun-06	0.00E+00	28-Jun-07	0.00E+00	27-Jun-08	0.00E+00
29-Jun-03	0.00E+00	28-Jun-04	0.00E+00	29-Jun-05	0.00E+00	29-Jun-06	0.00E+00	29-Jun-07	0.00E+00	28-Jun-08	0.00E+00
30-Jun-03	0.00E+00	29-Jun-04	3.58E-02	30-Jun-05	0.00E+00	30-Jun-06	0.00E+00	30-Jun-07	0.00E+00	29-Jun-08	0.00E+00
1-Jul-03	0.00E+00	30-Jun-04	4.68E-02	1-Jul-05	0.00E+00	1-Jul-06	0.00E+00	1-Jul-07	0.00E+00	30-Jun-08	0.00E+00
2-Jul-03	0.00E+00	1-Jul-04	1.00E-02	2-Jul-05	8.91E-03	2-Jul-06	0.00E+00	2-Jul-07	0.00E+00	1-Jul-08	0.00E+00
3-Jul-03	0.00E+00	2-Jul-04	0.00E+00	3-Jul-05	2.23E-02	3-Jul-06	5.63E-03	3-Jul-07	0.00E+00	2-Jul-08	0.00E+00
4-Jul-03	0.00E+00	3-Jul-04	0.00E+00	4-Jul-05	0.00E+00	4-Jul-06	4.78E-03	4-Jul-07	0.00E+00	3-Jul-08	0.00E+00
5-Jul-03	0.00E+00	4-Jul-04	0.00E+00	5-Jul-05	0.00E+00	5-Jul-06	3.24E-03	5-Jul-07	0.00E+00	4-Jul-08	0.00E+00
6-Jul-03	0.00E+00	5-Jul-04	0.00E+00	6-Jul-05	0.00E+00	6-Jul-06	2.24E-03	6-Jul-07	0.00E+00	5-Jul-08	0.00E+00
7-Jul-03	0.00E+00	6-Jul-04	0.00E+00	7-Jul-05	0.00E+00	7-Jul-06	0.00E+00	7-Jul-07	0.00E+00	6-Jul-08	0.00E+00
8-Jul-03	0.00E+00	7-Jul-04	0.00E+00	8-Jul-05	0.00E+00	8-Jul-06	8.83E-04	8-Jul-07	0.00E+00	7-Jul-08	0.00E+00
9-Jul-03	0.00E+00	8-Jul-04	0.00E+00	9-Jul-05	0.00E+00	9-Jul-06	2.84E-03	9-Jul-07	0.00E+00	8-Jul-08	0.00E+00
10-Jul-03	0.00E+00	9-Jul-04	0.00E+00	10-Jul-05	3.64E-02	10-Jul-06	0.00E+00	10-Jul-07	0.00E+00	9-Jul-08	0.00E+00
11-Jul-03	0.00E+00	10-Jul-04	3.48E-03	11-Jul-05	8.34E-02	11-Jul-06	0.00E+00	11-Jul-07	0.00E+00	10-Jul-08	0.00E+00
12-Jul-03	0.00E+00	11-Jul-04	9.16E-04	12-Jul-05	0.00E+00	12-Jul-06	0.00E+00	12-Jul-07	0.00E+00	11-Jul-08	0.00E+00
13-Jul-03	0.00E+00	12-Jul-04	0.00E+00	13-Jul-05	8.92E-03	13-Jul-06	0.00E+00	13-Jul-07	0.00E+00	12-Jul-08	0.00E+00
14-Jul-03	0.00E+00	13-Jul-04	0.00E+00	14-Jul-05	3.04E-03	14-Jul-06	0.00E+00	14-Jul-07	0.00E+00	13-Jul-08	0.00E+00
15-Jul-03	0.00E+00	14-Jul-04	4.75E-03	15-Jul-05	0.00E+00	15-Jul-06	0.00E+00	15-Jul-07	0.00E+00	14-Jul-08	0.00E+00
16-Jul-03	0.00E+00	15-Jul-04	1.26E-02	16-Jul-05	0.00E+00	16-Jul-06	0.00E+00	16-Jul-07	0.00E+00	15-Jul-08	0.00E+00
17-Jul-03	0.00E+00	16-Jul-04	4.02E-03	17-Jul-05	4.28E-03	17-Jul-06	0.00E+00	17-Jul-07	0.00E+00	16-Jul-08	0.00E+00
18-Jul-03	0.00E+00	17-Jul-04	6.87E-03	18-Jul-05	0.00E+00	18-Jul-06	0.00E+00	18-Jul-07	0.00E+00	17-Jul-08	0.00E+00
19-Jul-03	0.00E+00	18-Jul-04	6.56E-02	19-Jul-05	0.00E+00	19-Jul-06	0.00E+00	19-Jul-07	0.00E+00	18-Jul-08	0.00E+00
20-Jul-03	0.00E+00	19-Jul-04	6.91E-02	20-Jul-05	0.00E+00	20-Jul-06	0.00E+00	20-Jul-07	0.00E+00	19-Jul-08	0.00E+00
21-Jul-03	0.00E+00	20-Jul-04	1.03E-01	21-Jul-05	0.00E+00	21-Jul-06	0.00E+00	21-Jul-07	0.00E+00	20-Jul-08	0.00E+00
22-Jul-03	0.00E+00	21-Jul-04	4.30E-02	22-Jul-05	0.00E+00	22-Jul-06	0.00E+00	22-Jul-07	0.00E+00	21-Jul-08	0.00E+00
23-Jul-03	0.00E+00	22-Jul-04	3.13E-03	23-Jul-05	0.00E+00	23-Jul-06	0.00E+00	23-Jul-07	0.00E+00	22-Jul-08	0.00E+00
24-Jul-03	0.00E+00	23-Jul-04	0.00E+00	24-Jul-05	0.00E+00	24-Jul-06	0.00E+00	24-Jul-07	0.00E+00	23-Jul-08	0.00E+00
25-Jul-03	0.00E+00	24-Jul-04	3.57E-02	25-Jul-05	0.00E+00	25-Jul-06	0.00E+00	25-Jul-07	0.00E+00	24-Jul-08	0.00E+00
26-Jul-03	0.00E+00	25-Jul-04	2.26E-03	26-Jul-05	0.00E+00	26-Jul-06	0.00E+00	26-Jul-07	0.00E+00	25-Jul-08	0.00E+00
27-Jul-03	0.00E+00	26-Jul-04	2.15E-02	27-Jul-05	0.00E+00	27-Jul-06	0.00E+00	27-Jul-07	0.00E+00	26-Jul-08	0.00E+00
28-Jul-03	0.00E+00	27-Jul-04	3.78E-03	28-Jul-05	0.00E+00	28-Jul-06	0.00E+00	28-Jul-07	0.00E+00	27-Jul-08	0.00E+00
29-Jul-03	0.00E+00	28-Jul-04	3.88E-03	29-Jul-05	0.00E+00	29-Jul-06	0.00E+00	29-Jul-07	0.00E+00	28-Jul-08	0.00E+00
30-Jul-03	0.00E+00	29-Jul-04	1.44E-02	30-Jul-05	0.00E+00	30-Jul-06	0.00E+00	30-Jul-07	0.00E+00	29-Jul-08	0.00E+00
31-Jul-03	0.00E+00	30-Jul-04	0.00E+00	31-Jul-05	0.00E+00	31-Jul-06	0.00E+00	31-Jul-07	0.00E+00	30-Jul-08	0.00E+00

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
1-Aug-03	0.00E+00	31-Jul-04	0.00E+00	1-Aug-05	0.00E+00	1-Aug-06	0.00E+00	1-Aug-07	0.00E+00	31-Jul-08	0.00E+00
2-Aug-03	0.00E+00	1-Aug-04	0.00E+00	2-Aug-05	0.00E+00	2-Aug-06	0.00E+00	2-Aug-07	0.00E+00	1-Aug-08	2.63E-02
3-Aug-03	0.00E+00	2-Aug-04	0.00E+00	3-Aug-05	0.00E+00	3-Aug-06	0.00E+00	3-Aug-07	9.67E-02	2-Aug-08	2.59E-02
4-Aug-03	0.00E+00	3-Aug-04	0.00E+00	4-Aug-05	0.00E+00	4-Aug-06	0.00E+00	4-Aug-07	4.13E-02	3-Aug-08	9.83E-02
5-Aug-03	0.00E+00	4-Aug-04	0.00E+00	5-Aug-05	0.00E+00	5-Aug-06	0.00E+00	5-Aug-07	6.30E-03	4-Aug-08	2.55E-02
6-Aug-03	0.00E+00	5-Aug-04	0.00E+00	6-Aug-05	0.00E+00	6-Aug-06	0.00E+00	6-Aug-07	0.00E+00	5-Aug-08	0.00E+00
7-Aug-03	0.00E+00	6-Aug-04	0.00E+00	7-Aug-05	0.00E+00	7-Aug-06	0.00E+00	7-Aug-07	0.00E+00	6-Aug-08	0.00E+00
8-Aug-03	0.00E+00	7-Aug-04	0.00E+00	8-Aug-05	0.00E+00	8-Aug-06	0.00E+00	8-Aug-07	0.00E+00	7-Aug-08	0.00E+00
9-Aug-03	0.00E+00	8-Aug-04	0.00E+00	9-Aug-05	0.00E+00	9-Aug-06	0.00E+00	9-Aug-07	0.00E+00	8-Aug-08	0.00E+00
10-Aug-03	0.00E+00	9-Aug-04	0.00E+00	10-Aug-05	0.00E+00	10-Aug-06	0.00E+00	10-Aug-07	0.00E+00	9-Aug-08	0.00E+00
11-Aug-03	0.00E+00	10-Aug-04	0.00E+00	11-Aug-05	0.00E+00	11-Aug-06	0.00E+00	11-Aug-07	0.00E+00	10-Aug-08	0.00E+00
12-Aug-03	0.00E+00	11-Aug-04	0.00E+00	12-Aug-05	0.00E+00	12-Aug-06	0.00E+00	12-Aug-07	0.00E+00	11-Aug-08	0.00E+00
13-Aug-03	0.00E+00	12-Aug-04	0.00E+00	13-Aug-05	0.00E+00	13-Aug-06	0.00E+00	13-Aug-07	0.00E+00	12-Aug-08	0.00E+00
14-Aug-03	0.00E+00	13-Aug-04	0.00E+00	14-Aug-05	0.00E+00	14-Aug-06	0.00E+00	14-Aug-07	0.00E+00	13-Aug-08	0.00E+00
15-Aug-03	0.00E+00	14-Aug-04	0.00E+00	15-Aug-05	0.00E+00	15-Aug-06	0.00E+00	15-Aug-07	0.00E+00	14-Aug-08	0.00E+00
16-Aug-03	0.00E+00	15-Aug-04	0.00E+00	16-Aug-05	0.00E+00	16-Aug-06	0.00E+00	16-Aug-07	0.00E+00	15-Aug-08	0.00E+00
17-Aug-03	0.00E+00	16-Aug-04	0.00E+00	17-Aug-05	0.00E+00	17-Aug-06	0.00E+00	17-Aug-07	0.00E+00	16-Aug-08	0.00E+00
18-Aug-03	0.00E+00	17-Aug-04	0.00E+00	18-Aug-05	0.00E+00	18-Aug-06	0.00E+00	18-Aug-07	0.00E+00	17-Aug-08	1.10E-02
19-Aug-03	0.00E+00	18-Aug-04	0.00E+00	19-Aug-05	0.00E+00	19-Aug-06	0.00E+00	19-Aug-07	0.00E+00	18-Aug-08	5.61E-03
20-Aug-03	0.00E+00	19-Aug-04	0.00E+00	20-Aug-05	0.00E+00	20-Aug-06	0.00E+00	20-Aug-07	0.00E+00	19-Aug-08	3.23E-03
21-Aug-03	0.00E+00	20-Aug-04	0.00E+00	21-Aug-05	0.00E+00	21-Aug-06	0.00E+00	21-Aug-07	0.00E+00	20-Aug-08	1.67E-03
22-Aug-03	0.00E+00	21-Aug-04	0.00E+00	22-Aug-05	0.00E+00	22-Aug-06	0.00E+00	22-Aug-07	0.00E+00	21-Aug-08	0.00E+00
23-Aug-03	2.05E-02	22-Aug-04	0.00E+00	23-Aug-05	0.00E+00	23-Aug-06	0.00E+00	23-Aug-07	0.00E+00	22-Aug-08	0.00E+00
24-Aug-03	4.77E-03	23-Aug-04	0.00E+00	24-Aug-05	0.00E+00	24-Aug-06	0.00E+00	24-Aug-07	0.00E+00	23-Aug-08	1.22E-01
25-Aug-03	5.11E-03	24-Aug-04	0.00E+00	25-Aug-05	0.00E+00	25-Aug-06	0.00E+00	25-Aug-07	0.00E+00	24-Aug-08	1.20E-01
26-Aug-03	5.98E-03	25-Aug-04	0.00E+00	26-Aug-05	0.00E+00	26-Aug-06	0.00E+00	26-Aug-07	0.00E+00	25-Aug-08	1.99E-02
27-Aug-03	1.33E-03	26-Aug-04	0.00E+00	27-Aug-05	0.00E+00	27-Aug-06	0.00E+00	27-Aug-07	0.00E+00	26-Aug-08	0.00E+00
28-Aug-03	0.00E+00	27-Aug-04	0.00E+00	28-Aug-05	0.00E+00	28-Aug-06	0.00E+00	28-Aug-07	0.00E+00	27-Aug-08	0.00E+00
29-Aug-03	0.00E+00	28-Aug-04	0.00E+00	29-Aug-05	4.30E-02	29-Aug-06	0.00E+00	29-Aug-07	0.00E+00	28-Aug-08	0.00E+00
30-Aug-03	0.00E+00	29-Aug-04	0.00E+00	30-Aug-05	1.99E-02	30-Aug-06	2.88E-03	30-Aug-07	0.00E+00	29-Aug-08	0.00E+00
31-Aug-03	0.00E+00	30-Aug-04	0.00E+00	31-Aug-05	1.55E-02	31-Aug-06	4.27E-03	31-Aug-07	0.00E+00	30-Aug-08	0.00E+00
1-Sep-03	0.00E+00	31-Aug-04	0.00E+00	1-Sep-05	6.81E-02	1-Sep-06	0.00E+00	1-Sep-07	0.00E+00	31-Aug-08	0.00E+00
2-Sep-03	0.00E+00	1-Sep-04	0.00E+00	2-Sep-05	0.00E+00	2-Sep-06	0.00E+00	2-Sep-07	0.00E+00	1-Sep-08	0.00E+00
3-Sep-03	0.00E+00	2-Sep-04	0.00E+00	3-Sep-05	0.00E+00	3-Sep-06	0.00E+00	3-Sep-07	0.00E+00	2-Sep-08	0.00E+00
4-Sep-03	1.97E-02	3-Sep-04	0.00E+00	4-Sep-05	0.00E+00	4-Sep-06	0.00E+00	4-Sep-07	0.00E+00	3-Sep-08	0.00E+00
5-Sep-03	2.06E-02	4-Sep-04	0.00E+00	5-Sep-05	0.00E+00	5-Sep-06	0.00E+00	5-Sep-07	0.00E+00	4-Sep-08	0.00E+00
6-Sep-03	1.17E-02	5-Sep-04	0.00E+00	6-Sep-05	0.00E+00	6-Sep-06	3.07E-04	6-Sep-07	0.00E+00	5-Sep-08	0.00E+00
7-Sep-03	3.26E-03	6-Sep-04	8.15E-02	7-Sep-05	0.00E+00	7-Sep-06	2.45E-02	7-Sep-07	0.00E+00	6-Sep-08	0.00E+00
8-Sep-03	0.00E+00	7-Sep-04	1.40E-01	8-Sep-05	8.63E-03	8-Sep-06	2.28E-02	8-Sep-07	0.00E+00	7-Sep-08	0.00E+00
9-Sep-03	0.00E+00	8-Sep-04	1.09E-01	9-Sep-05	0.00E+00	9-Sep-06	1.10E-02	9-Sep-07	0.00E+00	8-Sep-08	0.00E+00
10-Sep-03	0.00E+00	9-Sep-04	0.00E+00	10-Sep-05	0.00E+00	10-Sep-06	3.75E-03	10-Sep-07	0.00E+00	9-Sep-08	0.00E+00
11-Sep-03	0.00E+00	10-Sep-04	0.00E+00	11-Sep-05	0.00E+00	11-Sep-06	9.21E-03	11-Sep-07	0.00E+00	10-Sep-08	0.00E+00
12-Sep-03	0.00E+00	11-Sep-04	0.00E+00	12-Sep-05	0.00E+00	12-Sep-06	0.00E+00	12-Sep-07	0.00E+00	11-Sep-08	0.00E+00
13-Sep-03	0.00E+00	12-Sep-04	0.00E+00	13-Sep-05	0.00E+00	13-Sep-06	4.77E-03	13-Sep-07	0.00E+00	12-Sep-08	0.00E+00
14-Sep-03	2.41E-03	13-Sep-04	0.00E+00	14-Sep-05	0.00E+00	14-Sep-06	4.25E-02	14-Sep-07	0.00E+00	13-Sep-08	0.00E+00

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
15-Sep-03	0.00E+00	14-Sep-04	2.11E-02	15-Sep-05	0.00E+00	15-Sep-06	0.00E+00	15-Sep-07	0.00E+00	14-Sep-08	0.00E+00
16-Sep-03	0.00E+00	15-Sep-04	1.08E-02	16-Sep-05	0.00E+00	16-Sep-06	0.00E+00	16-Sep-07	0.00E+00	15-Sep-08	0.00E+00
17-Sep-03	0.00E+00	16-Sep-04	3.94E-03	17-Sep-05	0.00E+00	17-Sep-06	0.00E+00	17-Sep-07	0.00E+00	16-Sep-08	0.00E+00
18-Sep-03	0.00E+00	17-Sep-04	2.76E-03	18-Sep-05	0.00E+00	18-Sep-06	4.36E-03	18-Sep-07	0.00E+00	17-Sep-08	0.00E+00
19-Sep-03	0.00E+00	18-Sep-04	0.00E+00	19-Sep-05	0.00E+00	19-Sep-06	1.13E-01	19-Sep-07	0.00E+00	18-Sep-08	0.00E+00
20-Sep-03	0.00E+00	19-Sep-04	0.00E+00	20-Sep-05	0.00E+00	20-Sep-06	1.23E-01	20-Sep-07	0.00E+00	19-Sep-08	0.00E+00
21-Sep-03	0.00E+00	20-Sep-04	0.00E+00	21-Sep-05	0.00E+00	21-Sep-06	1.20E-01	21-Sep-07	0.00E+00	20-Sep-08	0.00E+00
22-Sep-03	0.00E+00	21-Sep-04	2.44E-05	22-Sep-05	0.00E+00	22-Sep-06	5.58E-03	22-Sep-07	0.00E+00	21-Sep-08	0.00E+00
23-Sep-03	0.00E+00	22-Sep-04	2.90E-03	23-Sep-05	0.00E+00	23-Sep-06	0.00E+00	23-Sep-07	2.62E-03	22-Sep-08	0.00E+00
24-Sep-03	0.00E+00	23-Sep-04	1.53E-03	24-Sep-05	0.00E+00	24-Sep-06	0.00E+00	24-Sep-07	8.32E-03	23-Sep-08	0.00E+00
25-Sep-03	0.00E+00	24-Sep-04	0.00E+00	25-Sep-05	0.00E+00	25-Sep-06	0.00E+00	25-Sep-07	6.87E-03	24-Sep-08	0.00E+00
26-Sep-03	2.14E-02	25-Sep-04	0.00E+00	26-Sep-05	0.00E+00	26-Sep-06	0.00E+00	26-Sep-07	0.00E+00	25-Sep-08	0.00E+00
27-Sep-03	1.29E-02	26-Sep-04	1.06E-03	27-Sep-05	0.00E+00	27-Sep-06	0.00E+00	27-Sep-07	0.00E+00	26-Sep-08	0.00E+00
28-Sep-03	4.01E-03	27-Sep-04	7.29E-02	28-Sep-05	0.00E+00	28-Sep-06	0.00E+00	28-Sep-07	0.00E+00	27-Sep-08	0.00E+00
29-Sep-03	0.00E+00	28-Sep-04	2.31E-02	29-Sep-05	0.00E+00	29-Sep-06	0.00E+00	29-Sep-07	0.00E+00	28-Sep-08	0.00E+00
30-Sep-03	3.54E-03	29-Sep-04	1.43E-02	30-Sep-05	0.00E+00	30-Sep-06	0.00E+00	30-Sep-07	0.00E+00	29-Sep-08	0.00E+00
1-Oct-03	1.67E-03	30-Sep-04	8.15E-03	1-Oct-05	0.00E+00	1-Oct-06	0.00E+00	1-Oct-07	0.00E+00	30-Sep-08	0.00E+00
2-Oct-03	1.07E-02	1-Oct-04	6.48E-03	2-Oct-05	0.00E+00	2-Oct-06	0.00E+00	2-Oct-07	0.00E+00	1-Oct-08	0.00E+00
3-Oct-03	8.78E-03	2-Oct-04	2.50E-03	3-Oct-05	0.00E+00	3-Oct-06	0.00E+00	3-Oct-07	0.00E+00	2-Oct-08	0.00E+00
4-Oct-03	4.72E-03	3-Oct-04	0.00E+00	4-Oct-05	0.00E+00	4-Oct-06	0.00E+00	4-Oct-07	0.00E+00	3-Oct-08	0.00E+00
5-Oct-03	4.88E-03	4-Oct-04	0.00E+00	5-Oct-05	0.00E+00	5-Oct-06	0.00E+00	5-Oct-07	0.00E+00	4-Oct-08	0.00E+00
6-Oct-03	9.70E-04	5-Oct-04	0.00E+00	6-Oct-05	0.00E+00	6-Oct-06	0.00E+00	6-Oct-07	1.33E-03	5-Oct-08	0.00E+00
7-Oct-03	0.00E+00	6-Oct-04	0.00E+00	7-Oct-05	0.00E+00	7-Oct-06	0.00E+00	7-Oct-07	2.63E-03	6-Oct-08	0.00E+00
8-Oct-03	0.00E+00	7-Oct-04	0.00E+00	8-Oct-05	0.00E+00	8-Oct-06	0.00E+00	8-Oct-07	7.27E-03	7-Oct-08	0.00E+00
9-Oct-03	0.00E+00	8-Oct-04	0.00E+00	9-Oct-05	0.00E+00	9-Oct-06	0.00E+00	9-Oct-07	0.00E+00	8-Oct-08	0.00E+00
10-Oct-03	0.00E+00	9-Oct-04	0.00E+00	10-Oct-05	0.00E+00	10-Oct-06	0.00E+00	10-Oct-07	0.00E+00	9-Oct-08	0.00E+00
11-Oct-03	0.00E+00	10-Oct-04	0.00E+00	11-Oct-05	0.00E+00	11-Oct-06	0.00E+00	11-Oct-07	0.00E+00	10-Oct-08	0.00E+00
12-Oct-03	0.00E+00	11-Oct-04	0.00E+00	12-Oct-05	0.00E+00	12-Oct-06	0.00E+00	12-Oct-07	0.00E+00	11-Oct-08	0.00E+00
13-Oct-03	0.00E+00	12-Oct-04	0.00E+00	13-Oct-05	0.00E+00	13-Oct-06	0.00E+00	13-Oct-07	0.00E+00	12-Oct-08	0.00E+00
14-Oct-03	1.43E-03	13-Oct-04	0.00E+00	14-Oct-05	0.00E+00	14-Oct-06	0.00E+00	14-Oct-07	0.00E+00	13-Oct-08	0.00E+00
15-Oct-03	0.00E+00	14-Oct-04	0.00E+00	15-Oct-05	0.00E+00	15-Oct-06	0.00E+00	15-Oct-07	0.00E+00	14-Oct-08	0.00E+00
16-Oct-03	0.00E+00	15-Oct-04	0.00E+00	16-Oct-05	0.00E+00	16-Oct-06	0.00E+00	16-Oct-07	0.00E+00	15-Oct-08	0.00E+00
17-Oct-03	0.00E+00	16-Oct-04	0.00E+00	17-Oct-05	0.00E+00	17-Oct-06	0.00E+00	17-Oct-07	0.00E+00	16-Oct-08	0.00E+00
18-Oct-03	0.00E+00	17-Oct-04	0.00E+00	18-Oct-05	0.00E+00	18-Oct-06	0.00E+00	18-Oct-07	0.00E+00	17-Oct-08	0.00E+00
19-Oct-03	0.00E+00	18-Oct-04	0.00E+00	19-Oct-05	0.00E+00	19-Oct-06	0.00E+00	19-Oct-07	0.00E+00	18-Oct-08	0.00E+00
20-Oct-03	0.00E+00	19-Oct-04	0.00E+00	20-Oct-05	0.00E+00	20-Oct-06	0.00E+00	20-Oct-07	0.00E+00	19-Oct-08	0.00E+00
21-Oct-03	0.00E+00	20-Oct-04	0.00E+00	21-Oct-05	0.00E+00	21-Oct-06	0.00E+00	21-Oct-07	0.00E+00	20-Oct-08	0.00E+00
22-Oct-03	0.00E+00	21-Oct-04	0.00E+00	22-Oct-05	0.00E+00	22-Oct-06	0.00E+00	22-Oct-07	0.00E+00	21-Oct-08	0.00E+00
23-Oct-03	0.00E+00	22-Oct-04	0.00E+00	23-Oct-05	0.00E+00	23-Oct-06	0.00E+00	23-Oct-07	0.00E+00	22-Oct-08	0.00E+00
24-Oct-03	0.00E+00	23-Oct-04	0.00E+00	24-Oct-05	0.00E+00	24-Oct-06	0.00E+00	24-Oct-07	0.00E+00	23-Oct-08	0.00E+00
25-Oct-03	0.00E+00	24-Oct-04	0.00E+00	25-Oct-05	0.00E+00	25-Oct-06	0.00E+00	25-Oct-07	0.00E+00	24-Oct-08	0.00E+00
26-Oct-03	0.00E+00	25-Oct-04	0.00E+00	26-Oct-05	0.00E+00	26-Oct-06	0.00E+00	26-Oct-07	0.00E+00	25-Oct-08	0.00E+00
27-Oct-03	0.00E+00	26-Oct-04	0.00E+00	27-Oct-05	0.00E+00	27-Oct-06	0.00E+00	27-Oct-07	0.00E+00	26-Oct-08	0.00E+00
28-Oct-03	0.00E+00	27-Oct-04	0.00E+00	28-Oct-05	0.00E+00	28-Oct-06	0.00E+00	28-Oct-07	0.00E+00	27-Oct-08	0.00E+00
29-Oct-03	0.00E+00	28-Oct-04	0.00E+00	29-Oct-05	0.00E+00	29-Oct-06	0.00E+00	29-Oct-07	0.00E+00	28-Oct-08	0.00E+00

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
30-Oct-03	9.30E-03	29-Oct-04	0.00E+00	30-Oct-05	0.00E+00	30-Oct-06	0.00E+00	30-Oct-07	0.00E+00	29-Oct-08	0.00E+00
31-Oct-03	0.00E+00	30-Oct-04	0.00E+00	31-Oct-05	0.00E+00	31-Oct-06	0.00E+00	31-Oct-07	0.00E+00	30-Oct-08	0.00E+00
1-Nov-03	0.00E+00	31-Oct-04	0.00E+00	1-Nov-05	0.00E+00	1-Nov-06	0.00E+00	1-Nov-07	0.00E+00	31-Oct-08	0.00E+00
2-Nov-03	0.00E+00	1-Nov-04	0.00E+00	2-Nov-05	0.00E+00	2-Nov-06	0.00E+00	2-Nov-07	0.00E+00	1-Nov-08	0.00E+00
3-Nov-03	0.00E+00	2-Nov-04	0.00E+00	3-Nov-05	0.00E+00	3-Nov-06	0.00E+00	3-Nov-07	0.00E+00	2-Nov-08	0.00E+00
4-Nov-03	0.00E+00	3-Nov-04	0.00E+00	4-Nov-05	0.00E+00	4-Nov-06	0.00E+00	4-Nov-07	0.00E+00	3-Nov-08	0.00E+00
5-Nov-03	0.00E+00	4-Nov-04	0.00E+00	5-Nov-05	0.00E+00	5-Nov-06	0.00E+00	5-Nov-07	0.00E+00	4-Nov-08	0.00E+00
6-Nov-03	0.00E+00	5-Nov-04	0.00E+00	6-Nov-05	0.00E+00	6-Nov-06	0.00E+00	6-Nov-07	0.00E+00	5-Nov-08	0.00E+00
7-Nov-03	0.00E+00	6-Nov-04	0.00E+00	7-Nov-05	0.00E+00	7-Nov-06	0.00E+00	7-Nov-07	0.00E+00	6-Nov-08	0.00E+00
8-Nov-03	0.00E+00	7-Nov-04	0.00E+00	8-Nov-05	0.00E+00	8-Nov-06	4.82E-03	8-Nov-07	0.00E+00	7-Nov-08	0.00E+00
9-Nov-03	0.00E+00	8-Nov-04	0.00E+00	9-Nov-05	0.00E+00	9-Nov-06	0.00E+00	9-Nov-07	0.00E+00	8-Nov-08	0.00E+00
10-Nov-03	0.00E+00	9-Nov-04	0.00E+00	10-Nov-05	0.00E+00	10-Nov-06	0.00E+00	10-Nov-07	0.00E+00	9-Nov-08	0.00E+00
11-Nov-03	0.00E+00	10-Nov-04	0.00E+00	11-Nov-05	0.00E+00	11-Nov-06	3.75E-03	11-Nov-07	0.00E+00	10-Nov-08	0.00E+00
12-Nov-03	0.00E+00	11-Nov-04	0.00E+00	12-Nov-05	0.00E+00	12-Nov-06	8.03E-03	12-Nov-07	0.00E+00	11-Nov-08	0.00E+00
13-Nov-03	0.00E+00	12-Nov-04	0.00E+00	13-Nov-05	0.00E+00	13-Nov-06	5.19E-03	13-Nov-07	0.00E+00	12-Nov-08	0.00E+00
14-Nov-03	0.00E+00	13-Nov-04	0.00E+00	14-Nov-05	0.00E+00	14-Nov-06	3.05E-03	14-Nov-07	0.00E+00	13-Nov-08	0.00E+00
15-Nov-03	0.00E+00	14-Nov-04	0.00E+00	15-Nov-05	0.00E+00	15-Nov-06	1.19E-03	15-Nov-07	0.00E+00	14-Nov-08	0.00E+00
16-Nov-03	0.00E+00	15-Nov-04	0.00E+00	16-Nov-05	0.00E+00	16-Nov-06	7.07E-04	16-Nov-07	0.00E+00	15-Nov-08	0.00E+00
17-Nov-03	0.00E+00	16-Nov-04	0.00E+00	17-Nov-05	0.00E+00	17-Nov-06	8.92E-04	17-Nov-07	0.00E+00	16-Nov-08	0.00E+00
18-Nov-03	0.00E+00	17-Nov-04	0.00E+00	18-Nov-05	0.00E+00	18-Nov-06	3.25E-03	18-Nov-07	0.00E+00	17-Nov-08	0.00E+00
19-Nov-03	0.00E+00	18-Nov-04	0.00E+00	19-Nov-05	0.00E+00	19-Nov-06	1.46E-02	19-Nov-07	0.00E+00	18-Nov-08	0.00E+00
20-Nov-03	0.00E+00	19-Nov-04	0.00E+00	20-Nov-05	0.00E+00	20-Nov-06	8.19E-03	20-Nov-07	0.00E+00	19-Nov-08	0.00E+00
21-Nov-03	0.00E+00	20-Nov-04	0.00E+00	21-Nov-05	0.00E+00	21-Nov-06	4.64E-03	21-Nov-07	0.00E+00	20-Nov-08	0.00E+00
22-Nov-03	0.00E+00	21-Nov-04	0.00E+00	22-Nov-05	0.00E+00	22-Nov-06	4.92E-03	22-Nov-07	0.00E+00	21-Nov-08	0.00E+00
23-Nov-03	0.00E+00	22-Nov-04	0.00E+00	23-Nov-05	0.00E+00	23-Nov-06	0.00E+00	23-Nov-07	0.00E+00	22-Nov-08	0.00E+00
24-Nov-03	0.00E+00	23-Nov-04	0.00E+00	24-Nov-05	0.00E+00	24-Nov-06	0.00E+00	24-Nov-07	0.00E+00	23-Nov-08	0.00E+00
25-Nov-03	0.00E+00	24-Nov-04	0.00E+00	25-Nov-05	0.00E+00	25-Nov-06	0.00E+00	25-Nov-07	0.00E+00	24-Nov-08	0.00E+00
26-Nov-03	0.00E+00	25-Nov-04	0.00E+00	26-Nov-05	0.00E+00	26-Nov-06	0.00E+00	26-Nov-07	0.00E+00	25-Nov-08	0.00E+00
27-Nov-03	0.00E+00	26-Nov-04	0.00E+00	27-Nov-05	0.00E+00	27-Nov-06	0.00E+00	27-Nov-07	0.00E+00	26-Nov-08	0.00E+00
28-Nov-03	0.00E+00	27-Nov-04	0.00E+00	28-Nov-05	0.00E+00	28-Nov-06	0.00E+00	28-Nov-07	0.00E+00	27-Nov-08	0.00E+00
29-Nov-03	0.00E+00	28-Nov-04	0.00E+00	29-Nov-05	0.00E+00	29-Nov-06	0.00E+00	29-Nov-07	0.00E+00	28-Nov-08	0.00E+00
30-Nov-03	0.00E+00	29-Nov-04	0.00E+00	30-Nov-05	0.00E+00	30-Nov-06	0.00E+00	30-Nov-07	0.00E+00	29-Nov-08	0.00E+00
1-Dec-03	0.00E+00	30-Nov-04	0.00E+00	1-Dec-05	0.00E+00	1-Dec-06	0.00E+00	1-Dec-07	0.00E+00	30-Nov-08	0.00E+00
2-Dec-03	0.00E+00	1-Dec-04	0.00E+00	2-Dec-05	0.00E+00	2-Dec-06	0.00E+00	2-Dec-07	0.00E+00	1-Dec-08	0.00E+00
3-Dec-03	0.00E+00	2-Dec-04	0.00E+00	3-Dec-05	0.00E+00	3-Dec-06	0.00E+00	3-Dec-07	0.00E+00	2-Dec-08	0.00E+00
4-Dec-03	0.00E+00	3-Dec-04	0.00E+00	4-Dec-05	0.00E+00	4-Dec-06	0.00E+00	4-Dec-07	0.00E+00	3-Dec-08	0.00E+00
5-Dec-03	0.00E+00	4-Dec-04	0.00E+00	5-Dec-05	0.00E+00	5-Dec-06	0.00E+00	5-Dec-07	0.00E+00	4-Dec-08	0.00E+00
6-Dec-03	0.00E+00	5-Dec-04	0.00E+00	6-Dec-05	7.03E-03	6-Dec-06	0.00E+00	6-Dec-07	0.00E+00	5-Dec-08	0.00E+00
7-Dec-03	0.00E+00	6-Dec-04	0.00E+00	7-Dec-05	1.42E-02	7-Dec-06	0.00E+00	7-Dec-07	0.00E+00	6-Dec-08	0.00E+00
8-Dec-03	0.00E+00	7-Dec-04	0.00E+00	8-Dec-05	1.46E-02	8-Dec-06	0.00E+00	8-Dec-07	0.00E+00	7-Dec-08	0.00E+00
9-Dec-03	0.00E+00	8-Dec-04	0.00E+00	9-Dec-05	4.45E-02	9-Dec-06	0.00E+00	9-Dec-07	0.00E+00	8-Dec-08	0.00E+00
10-Dec-03	0.00E+00	9-Dec-04	0.00E+00	10-Dec-05	1.34E-02	10-Dec-06	0.00E+00	10-Dec-07	0.00E+00	9-Dec-08	0.00E+00
11-Dec-03	0.00E+00	10-Dec-04	0.00E+00	11-Dec-05	0.00E+00	11-Dec-06	0.00E+00	11-Dec-07	0.00E+00	10-Dec-08	0.00E+00
12-Dec-03	0.00E+00	11-Dec-04	0.00E+00	12-Dec-05	1.98E-02	12-Dec-06	0.00E+00	12-Dec-07	0.00E+00	11-Dec-08	0.00E+00
13-Dec-03	0.00E+00	12-Dec-04	0.00E+00	13-Dec-05	0.00E+00	13-Dec-06	0.00E+00	13-Dec-07	0.00E+00	12-Dec-08	0.00E+00

CY 2003 Date	Recharge (ft/day)	CY 2004 Date	Recharge (ft/day)	CY 2005 Date	Recharge (ft/day)	CY 2006 Date	Recharge (ft/day)	CY 2007 Date	Recharge (ft/day)	CY 2008 Date	Recharge (ft/day)
14-Dec-03	0.00E+00	13-Dec-04	0.00E+00	14-Dec-05	0.00E+00	14-Dec-06	0.00E+00	14-Dec-07	0.00E+00	13-Dec-08	0.00E+00
15-Dec-03	0.00E+00	14-Dec-04	0.00E+00	15-Dec-05	2.90E-03	15-Dec-06	0.00E+00	15-Dec-07	0.00E+00	14-Dec-08	0.00E+00
16-Dec-03	0.00E+00	15-Dec-04	2.35E-04	16-Dec-05	6.43E-03	16-Dec-06	0.00E+00	16-Dec-07	0.00E+00	15-Dec-08	0.00E+00
17-Dec-03	0.00E+00	16-Dec-04	0.00E+00	17-Dec-05	0.00E+00	17-Dec-06	0.00E+00	17-Dec-07	0.00E+00	16-Dec-08	0.00E+00
18-Dec-03	0.00E+00	17-Dec-04	0.00E+00	18-Dec-05	0.00E+00	18-Dec-06	0.00E+00	18-Dec-07	0.00E+00	17-Dec-08	0.00E+00
19-Dec-03	0.00E+00	18-Dec-04	0.00E+00	19-Dec-05	2.82E-03	19-Dec-06	0.00E+00	19-Dec-07	0.00E+00	18-Dec-08	0.00E+00
20-Dec-03	0.00E+00	19-Dec-04	0.00E+00	20-Dec-05	3.40E-03	20-Dec-06	0.00E+00	20-Dec-07	0.00E+00	19-Dec-08	0.00E+00
21-Dec-03	0.00E+00	20-Dec-04	0.00E+00	21-Dec-05	6.45E-03	21-Dec-06	0.00E+00	21-Dec-07	0.00E+00	20-Dec-08	0.00E+00
22-Dec-03	0.00E+00	21-Dec-04	0.00E+00	22-Dec-05	1.98E-02	22-Dec-06	0.00E+00	22-Dec-07	0.00E+00	21-Dec-08	0.00E+00
23-Dec-03	0.00E+00	22-Dec-04	0.00E+00	23-Dec-05	1.22E-02	23-Dec-06	0.00E+00	23-Dec-07	0.00E+00	22-Dec-08	0.00E+00
24-Dec-03	0.00E+00	23-Dec-04	0.00E+00	24-Dec-05	6.47E-03	24-Dec-06	0.00E+00	24-Dec-07	0.00E+00	23-Dec-08	0.00E+00
25-Dec-03	0.00E+00	24-Dec-04	0.00E+00	25-Dec-05	1.77E-03	25-Dec-06	0.00E+00	25-Dec-07	0.00E+00	24-Dec-08	0.00E+00
26-Dec-03	0.00E+00	25-Dec-04	0.00E+00	26-Dec-05	2.70E-03	26-Dec-06	9.23E-02	26-Dec-07	2.78E-03	25-Dec-08	0.00E+00
27-Dec-03	0.00E+00	26-Dec-04	0.00E+00	27-Dec-05	3.97E-03	27-Dec-06	0.00E+00	27-Dec-07	0.00E+00	26-Dec-08	0.00E+00
28-Dec-03	0.00E+00	27-Dec-04	0.00E+00	28-Dec-05	0.00E+00	28-Dec-06	0.00E+00	28-Dec-07	0.00E+00	27-Dec-08	0.00E+00
29-Dec-03	0.00E+00	28-Dec-04	9.34E-04	29-Dec-05	0.00E+00	29-Dec-06	0.00E+00	29-Dec-07	0.00E+00	28-Dec-08	0.00E+00
30-Dec-03	0.00E+00	29-Dec-04	0.00E+00	30-Dec-05	6.75E-04	30-Dec-06	0.00E+00	30-Dec-07	0.00E+00	29-Dec-08	0.00E+00
31-Dec-03	0.00E+00	30-Dec-04	0.00E+00	31-Dec-05	2.91E-03	31-Dec-06	0.00E+00	31-Dec-07	0.00E+00	30-Dec-08	0.00E+00
		31-Dec-04	0.00E+00							31-Dec-08	0.00E+00

Key: CY=calendar year; ft/day=feet per day.

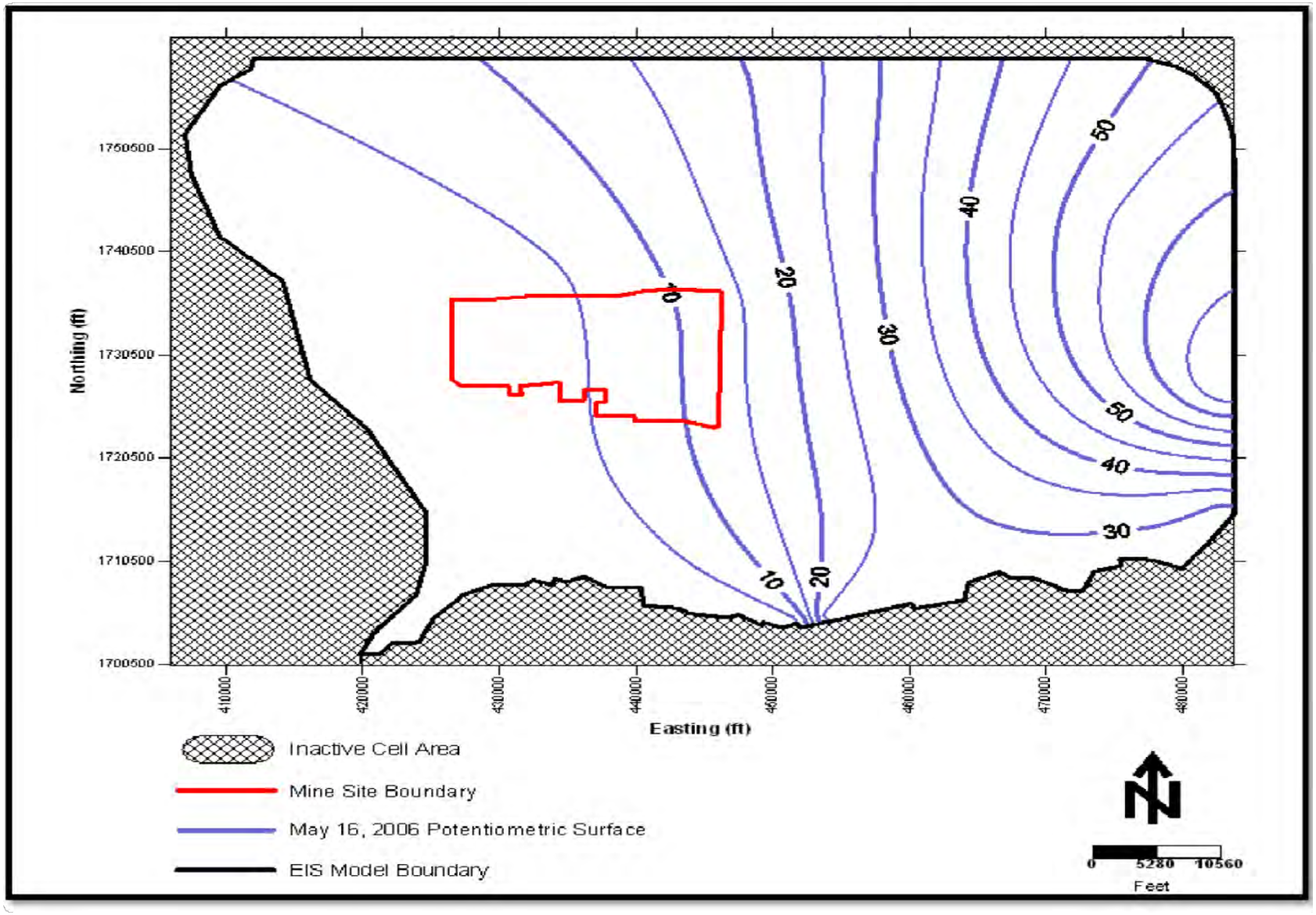

Figure A-1a. King Road EIS Model Boundary Area Showing Potentiometric Surface for May 16, 2006

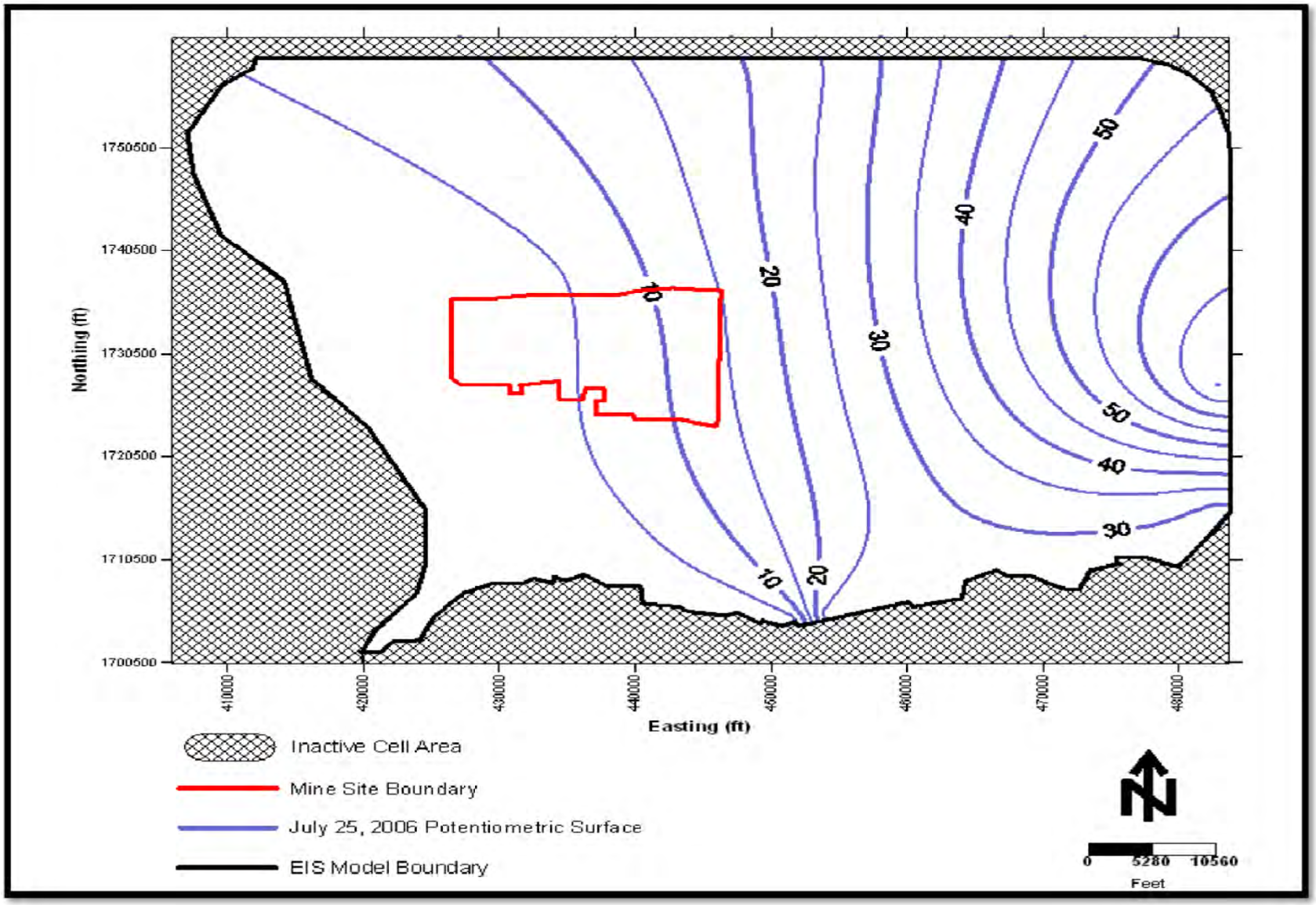

Figure A–1b. ***King Road EIS*** **Model Boundary Area Showing Potentiometric Surface for July 25, 2006**

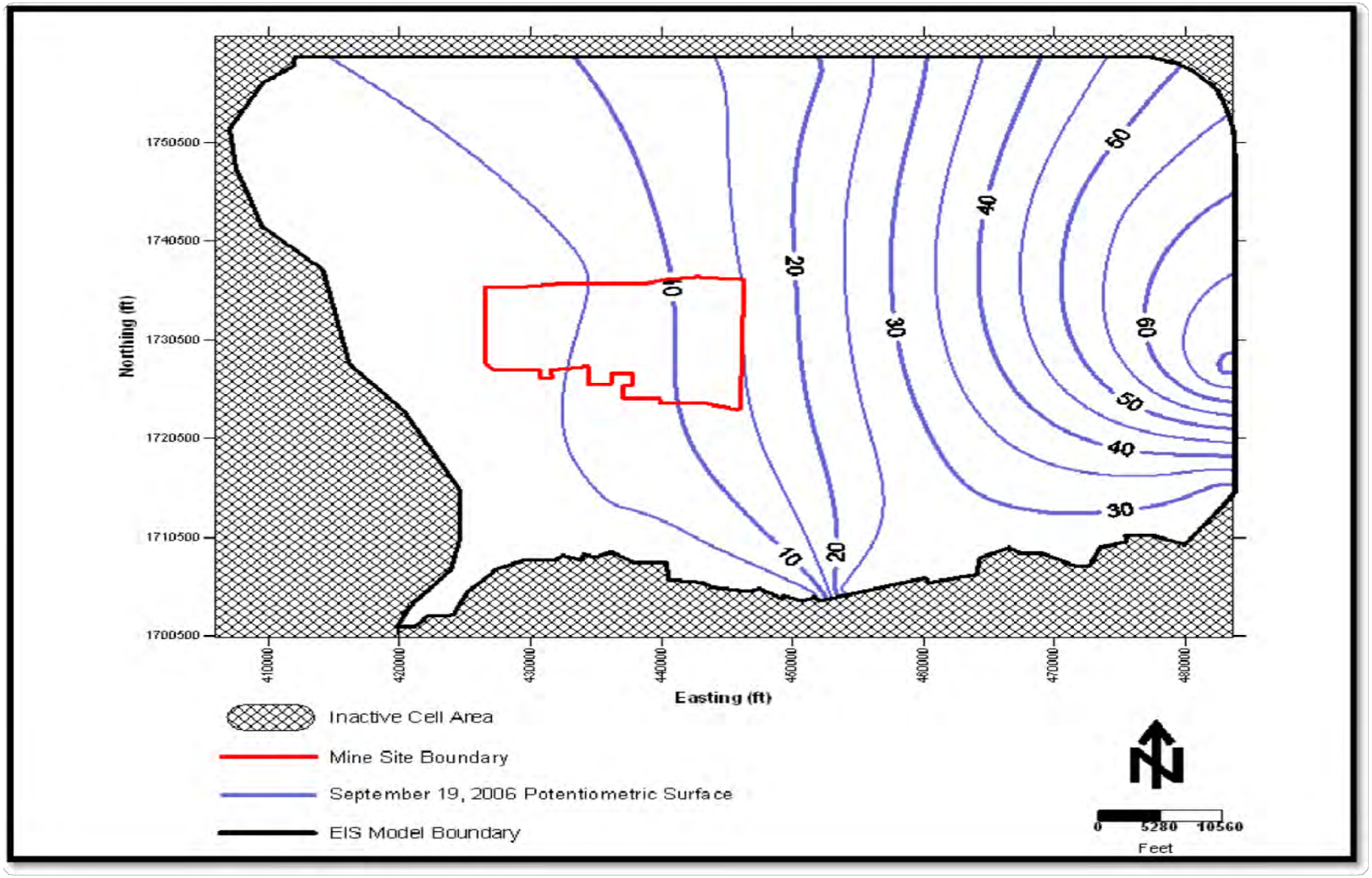

Figure A–1c. ***King Road EIS*** **Model Boundary Area Showing Potentiometric Surface for September 19, 2006**

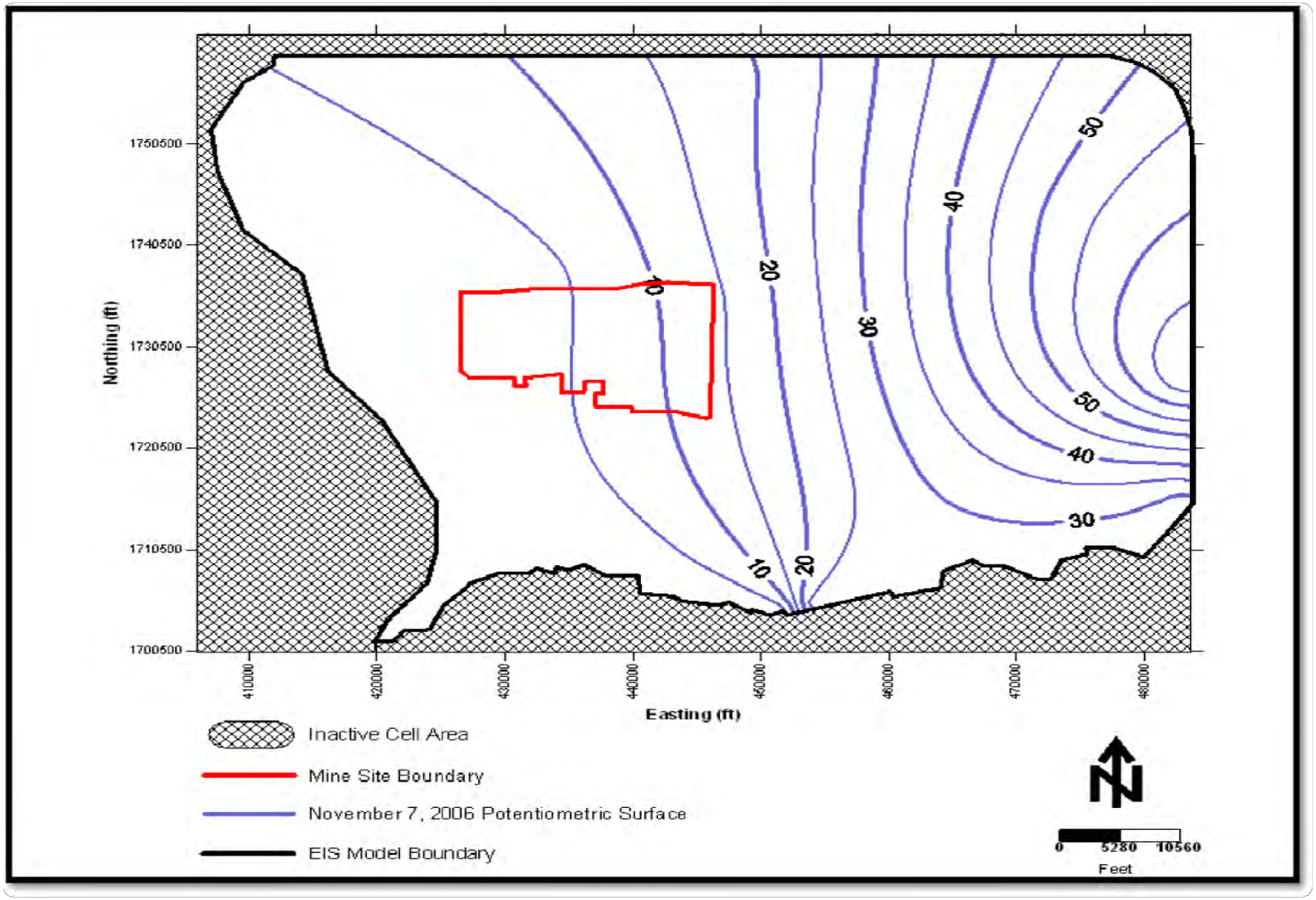

Figure A–1d. ***King Road EIS*** **Model Boundary Area Showing Potentiometric Surface for November 7, 2006**

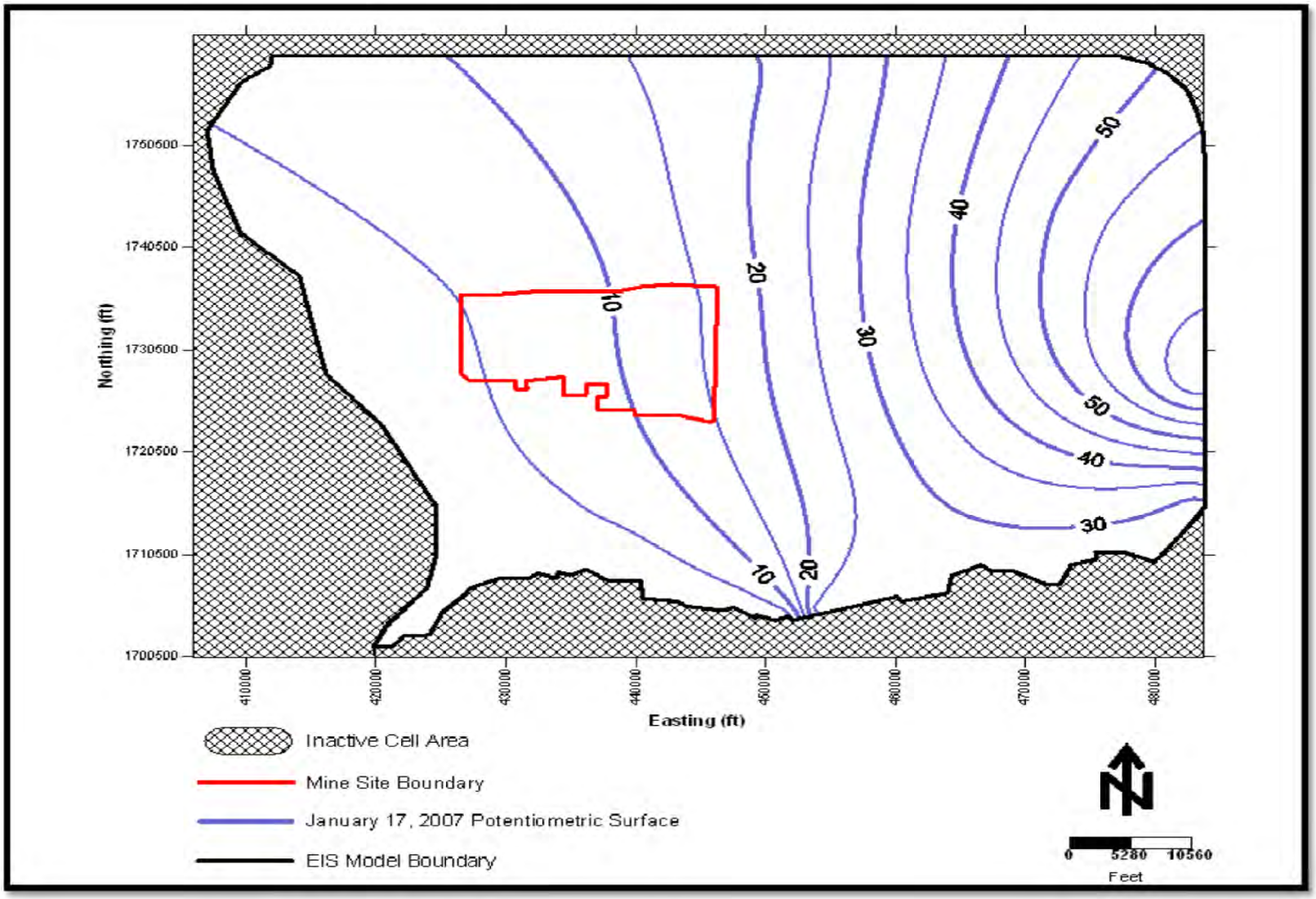

Figure A–1e. ***King Road EIS*** **Model Boundary Area Showing Potentiometric Surface for January 17, 2007**

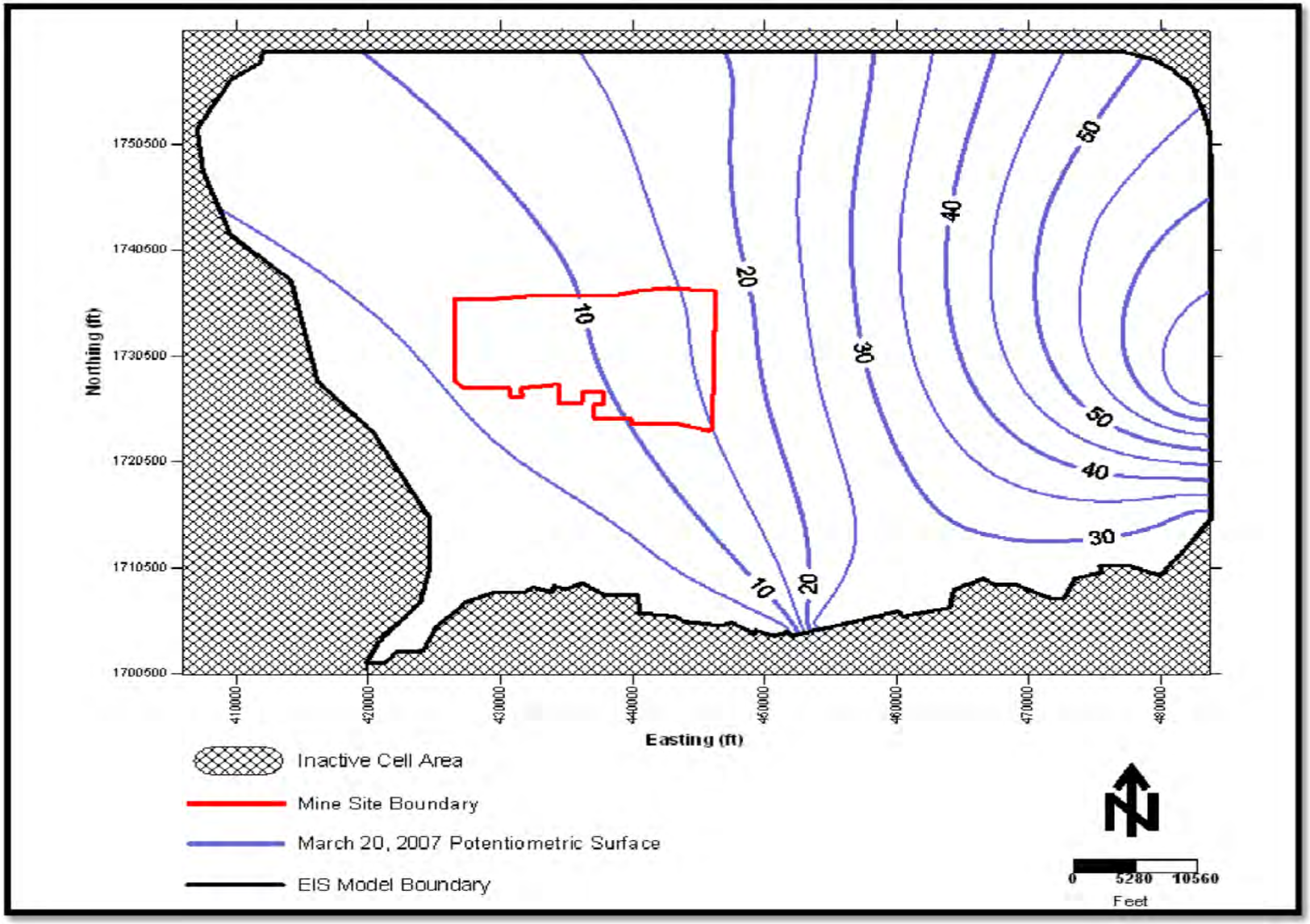

Figure A–1f. ***King Road EIS*** **Model Boundary Area Showing Potentiometric Surface for March 20, 2007**

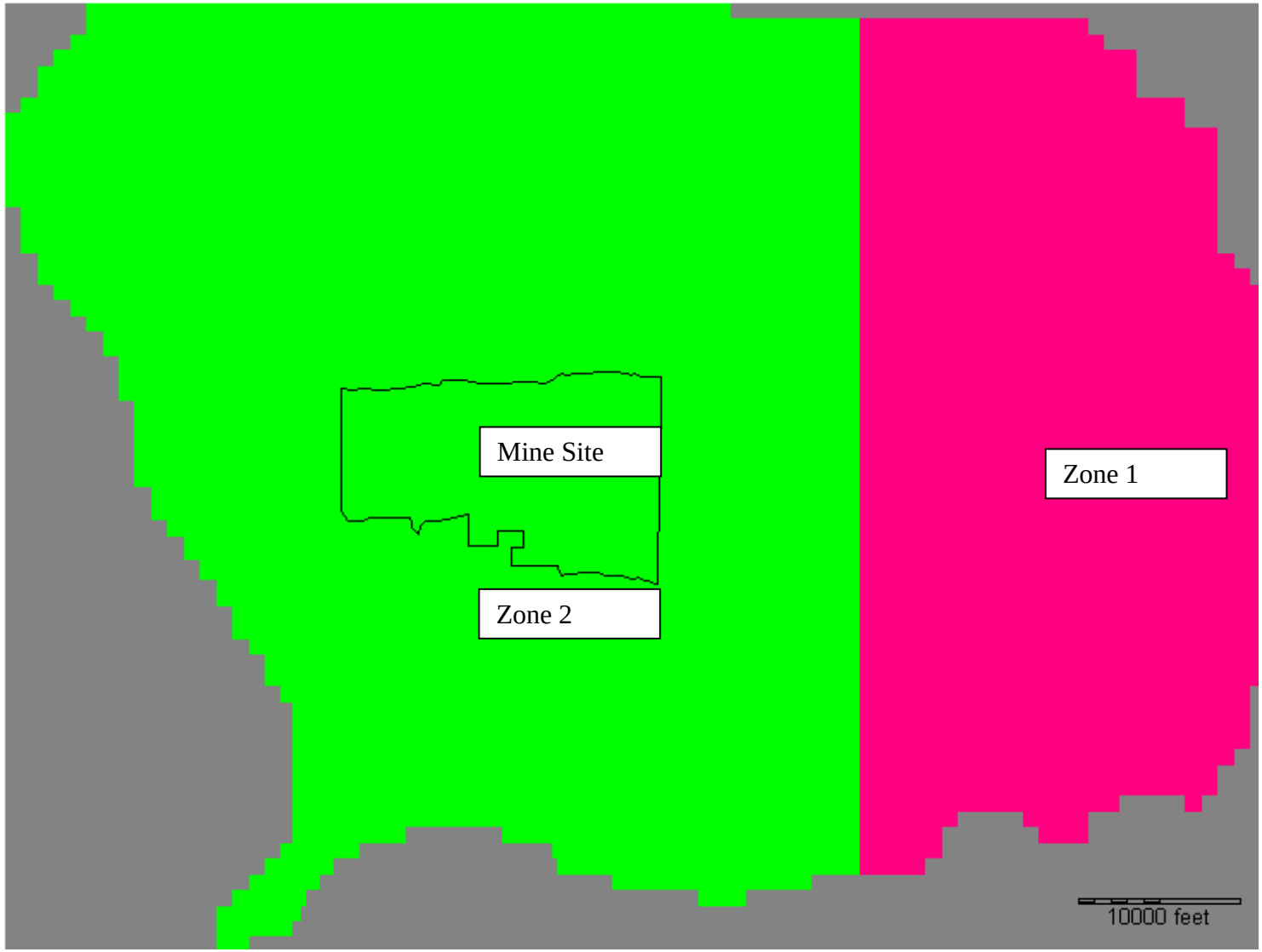

Figure A–2. Recharge Zonation for King Road Limestone Mine Site Groundwater Flow Model in Layer 1

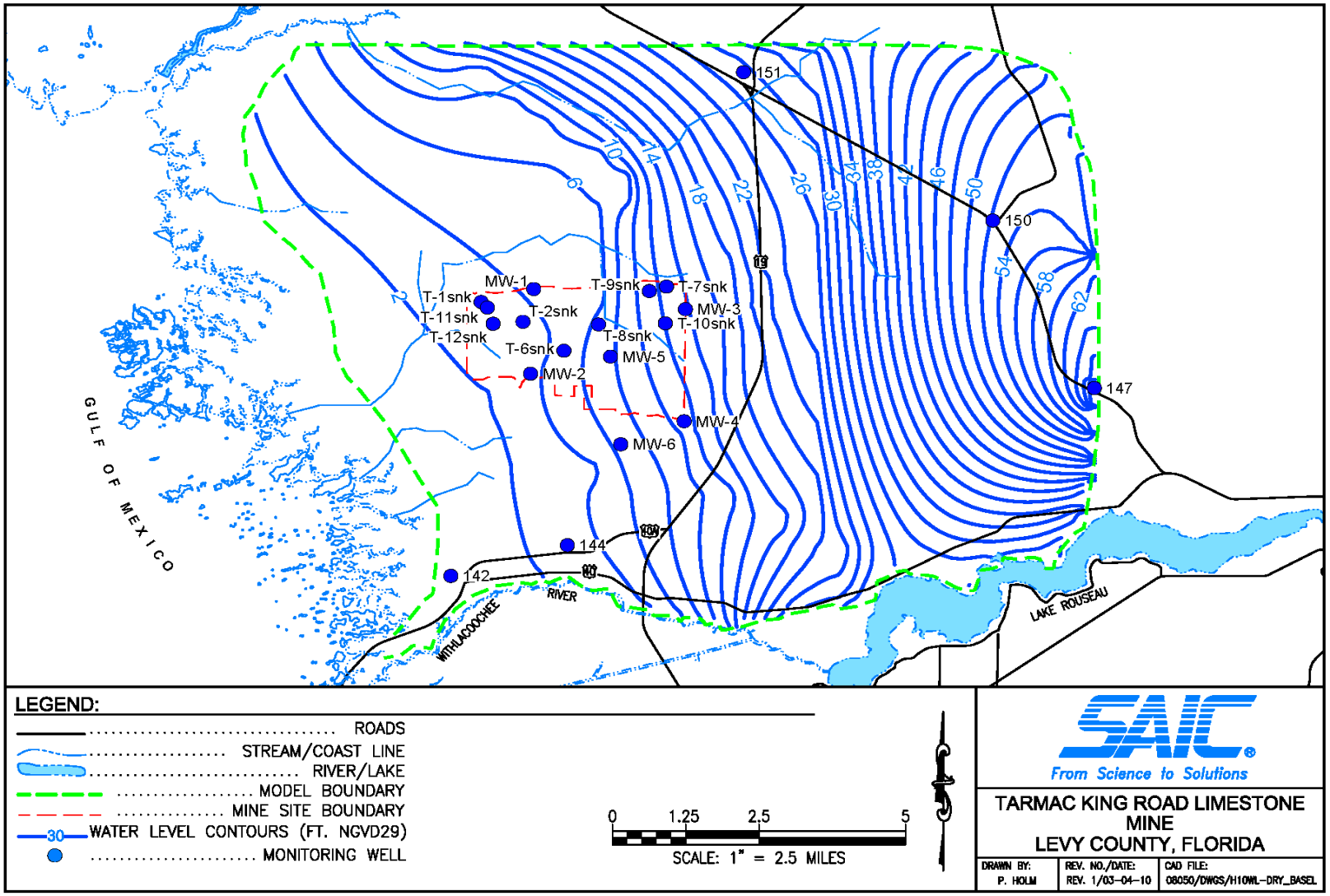

Figure A–3. Water Level Contours Under Dry Conditions, 02/14/07 – Baseline

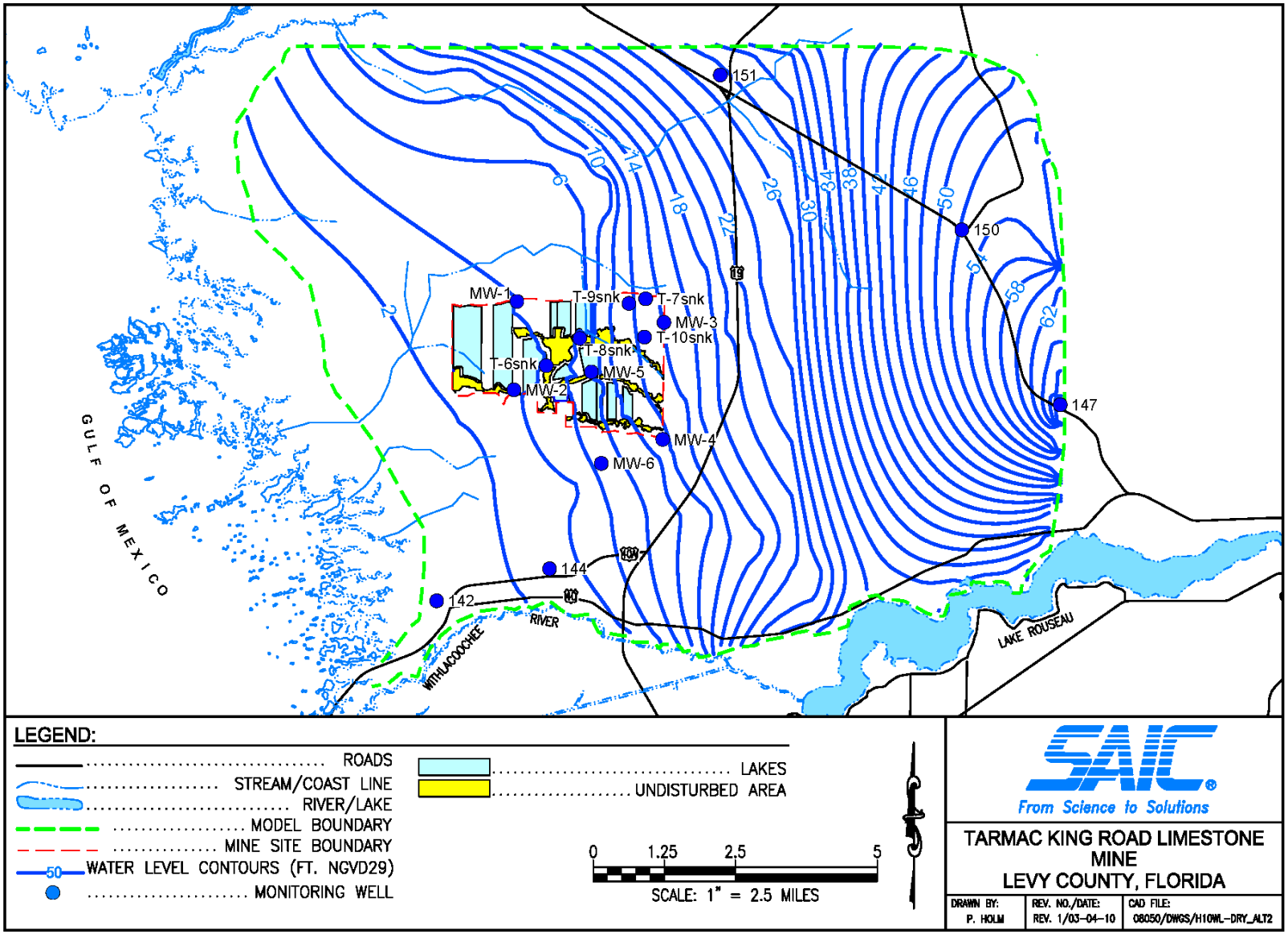

Figure A–4. Water Level Contours Under Dry Conditions, 02/14/07 – Alternative 2

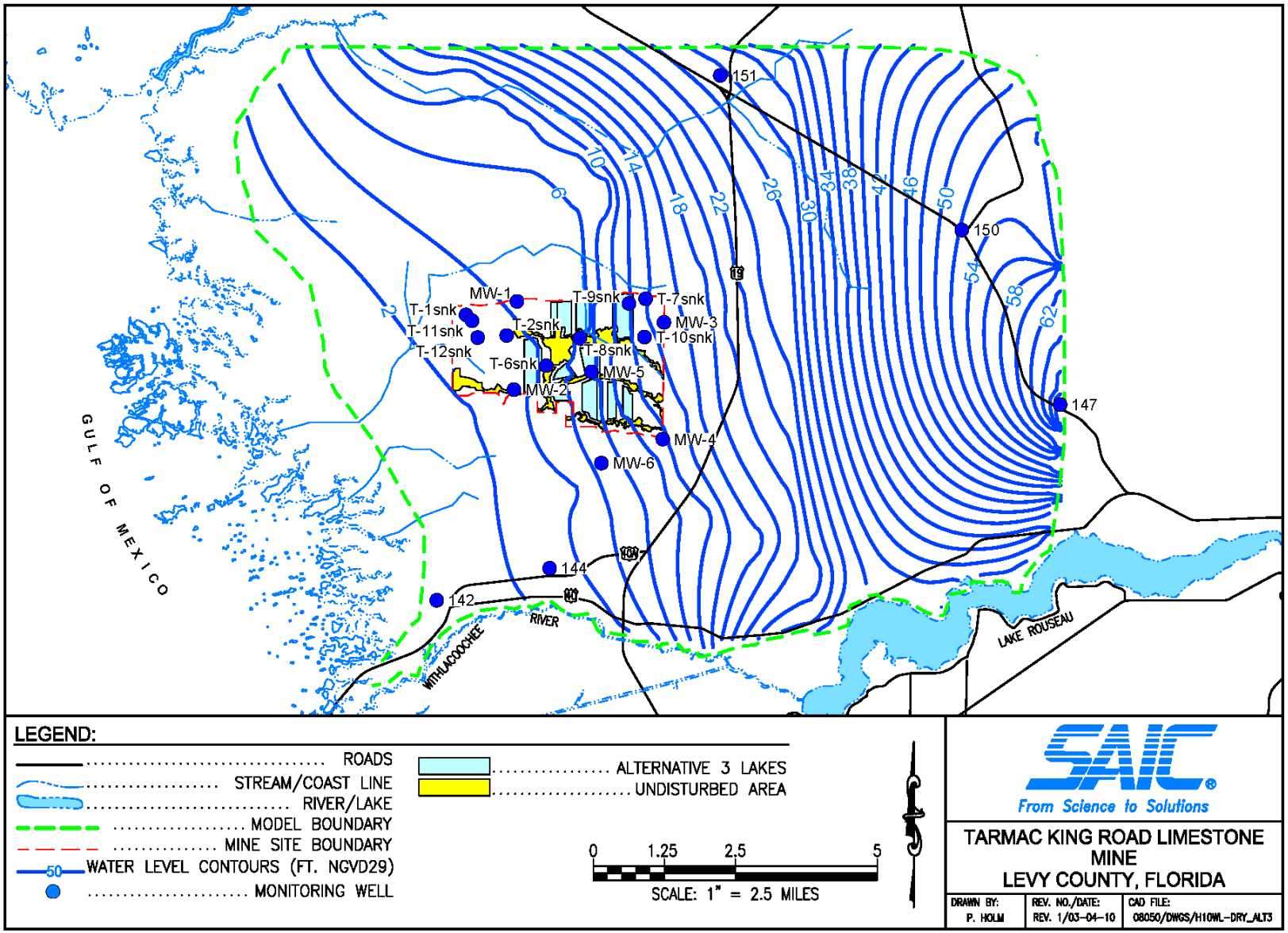

Figure A–5. Water Level Contours Under Dry Conditions, 02/14/07 – Alternative 3

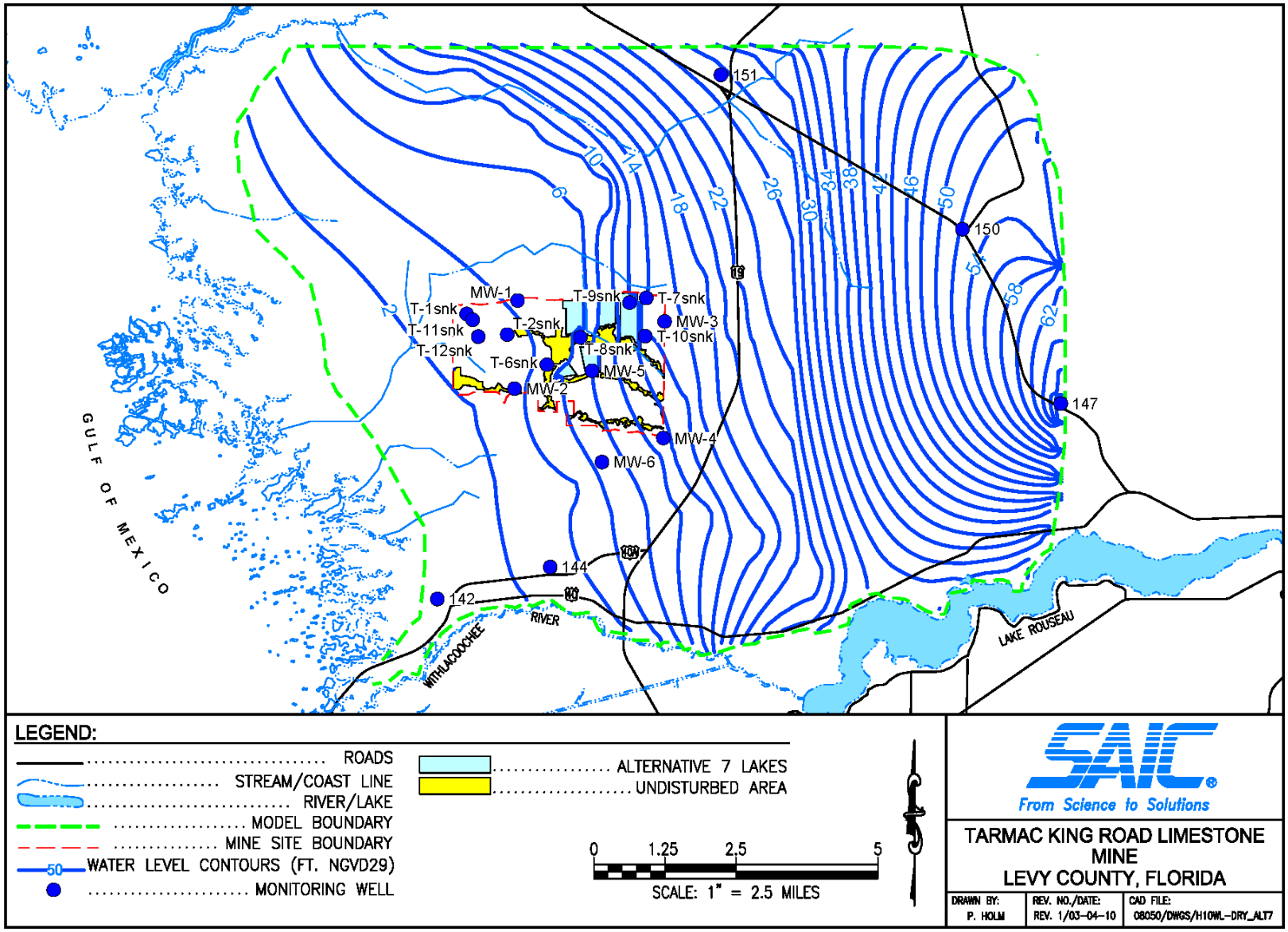

Figure A–6. Water Level Contours Under Dry Conditions, 02/14/07 – Alternative 7

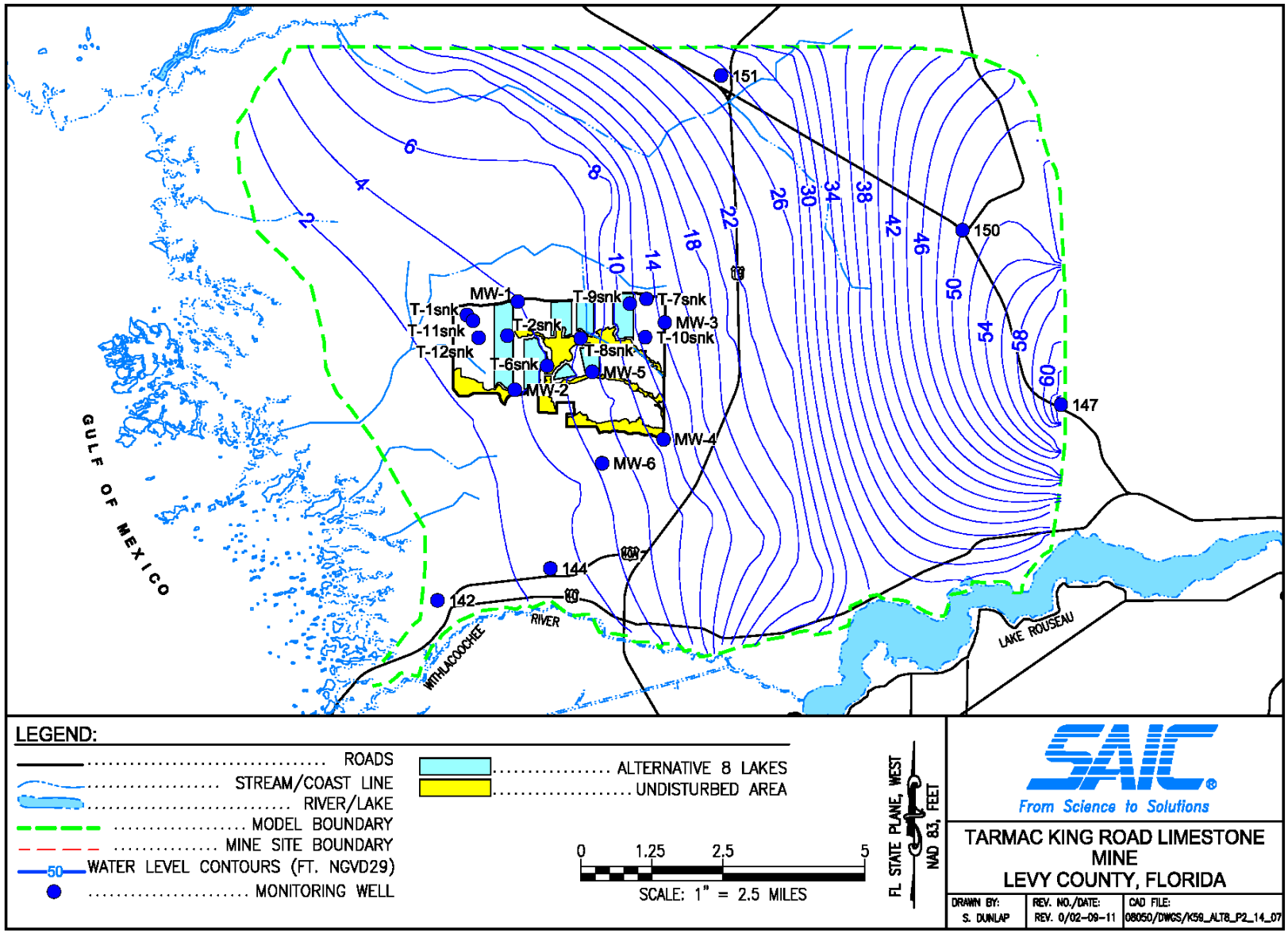

Figure A–7. Water Level Contours Under Dry Conditions, 02/14/07 – Alternative 8

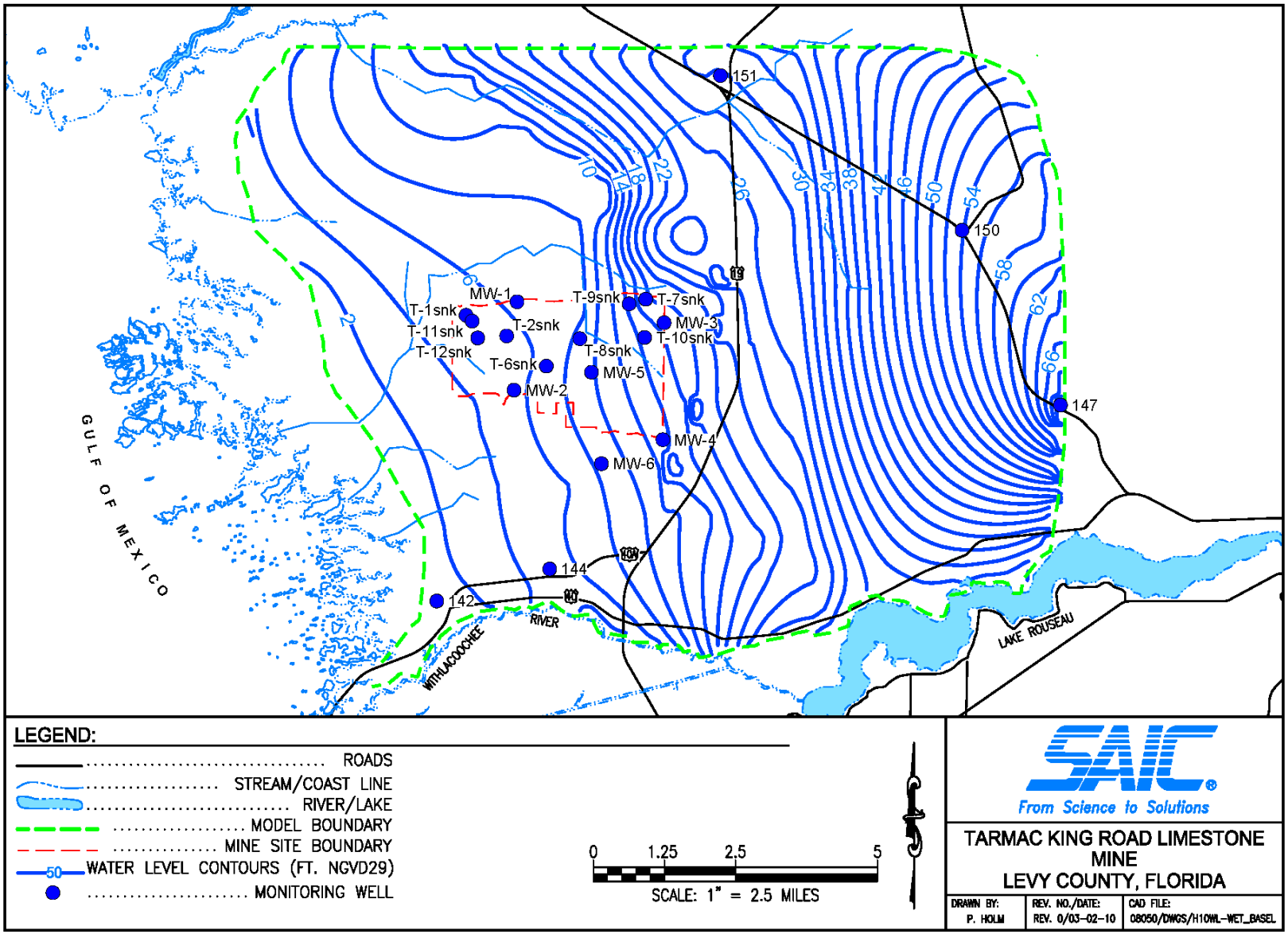

Figure A–8. Water Level Contours Under Wet Conditions, 09/07/04 – Baseline

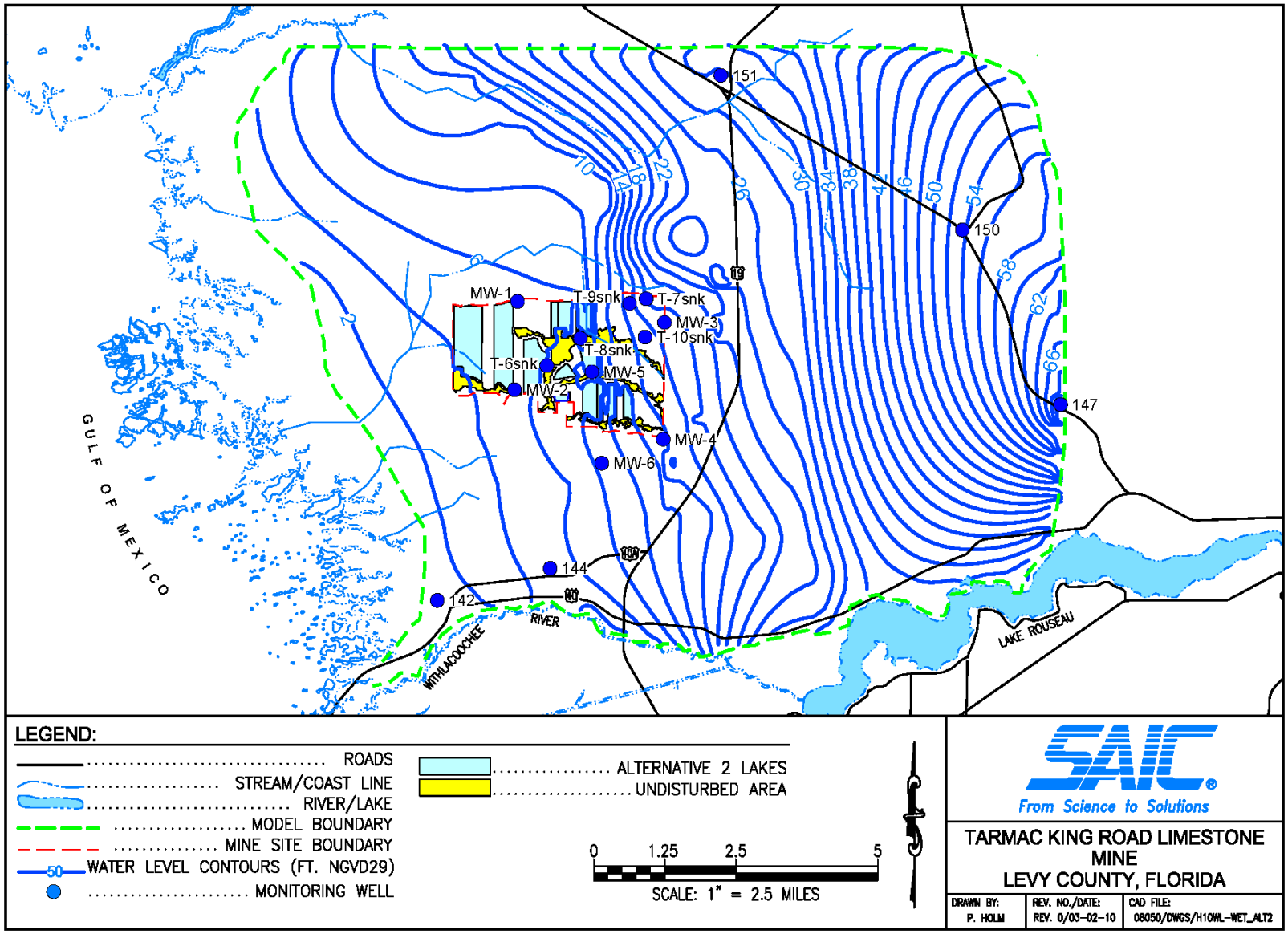

Figure A–9. Water Level Contours Under Wet Conditions, 09/07/04 – Alternative 2

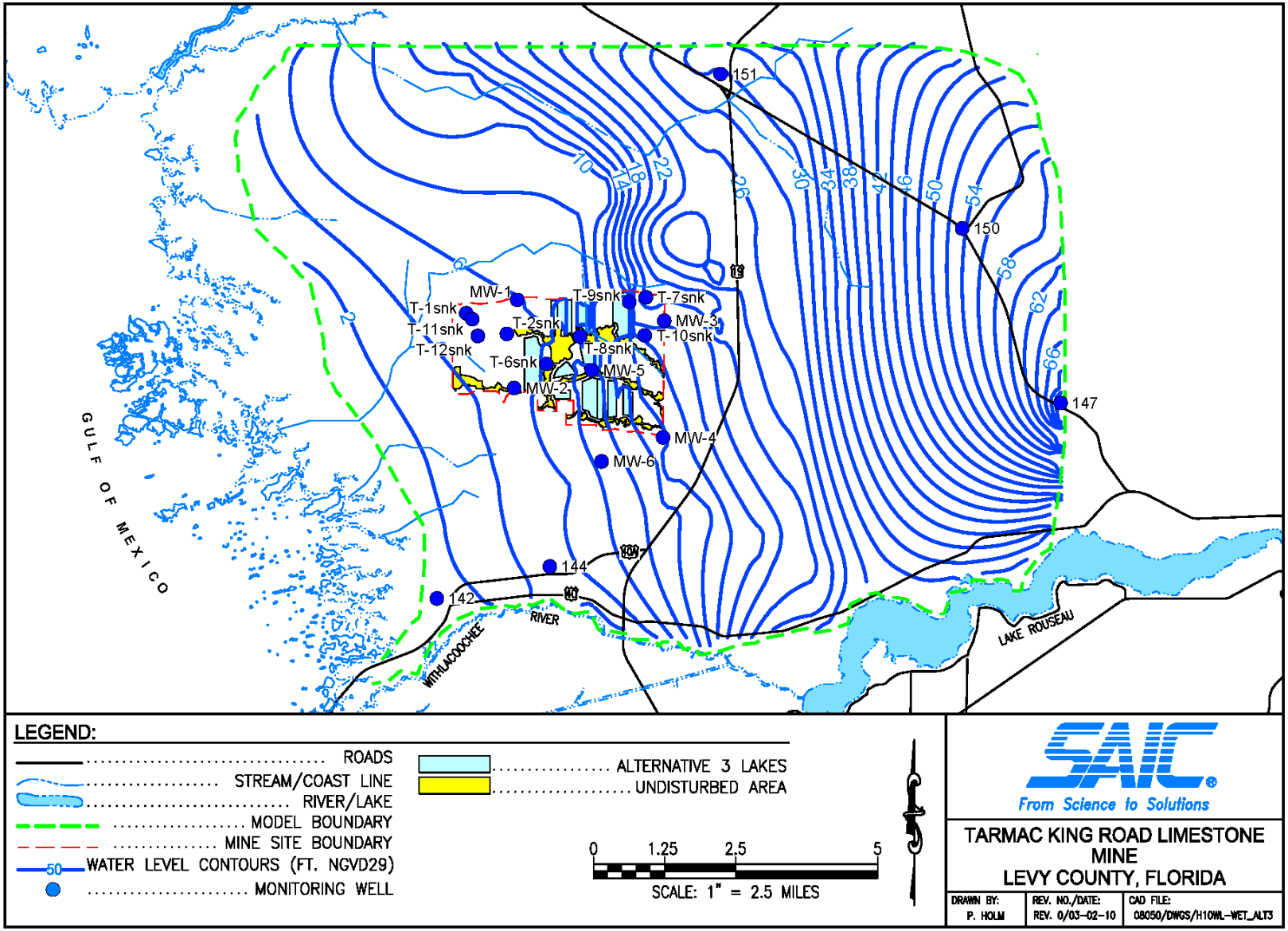

Figure A–10. Water Level Contours Under Wet Conditions, 09/07/04 – Alternative 3

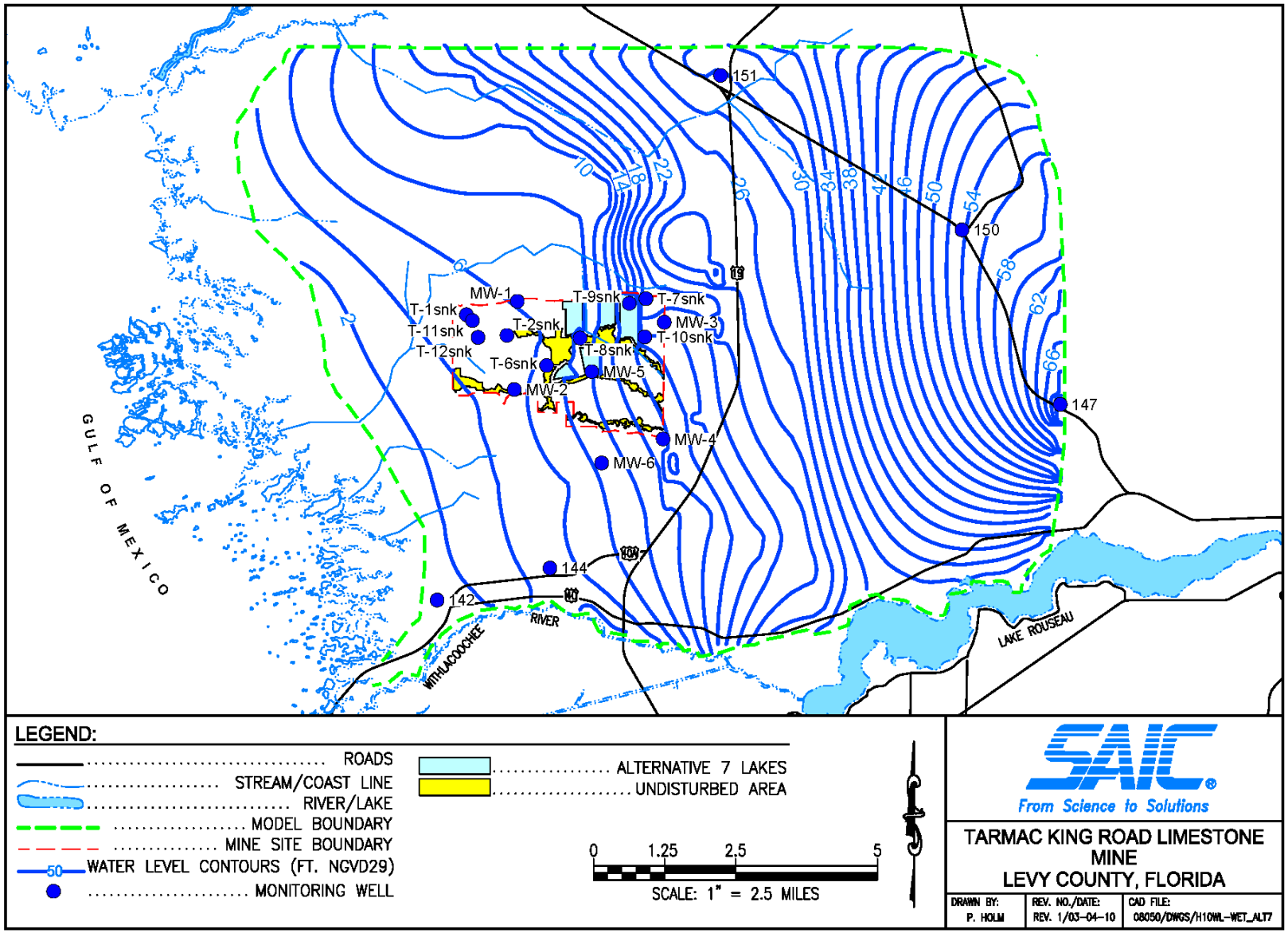

Figure A–11. Water Level Contours Under Wet Conditions, 09/07/04 – Alternative 7

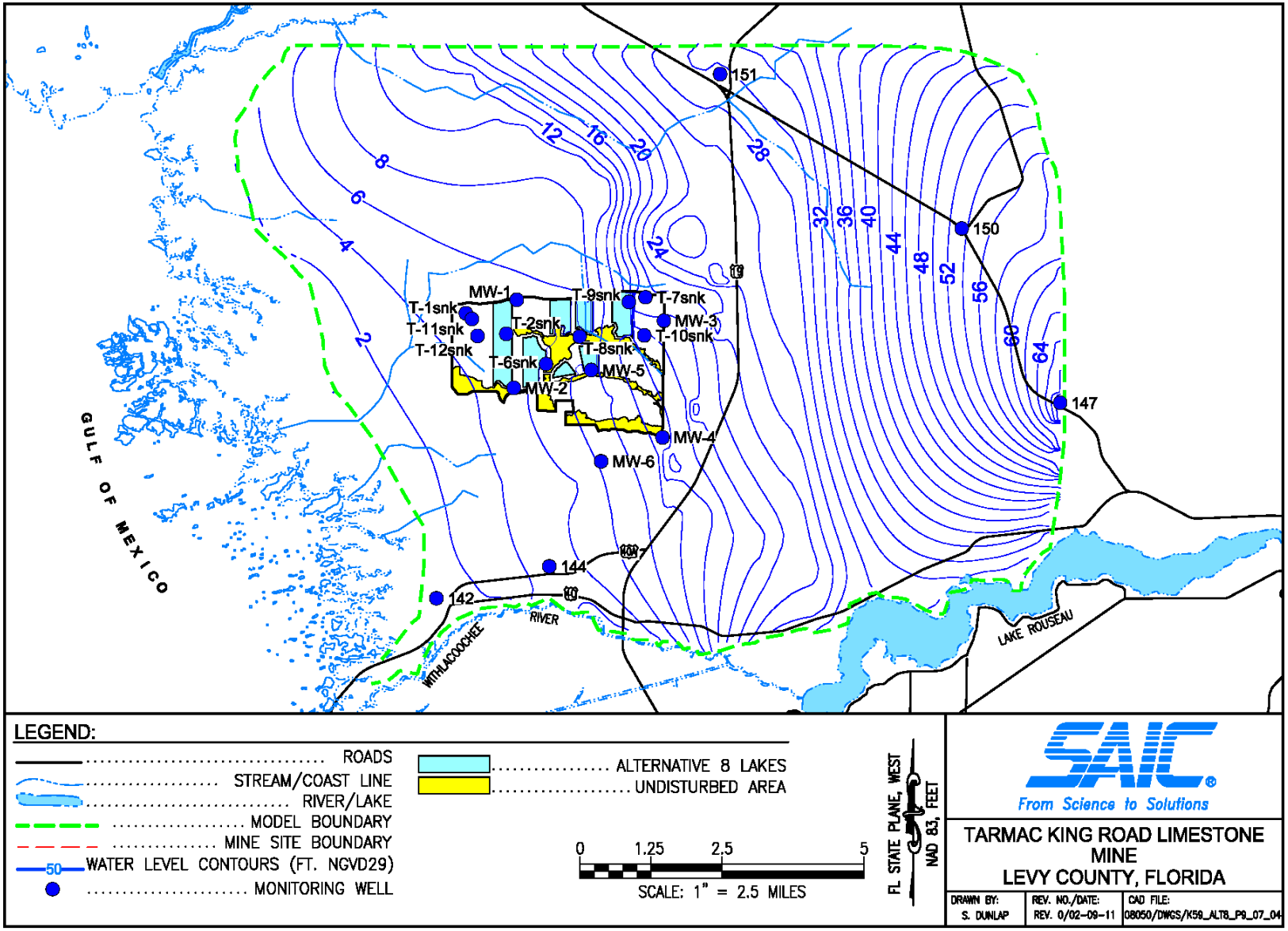

Figure A–12. Water Level Contours Under Wet Conditions, 09/07/04 – Alternative 8

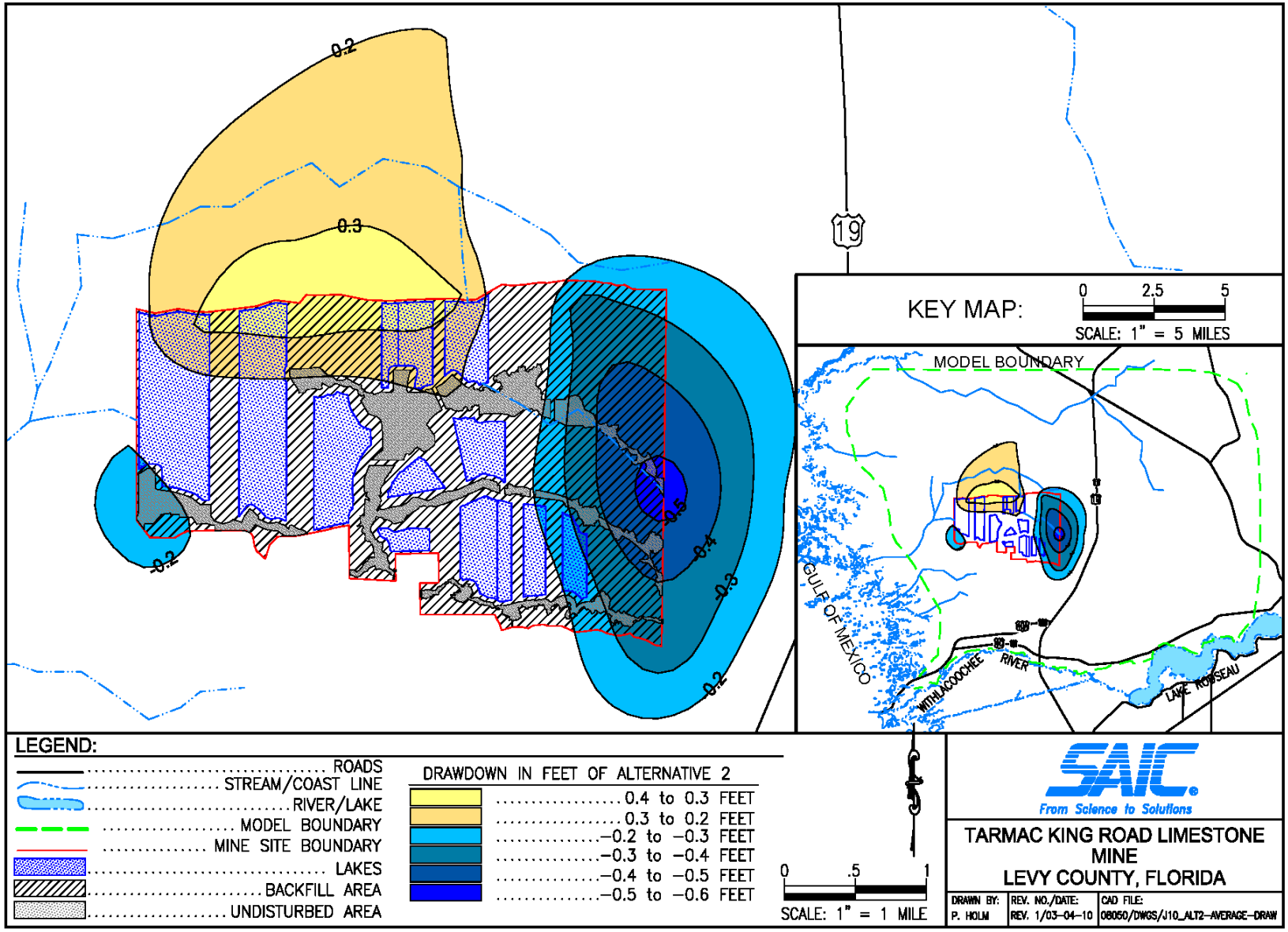

Figure A–13. Alternative 2 Drawdown Under Average Conditions (CY 2006 Simulation)

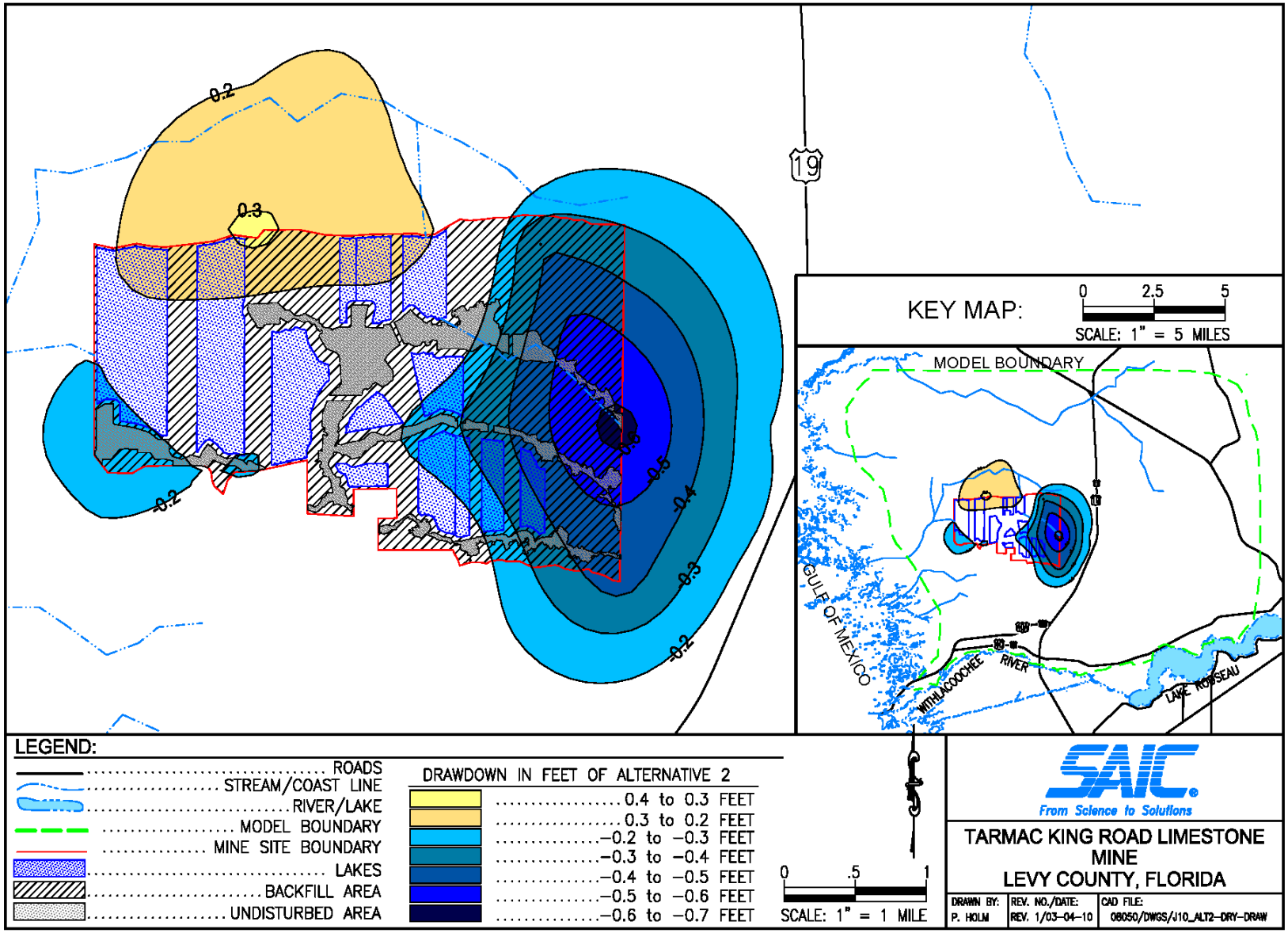

Figure A–14. Alternative 2 Drawdown Under Dry Conditions (CY 2007 Simulation)

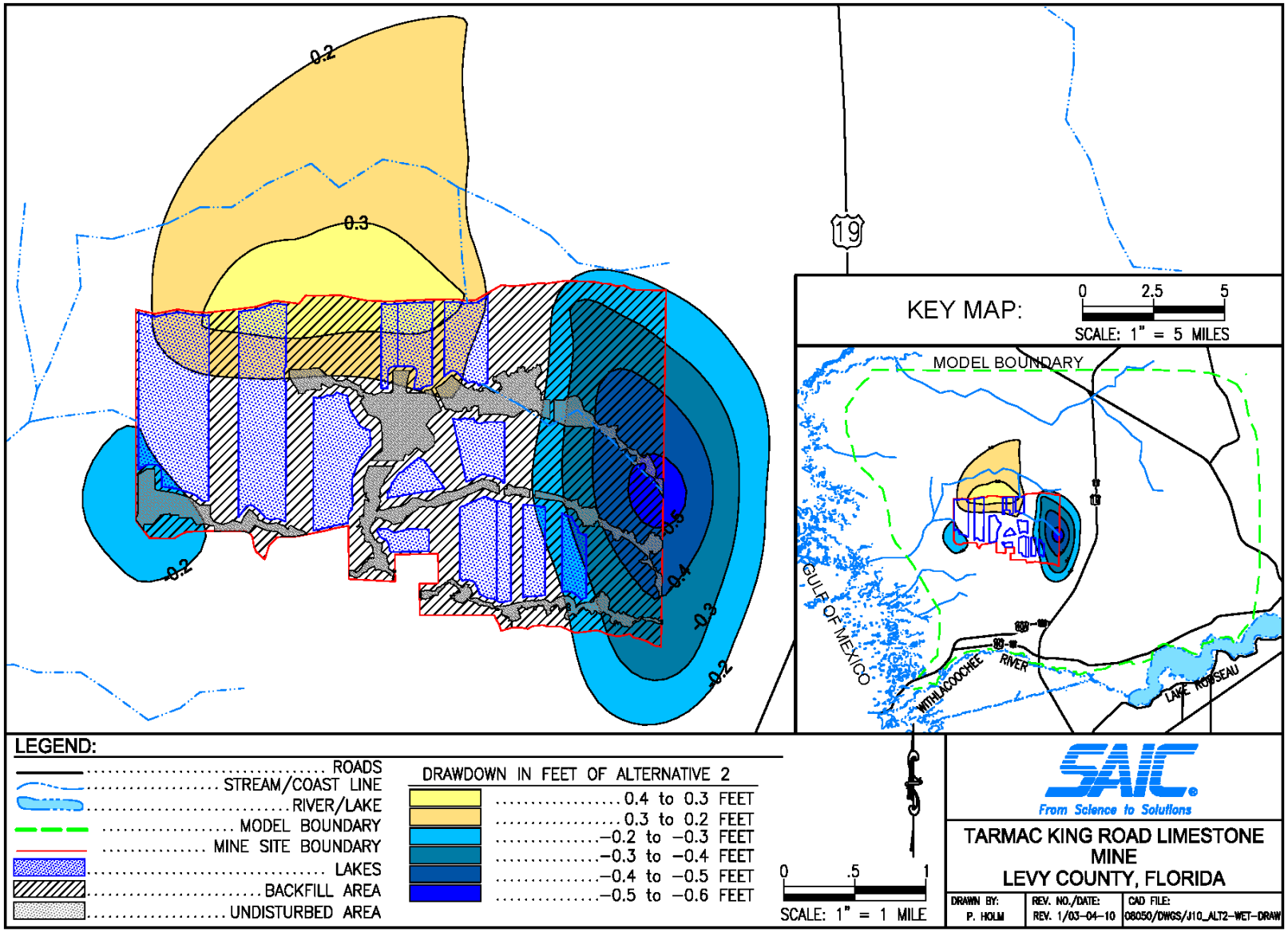

Figure A–15. Alternative 2 Drawdown Under Wet Conditions (CY 2004 Simulation)

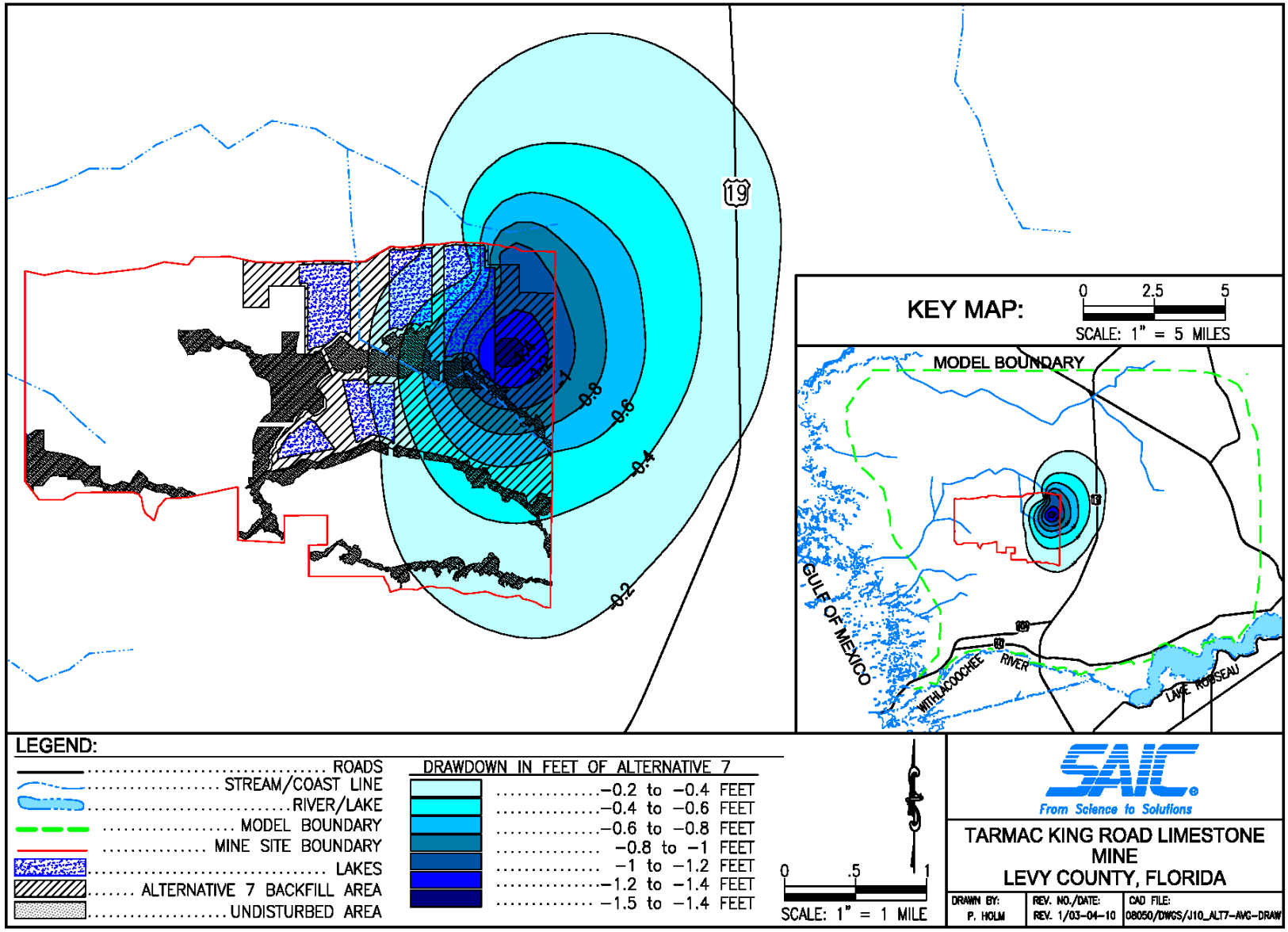

Figure A–16. Alternative 7 Drawdown Under Average Conditions (CY 2006 Simulation)

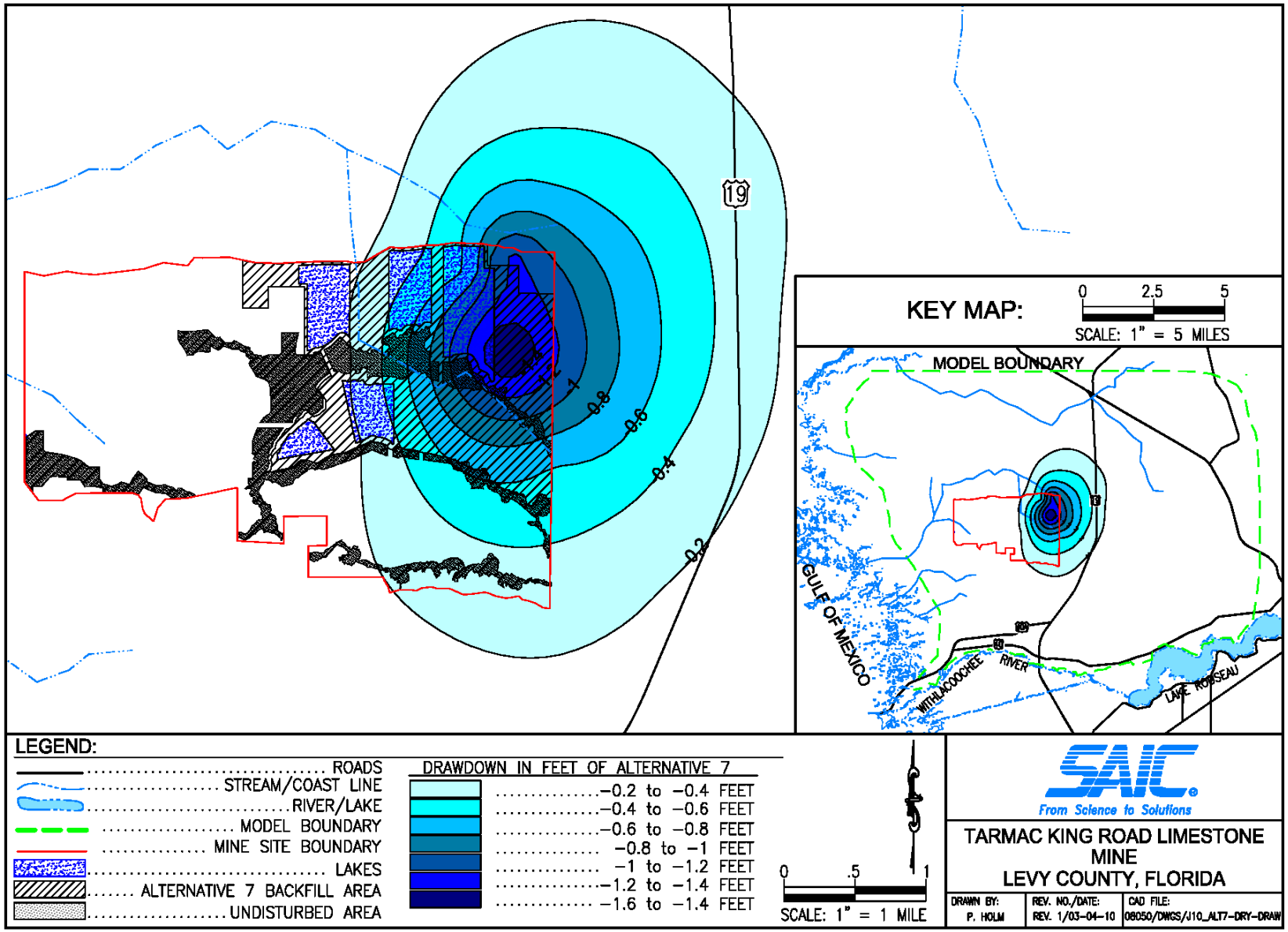

Figure A–17. Alternative 7 Drawdown Under Dry Conditions (CY 2007 Simulation)

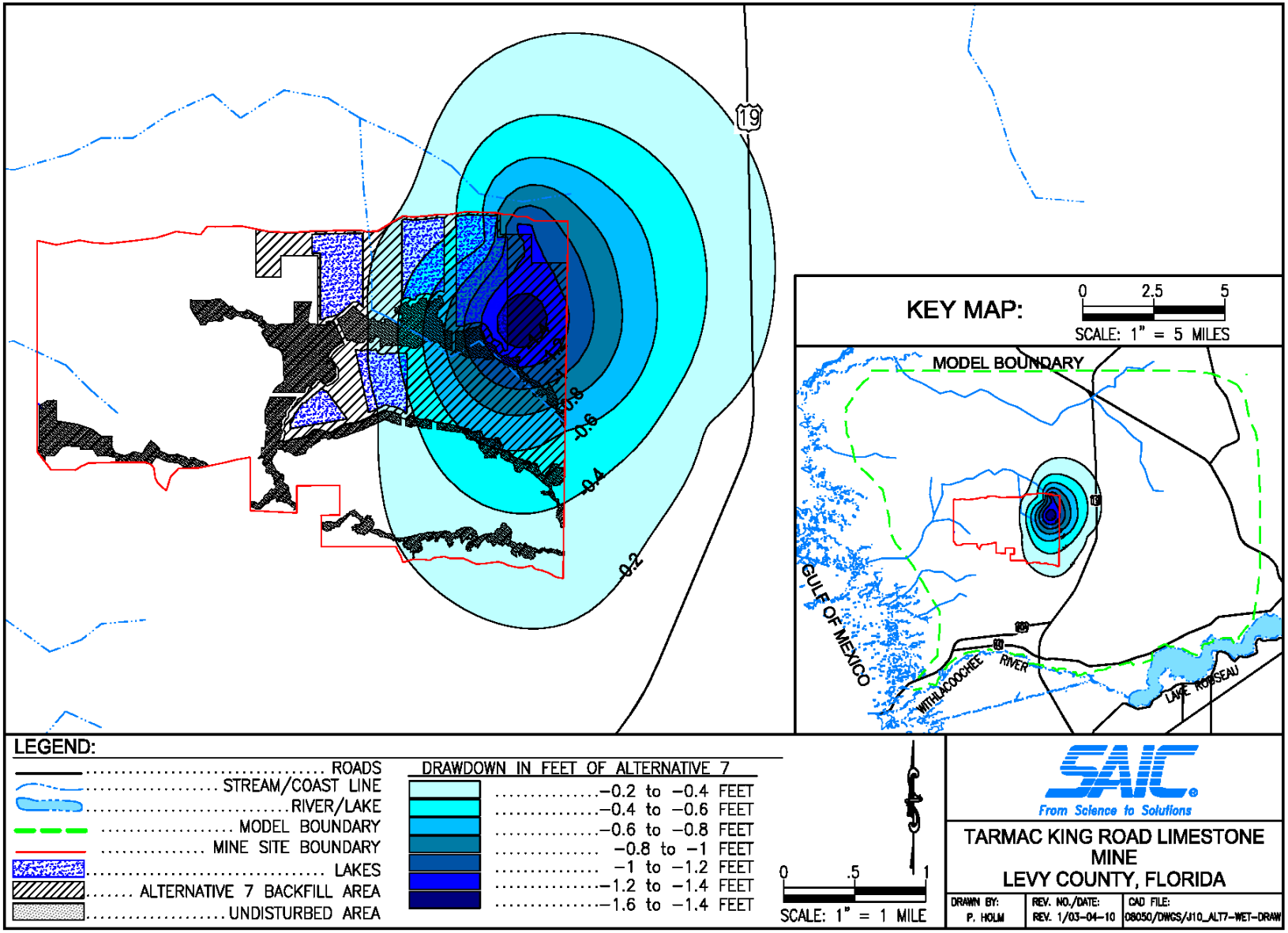

Figure A–18. Alternative 7 Drawdown Under Wet Conditions (CY 2004 Simulation)

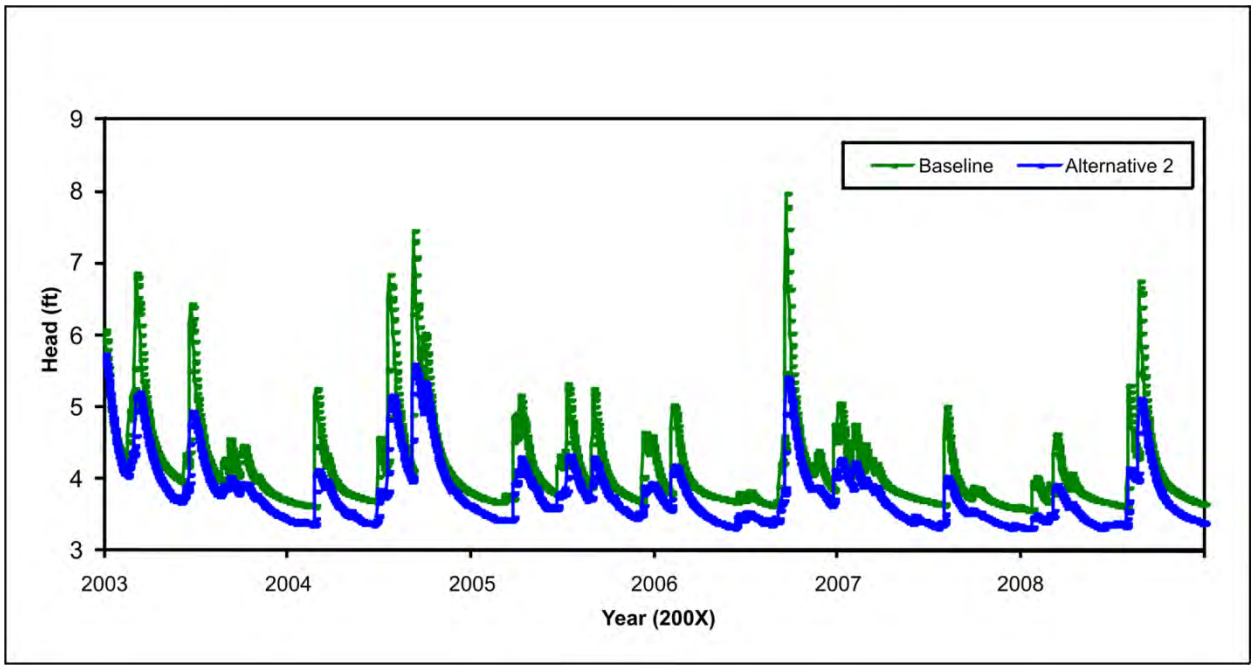

Figure A–19. Monitoring Station Monitoring Well 1 – Baseline vs. Alternative 2

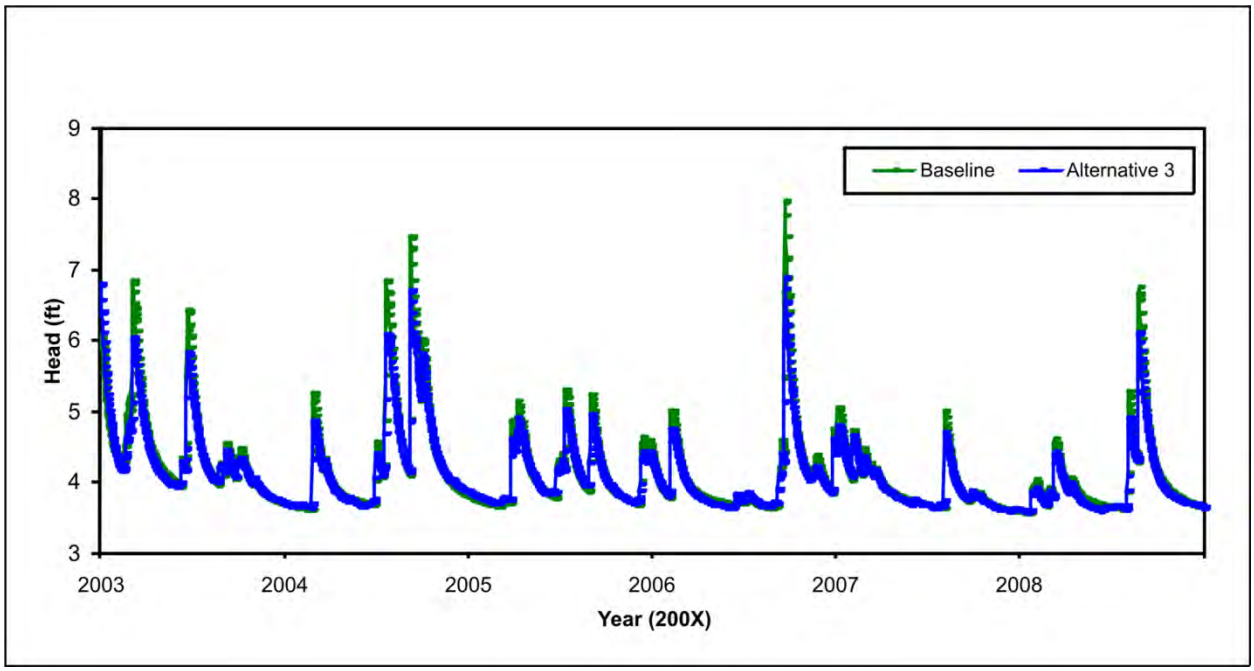

Figure A–20. Monitoring Station Monitoring Well 1 – Baseline vs. Alternative 3

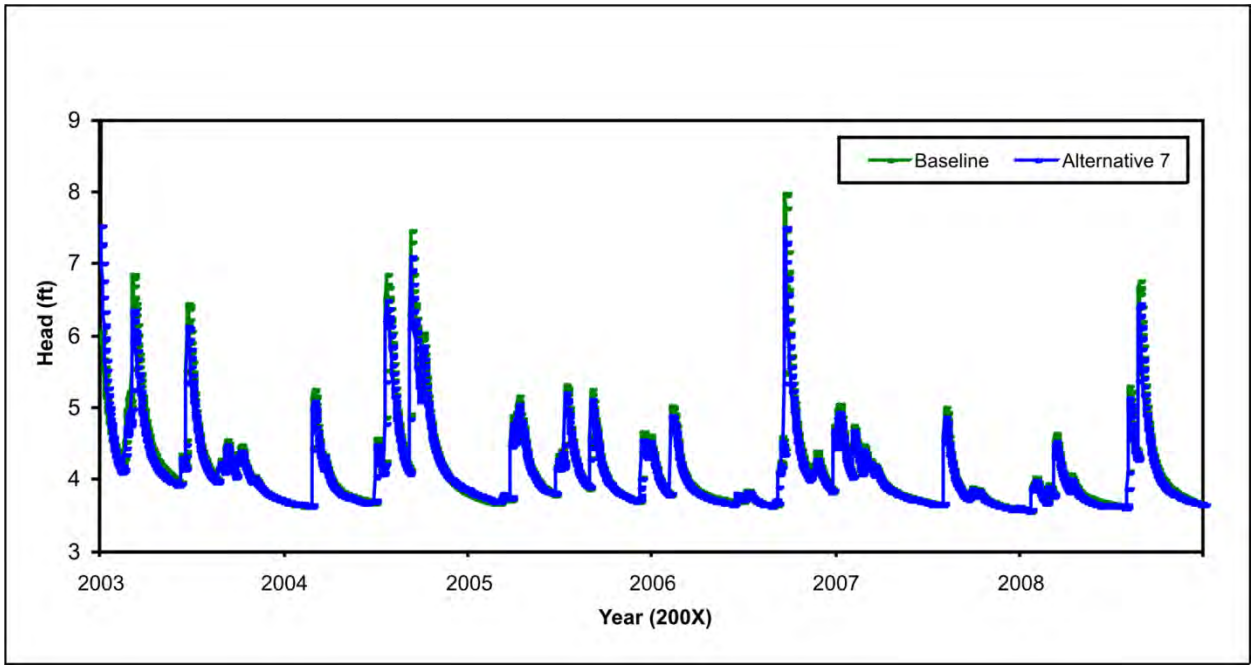

Figure A–21. Monitoring Station Monitoring Well 1 – Baseline vs. Alternative 7

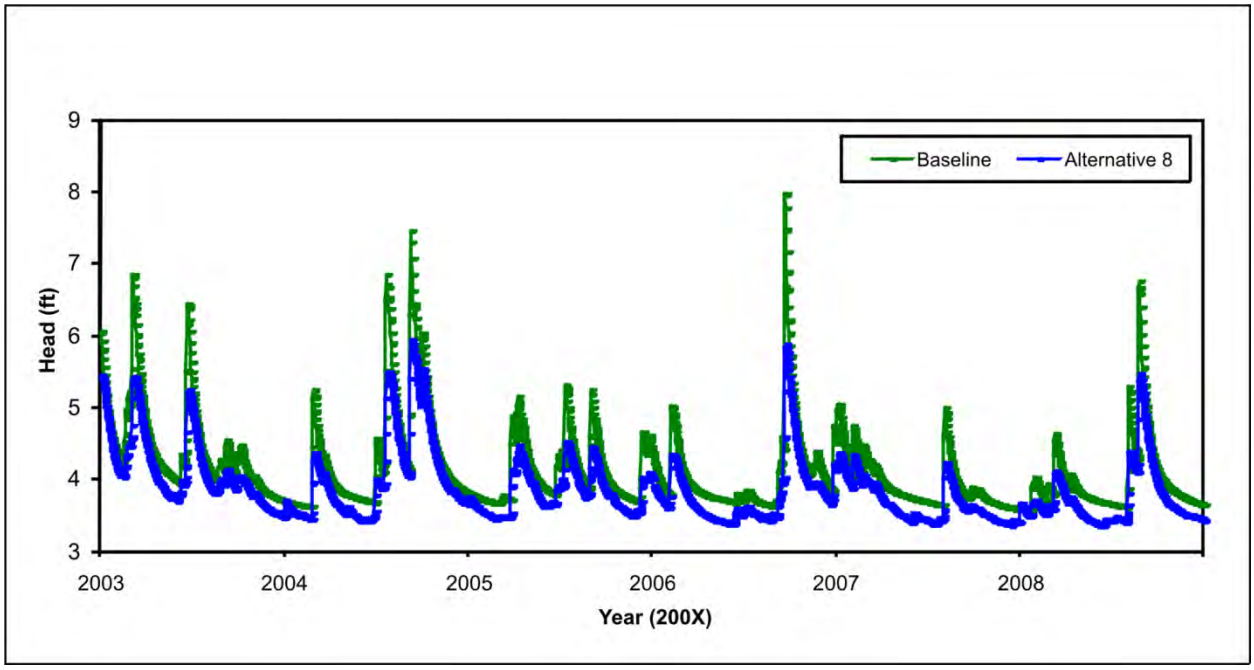

Figure A–22. Monitoring Station Monitoring Well 1 – Baseline vs. Alternative 8

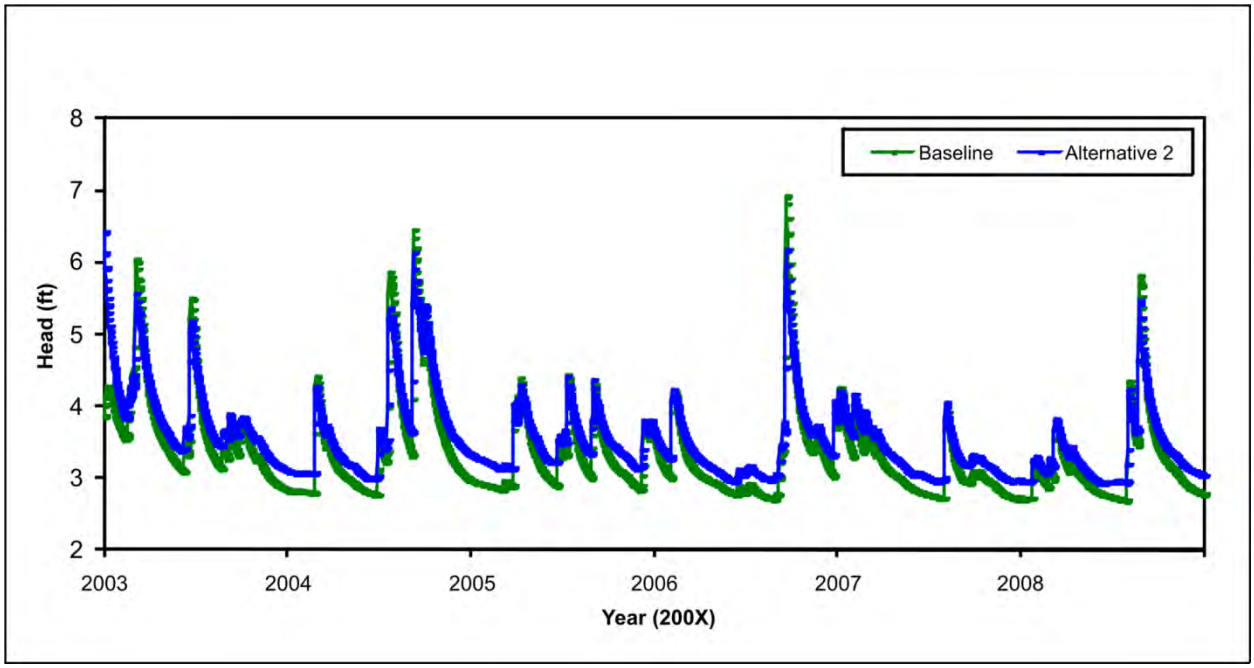

Figure A–23. Monitoring Station Monitoring Well 2 – Baseline vs. Alternative 2

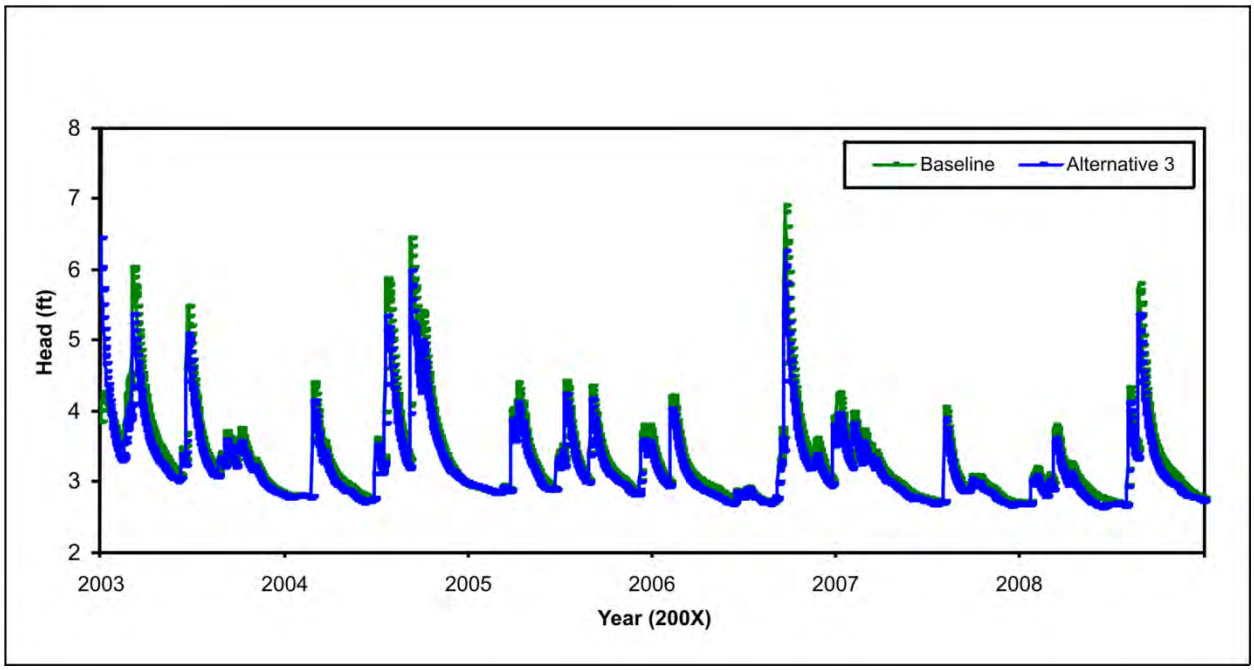

Figure A–24. Monitoring Station Monitoring Well 2 – Baseline vs. Alternative 3

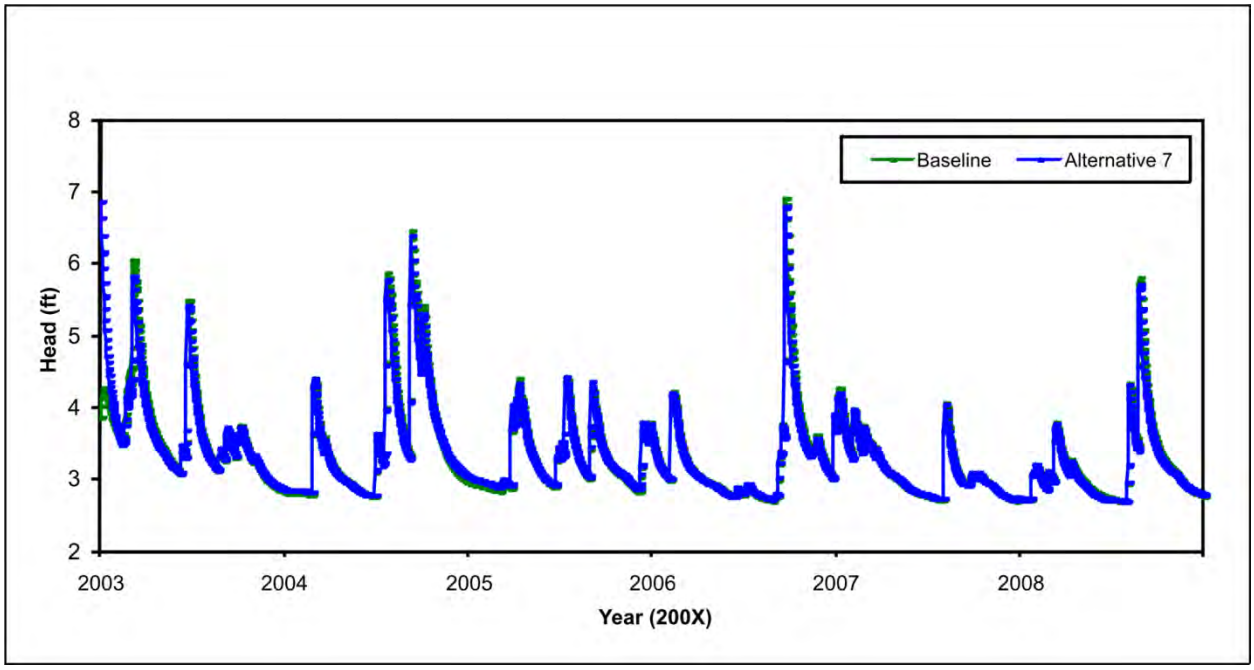

Figure A–25. Monitoring Station Monitoring Well 2 – Baseline vs. Alternative 7

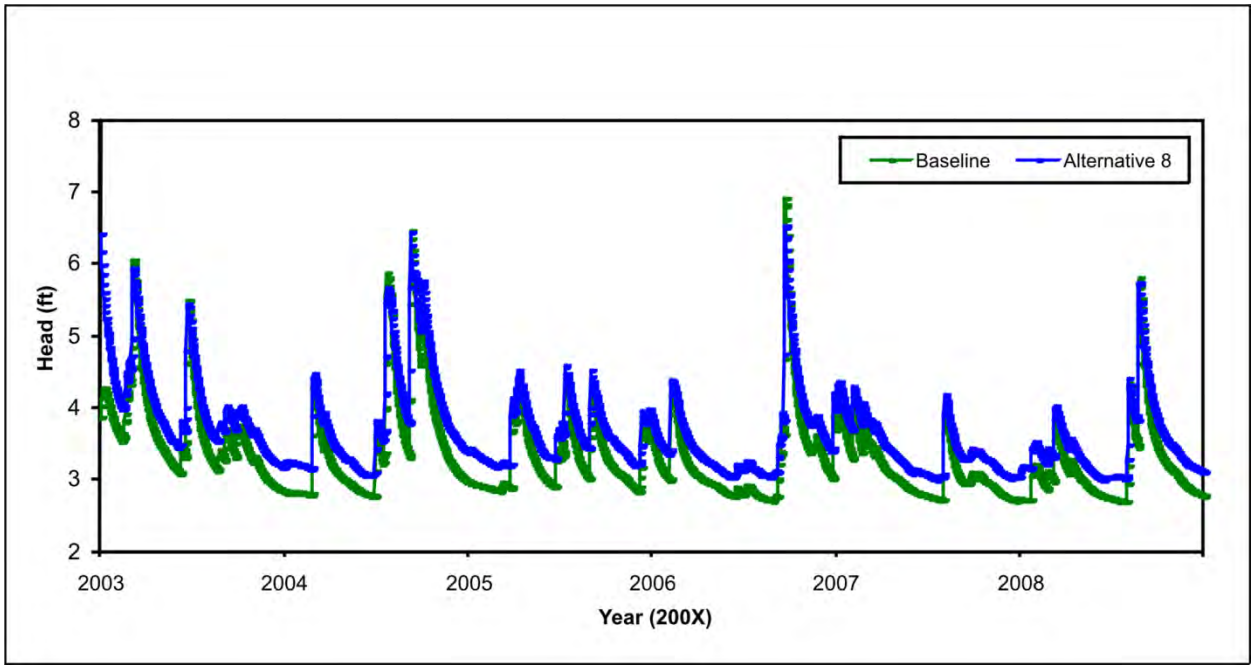

Figure A–26. Monitoring Station Monitoring Well 2 – Baseline vs. Alternative 8

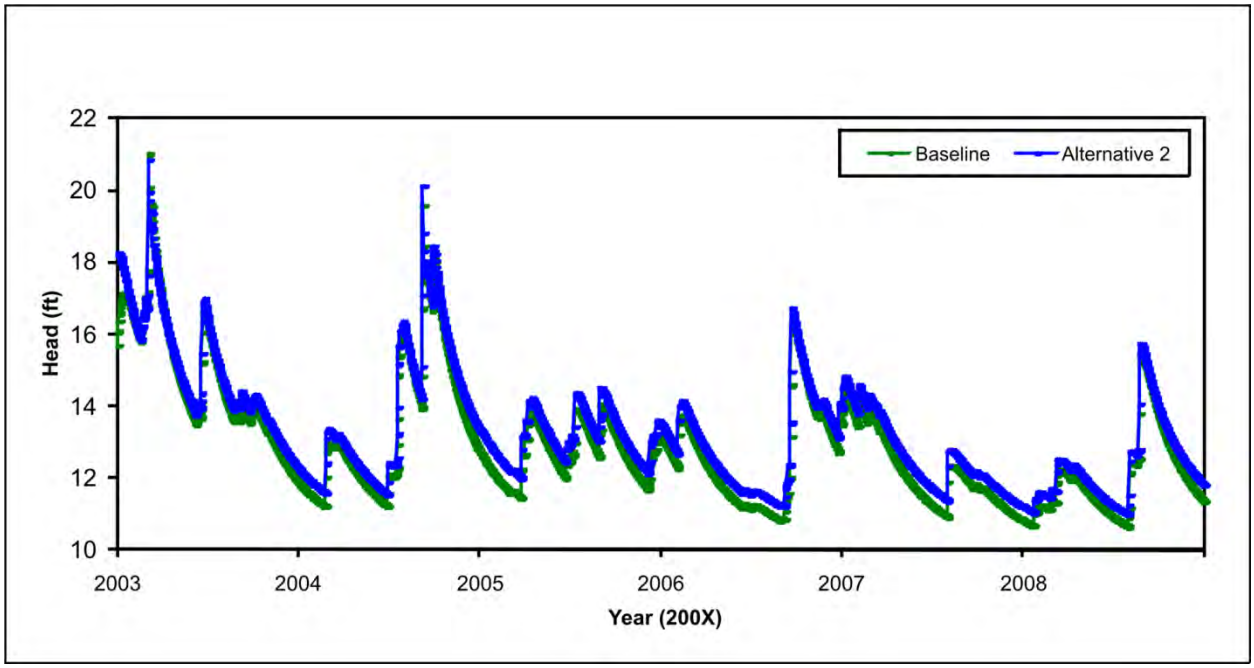

Figure A–27. Monitoring Station Monitoring Well 3 – Baseline vs. Alternative 2

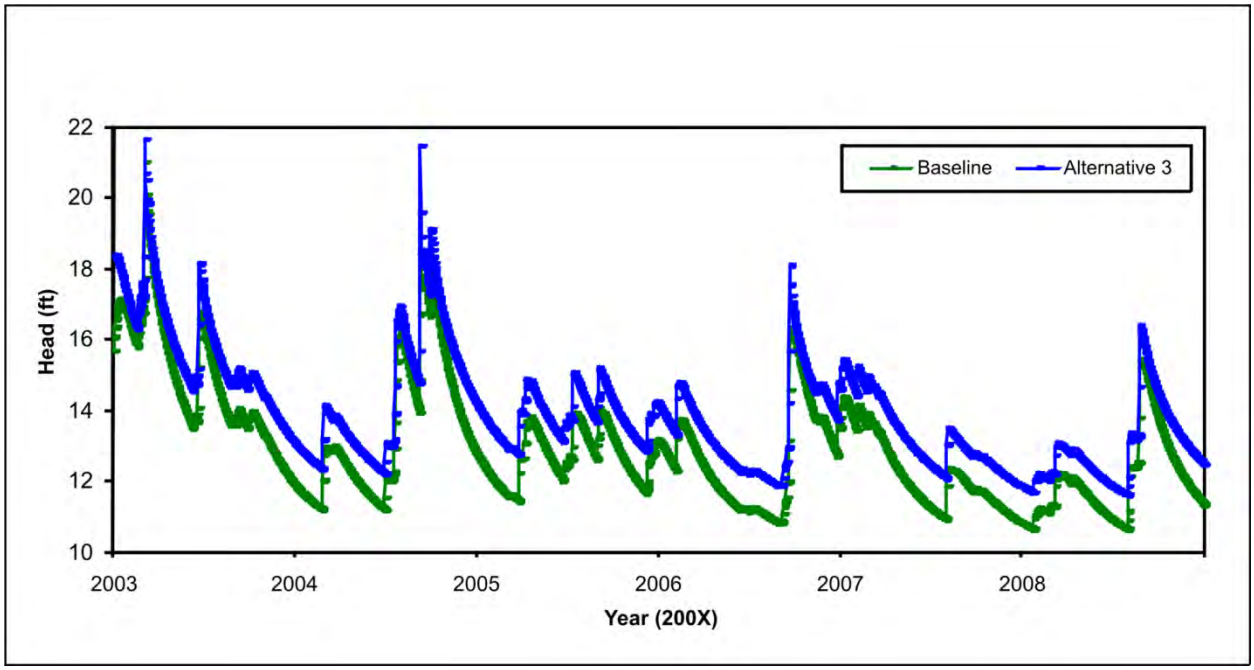

Figure A–28. Monitoring Station Monitoring Well 3 – Baseline vs. Alternative 3

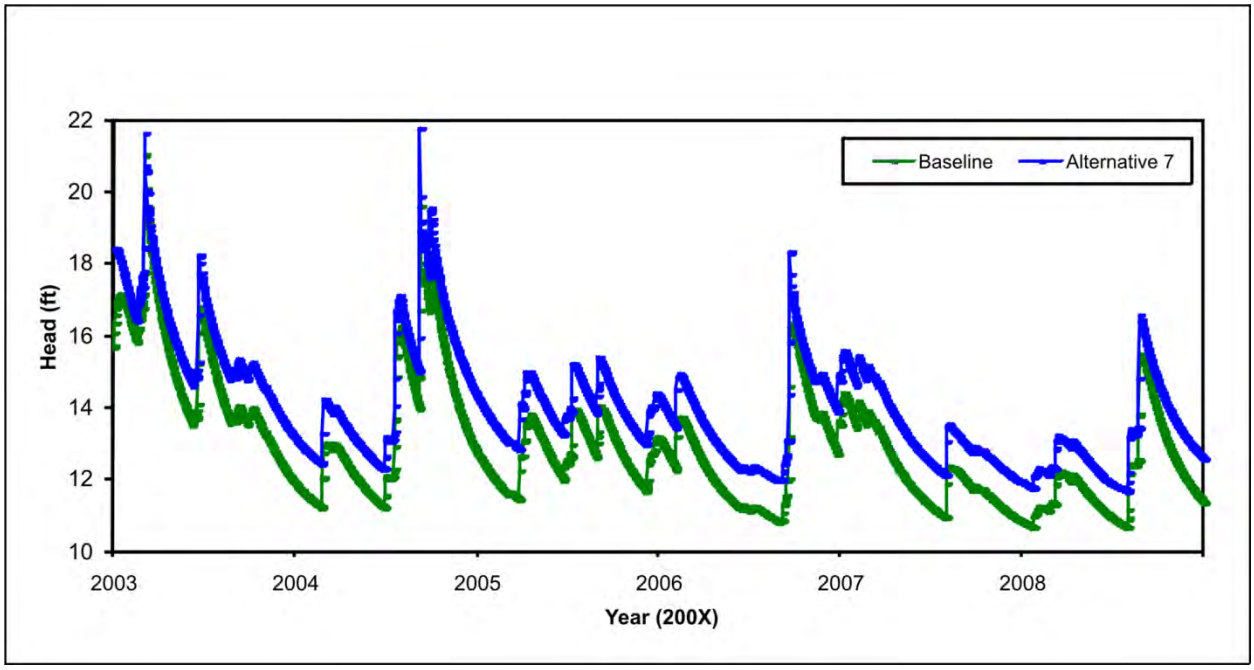

Figure A–29. Monitoring Station Monitoring Well 3 – Baseline vs. Alternative 7

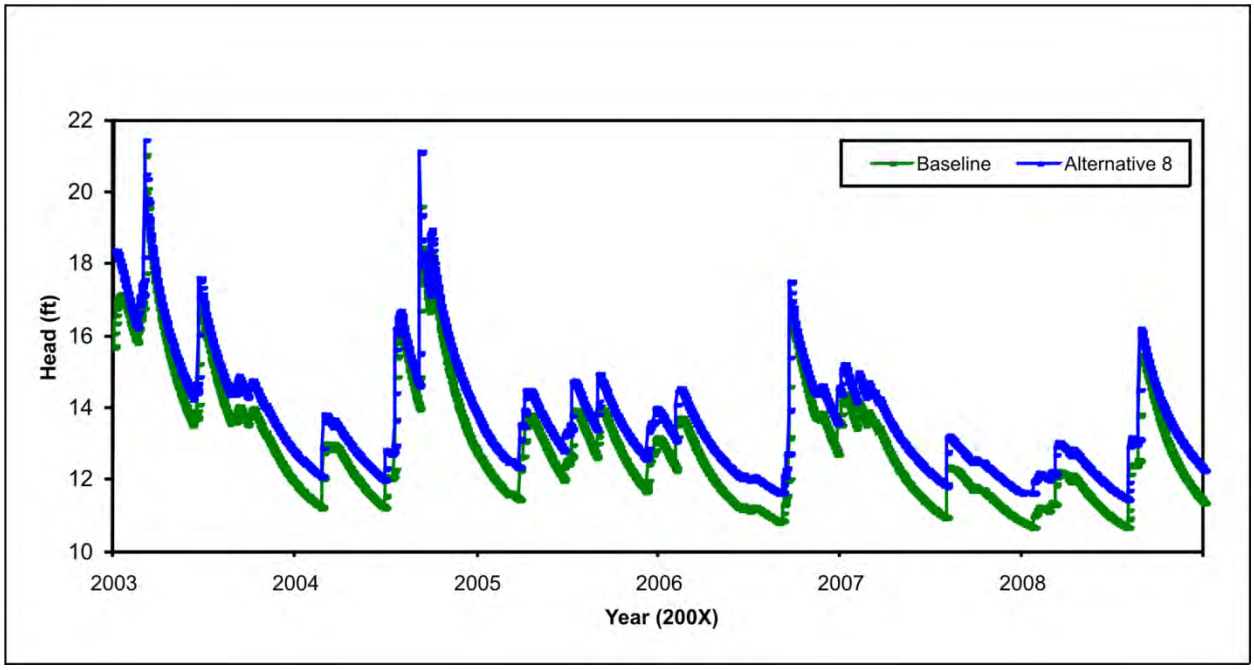

Figure A–30. Monitoring Station Monitoring Well 3 – Baseline vs. Alternative 8

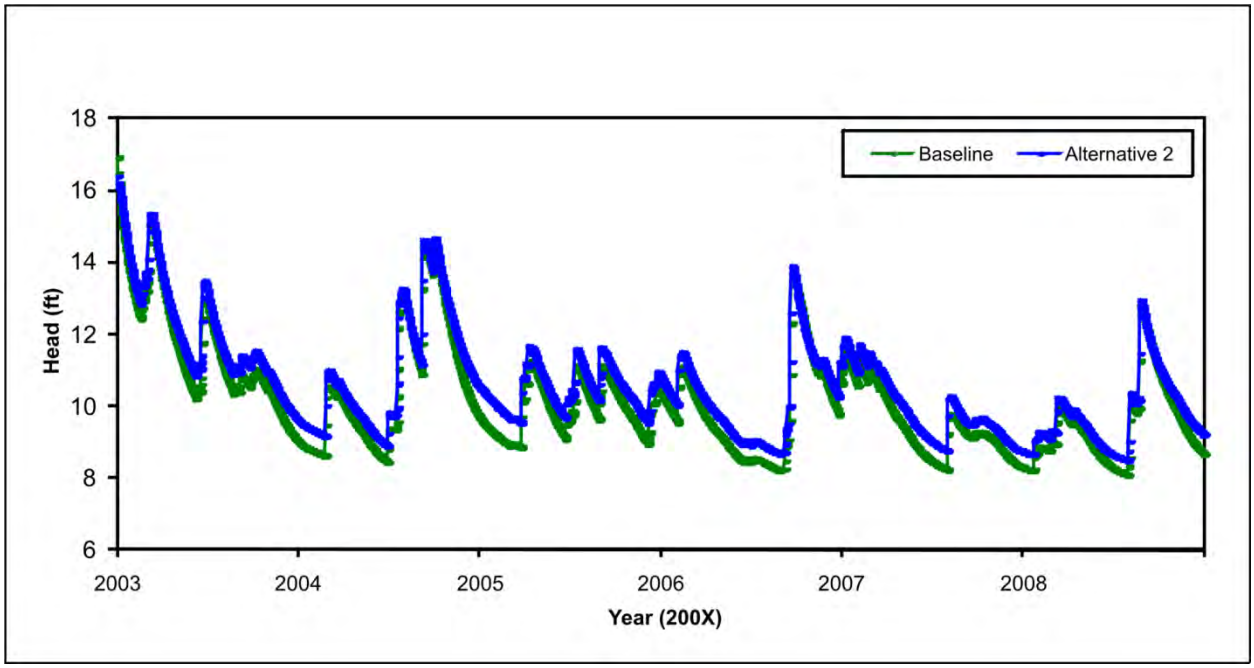

Figure A–31. Monitoring Station Monitoring Well 4 – Baseline vs. Alternative 2

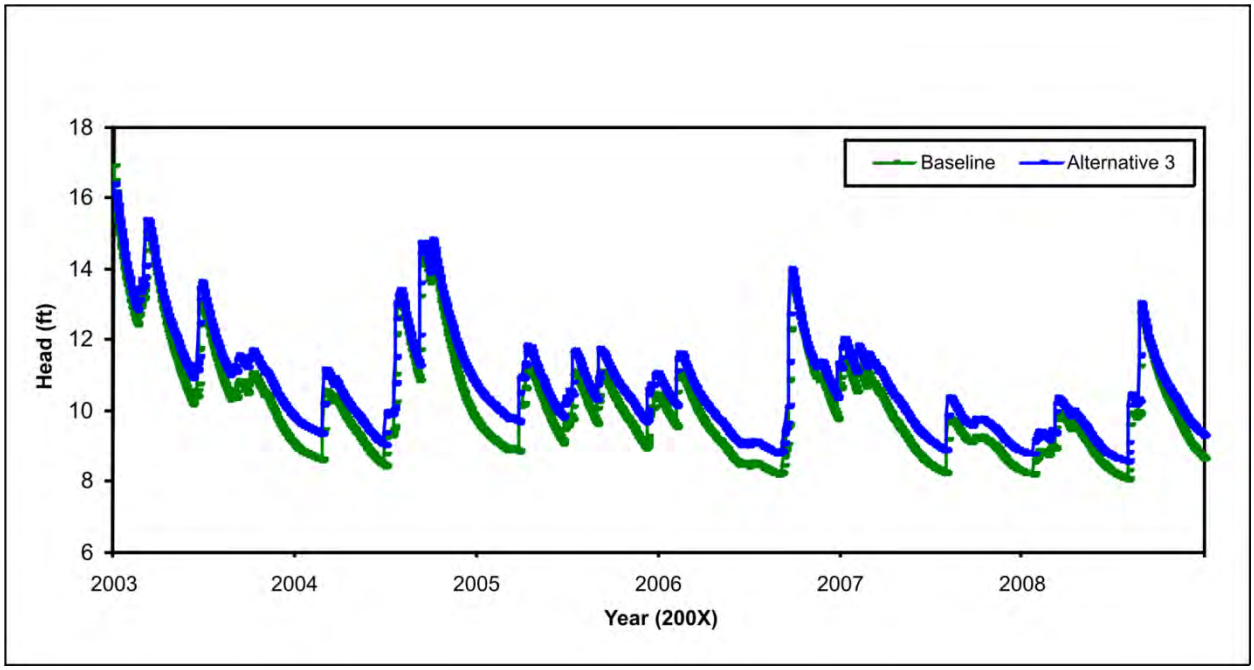

Figure A–32. Monitoring Station Monitoring Well 4 – Baseline vs. Alternative 3

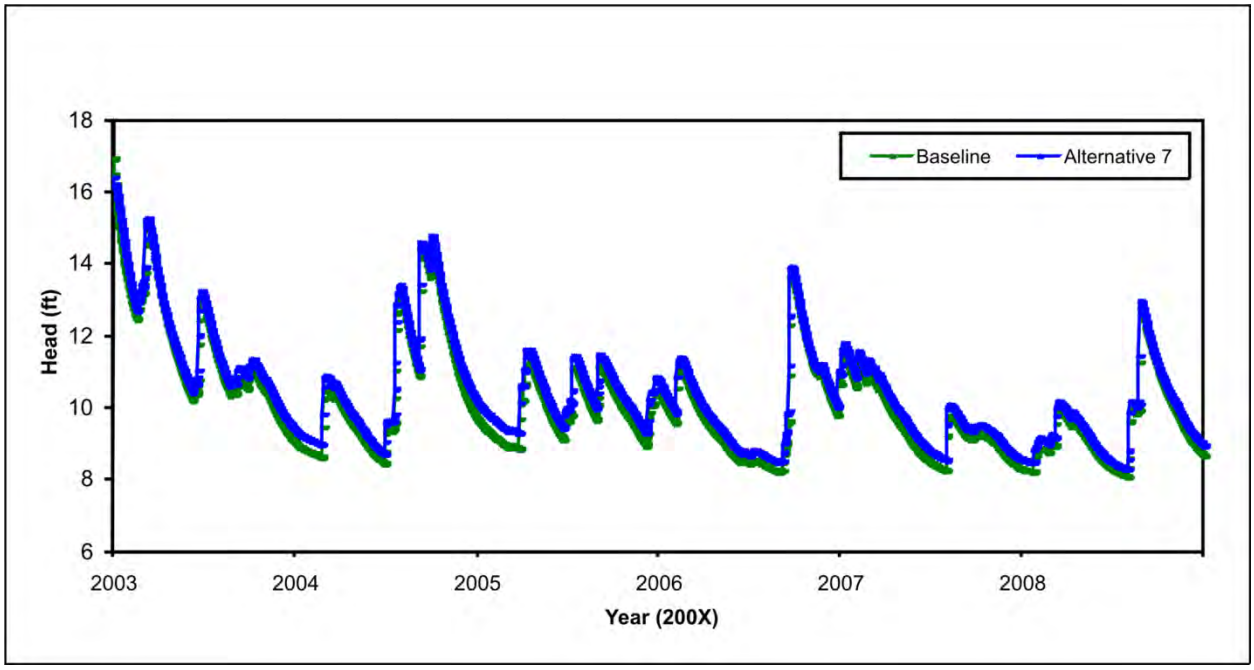

Figure A–33. Monitoring Station Monitoring Well 4 – Baseline vs. Alternative 7

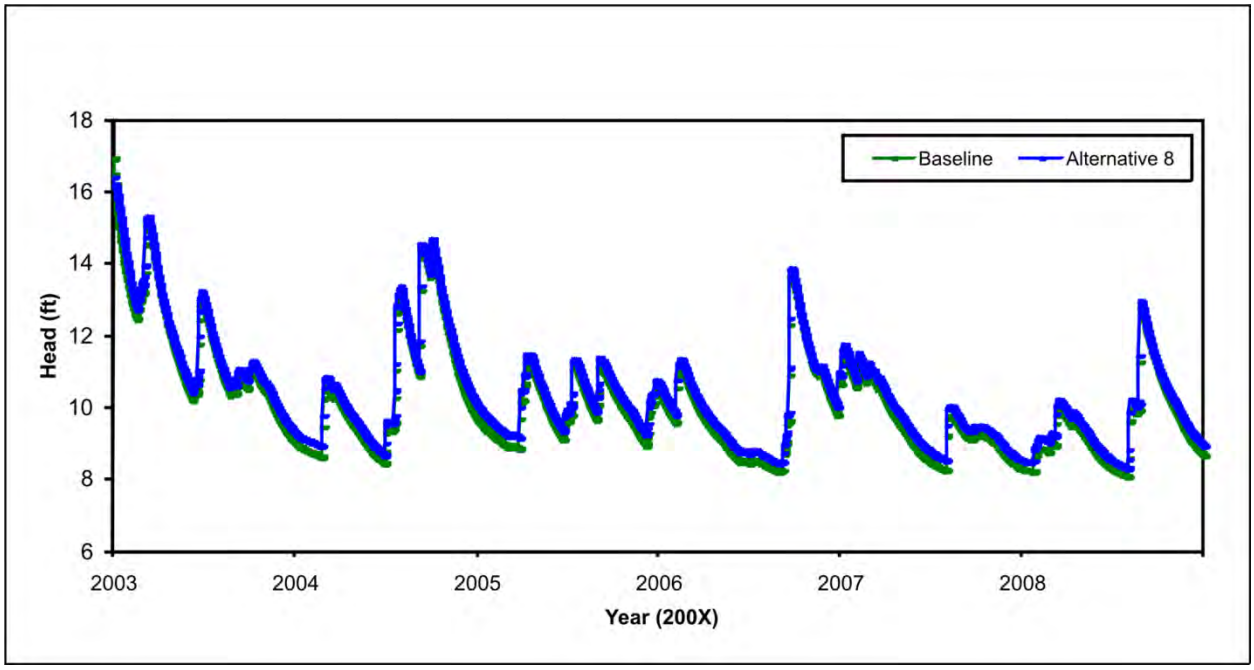

Figure A–34. Monitoring Station Monitoring Well 4 – Baseline vs. Alternative 8

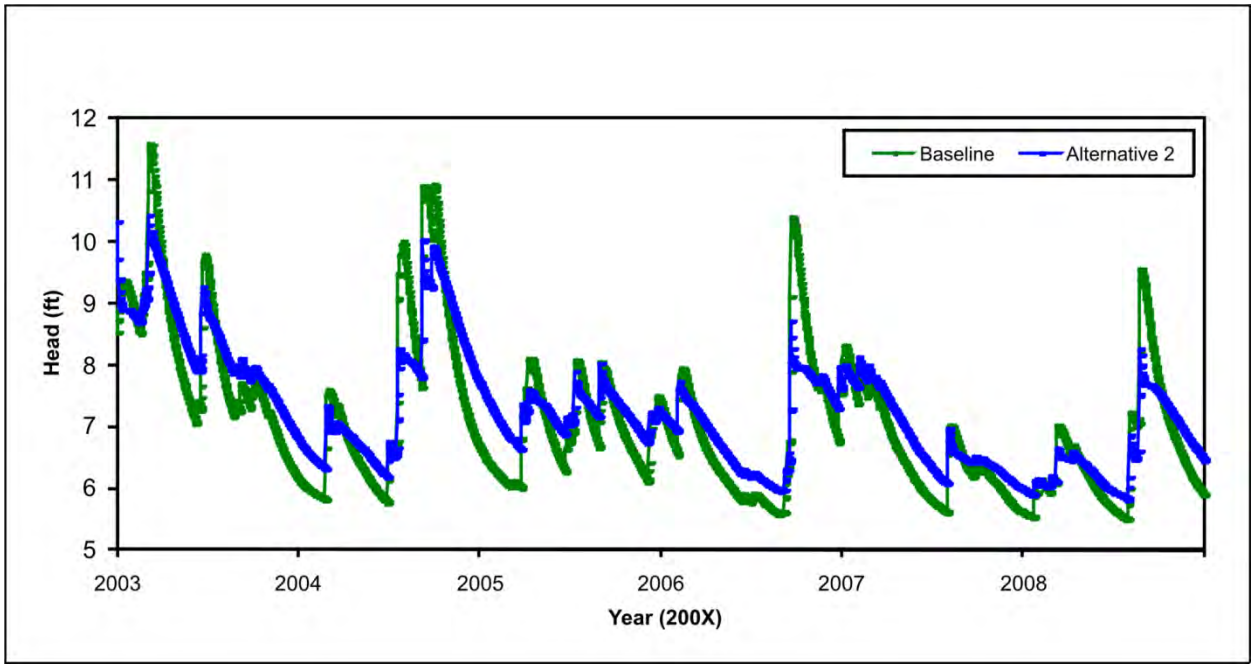

Figure A–35. Monitoring Station Monitoring Well 5 – Baseline vs. Alternative 2

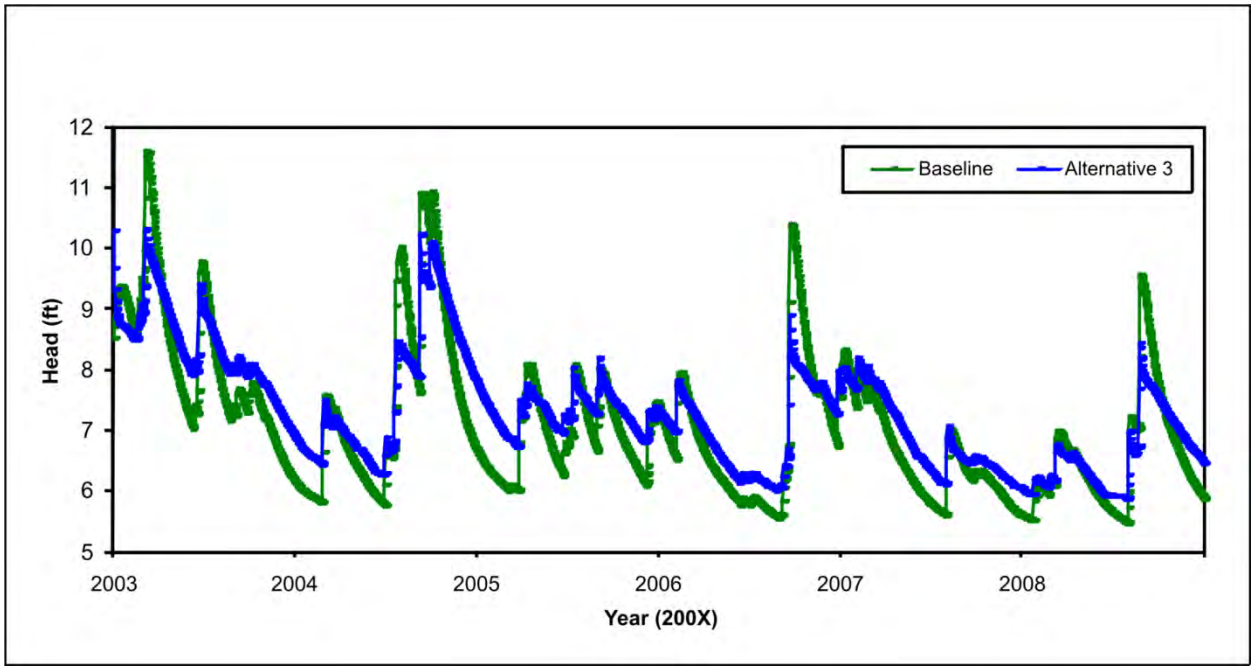

Figure A–36. Monitoring Station Monitoring Well 5 – Baseline vs. Alternative 3

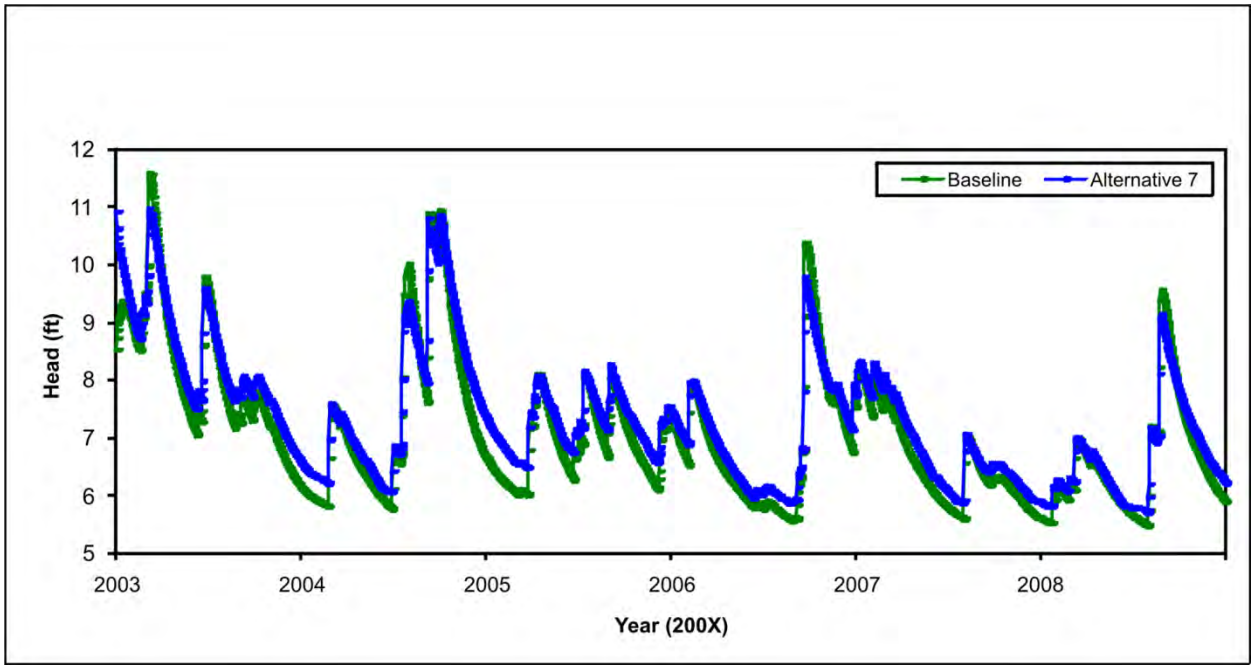

Figure A–37. Monitoring Station Monitoring Well 5 – Baseline vs. Alternative 7

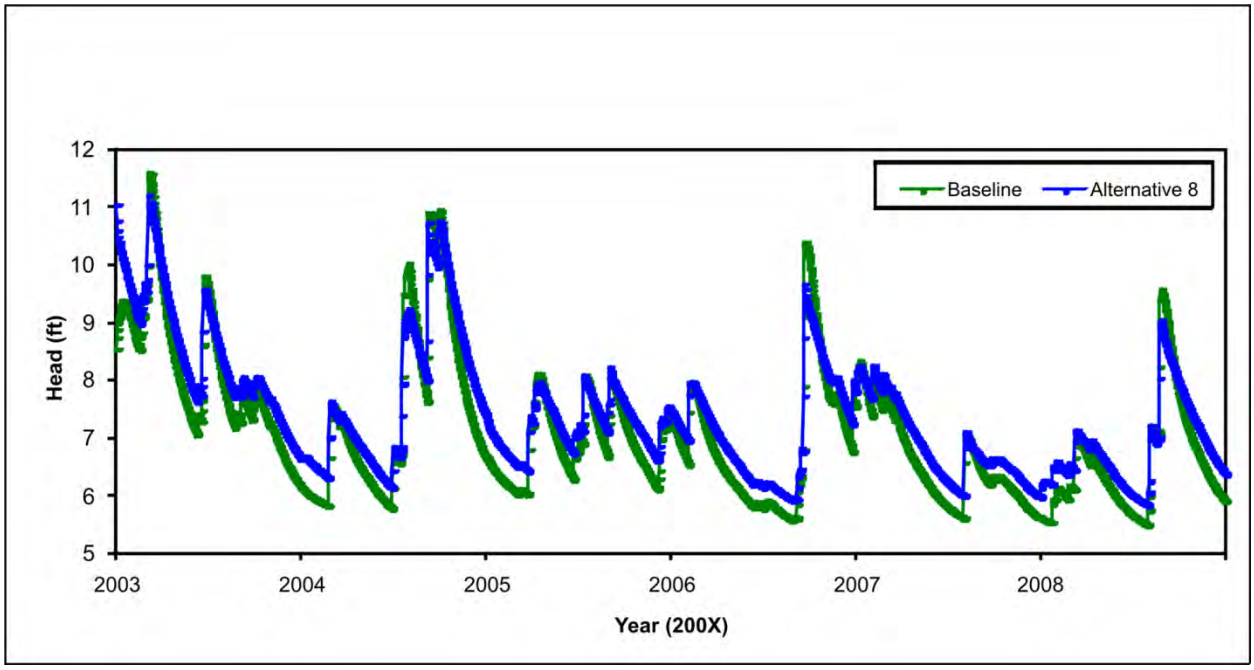

Figure A–38. Monitoring Station Monitoring Well 5 – Baseline vs. Alternative 8

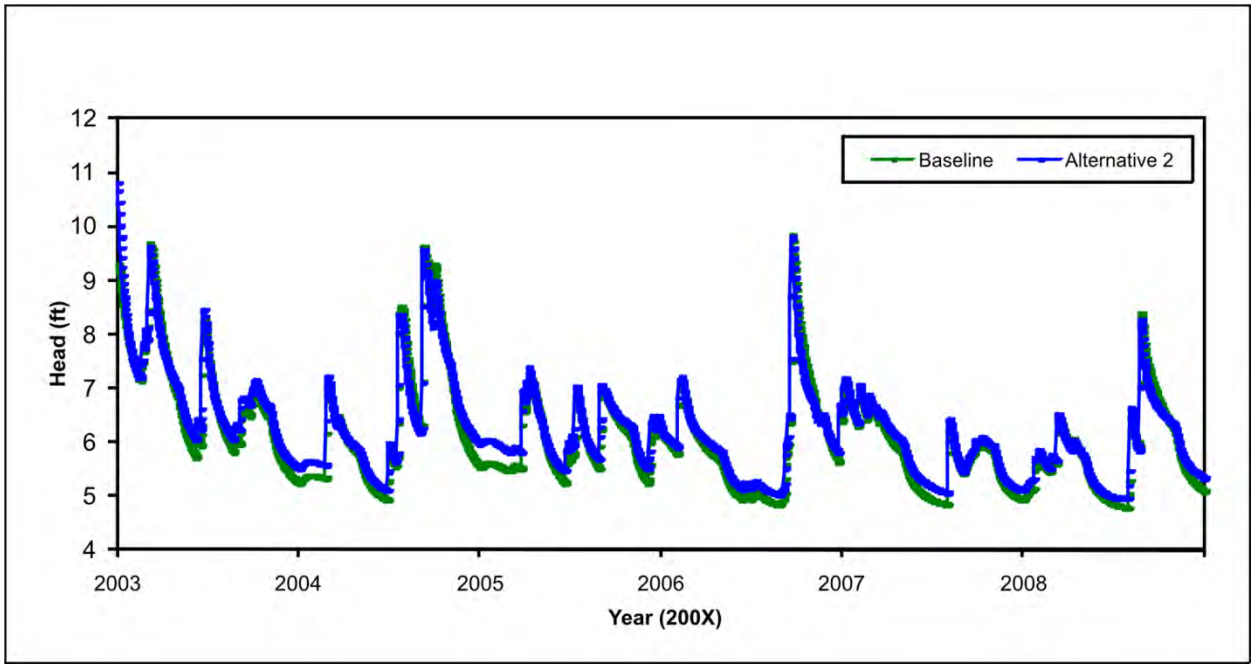

Figure A–39. Monitoring Station Monitoring Well 6 – Baseline vs. Alternative 2

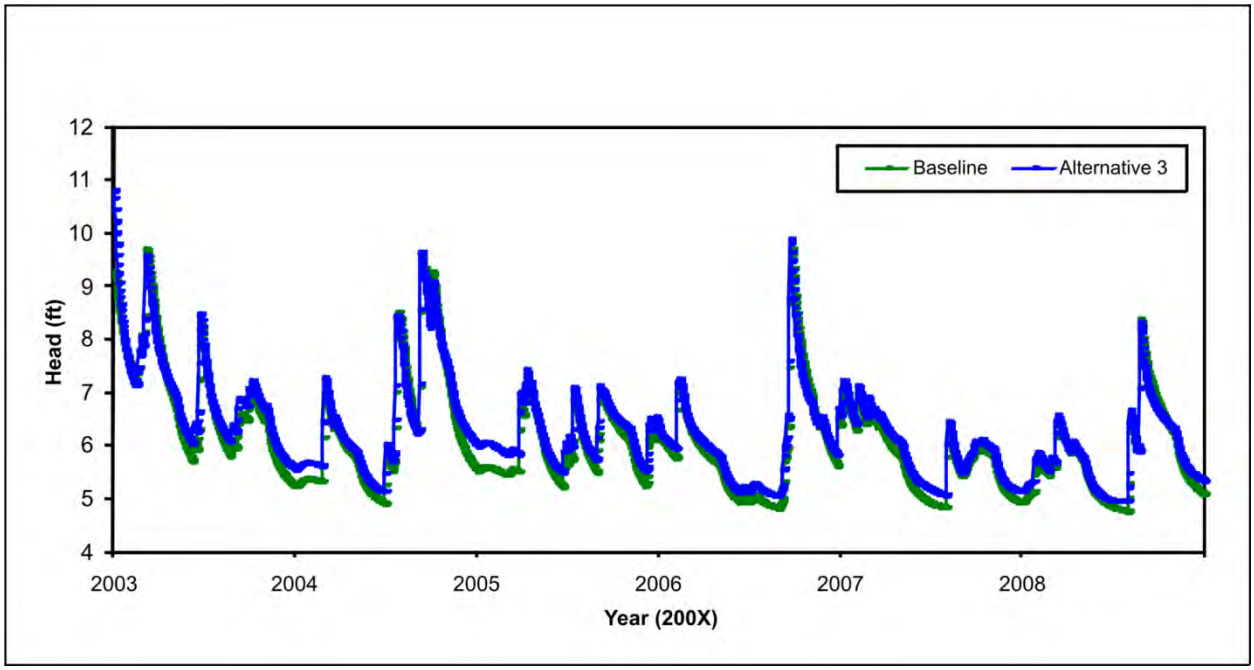

Figure A–40. Monitoring Station Monitoring Well 6 – Baseline vs. Alternative 3

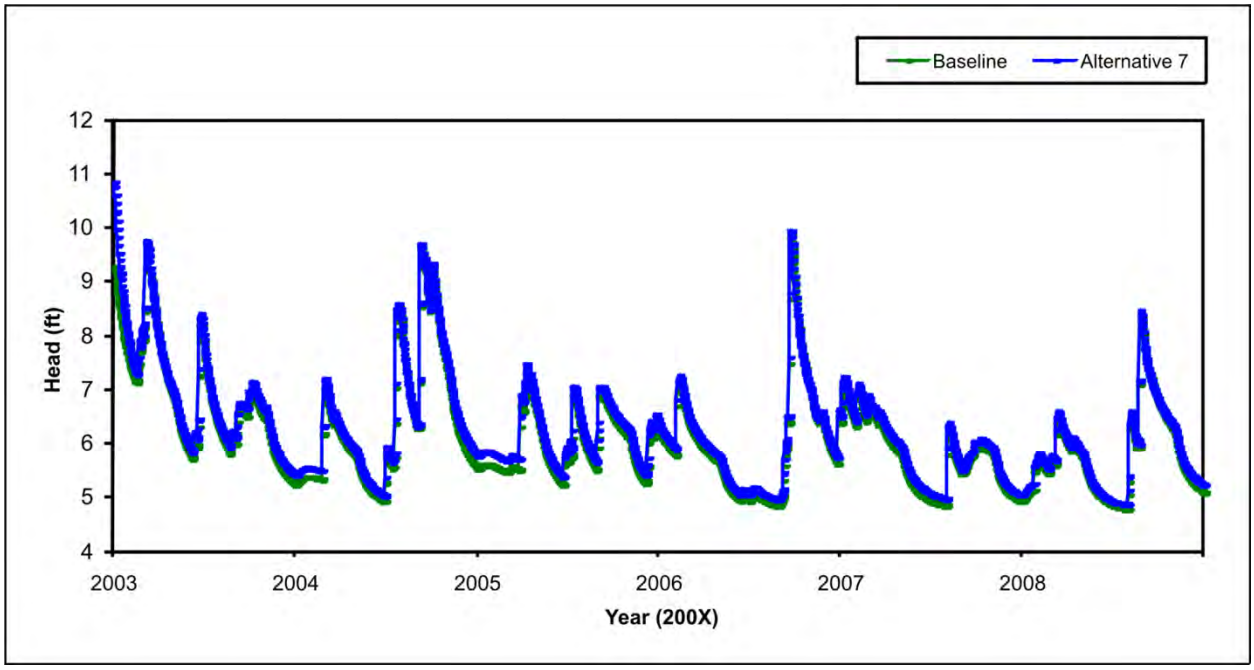

Figure A–41. Monitoring Station Monitoring Well 6 – Baseline vs. Alternative 7

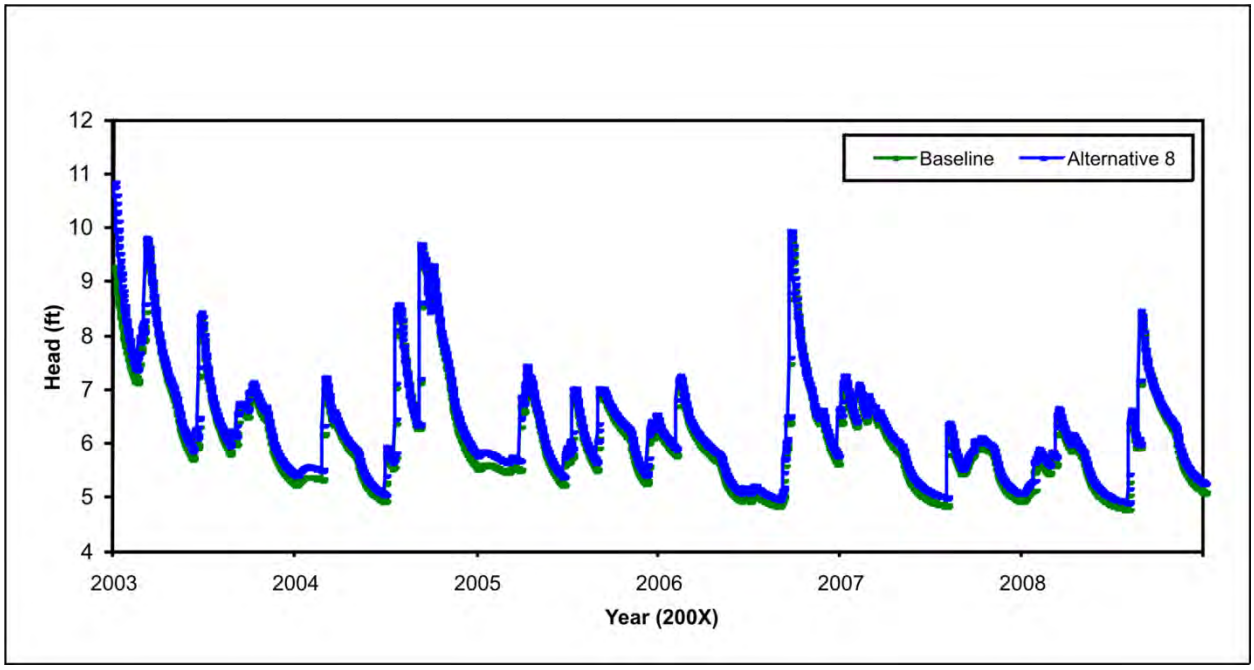

Figure A–42. Monitoring Station Monitoring Well 6 – Baseline vs. Alternative 8

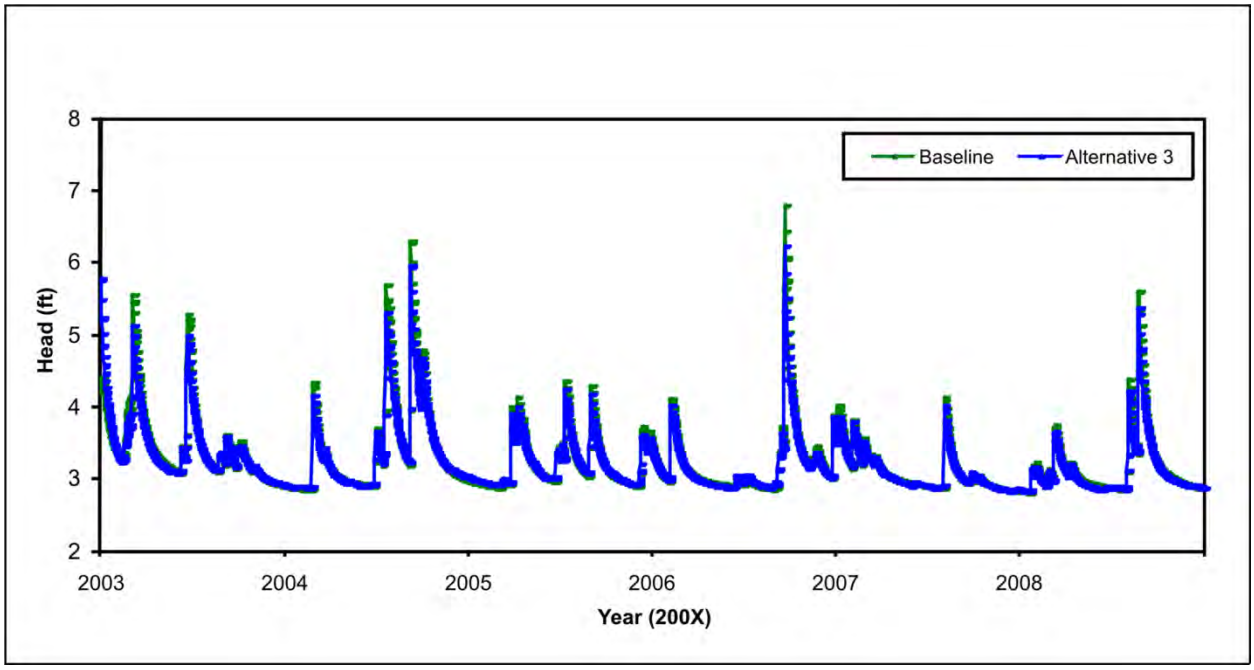

Figure A–43. Monitoring Station Transect Well 1snk – Baseline vs. Alternative 3

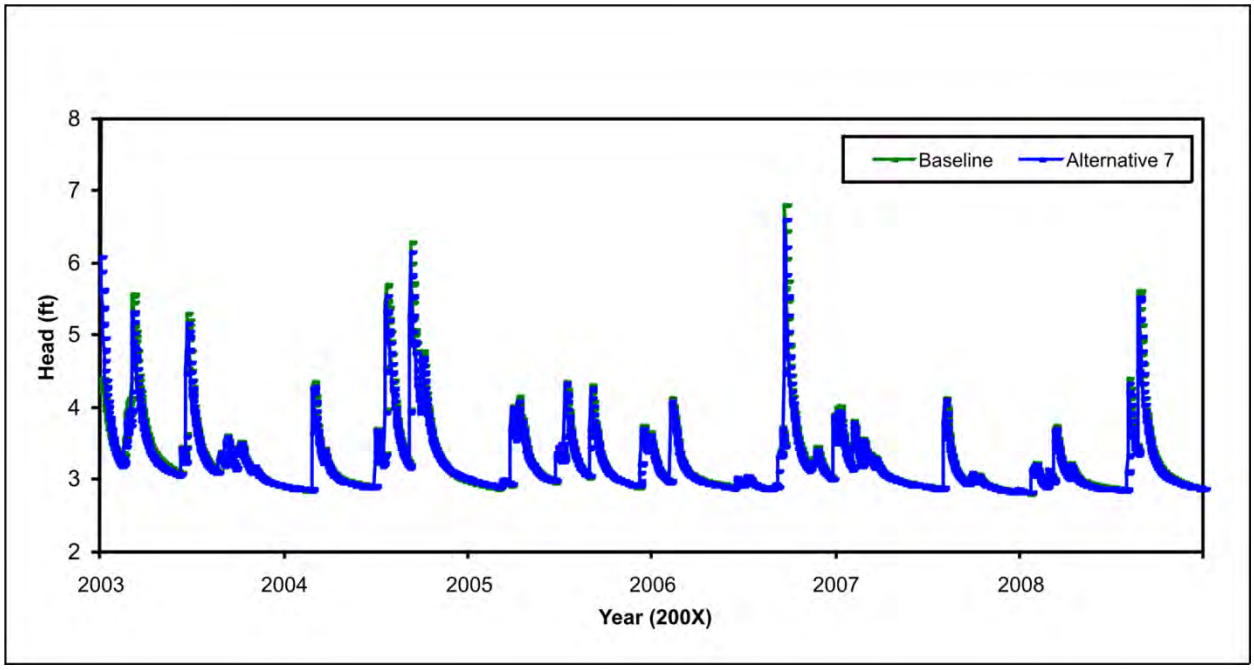

Figure A–44. Monitoring Station Transect Well 1snk – Baseline vs. Alternative 7

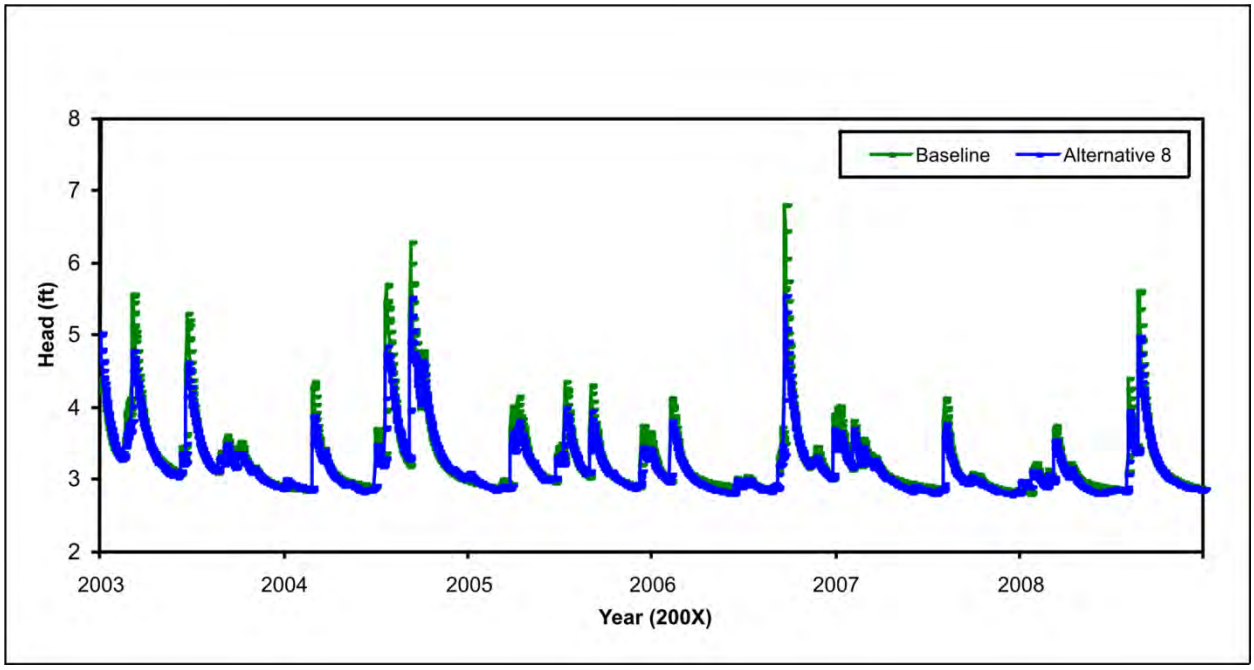

Figure A–45. Monitoring Station Transect Well 1snk – Baseline vs. Alternative 8

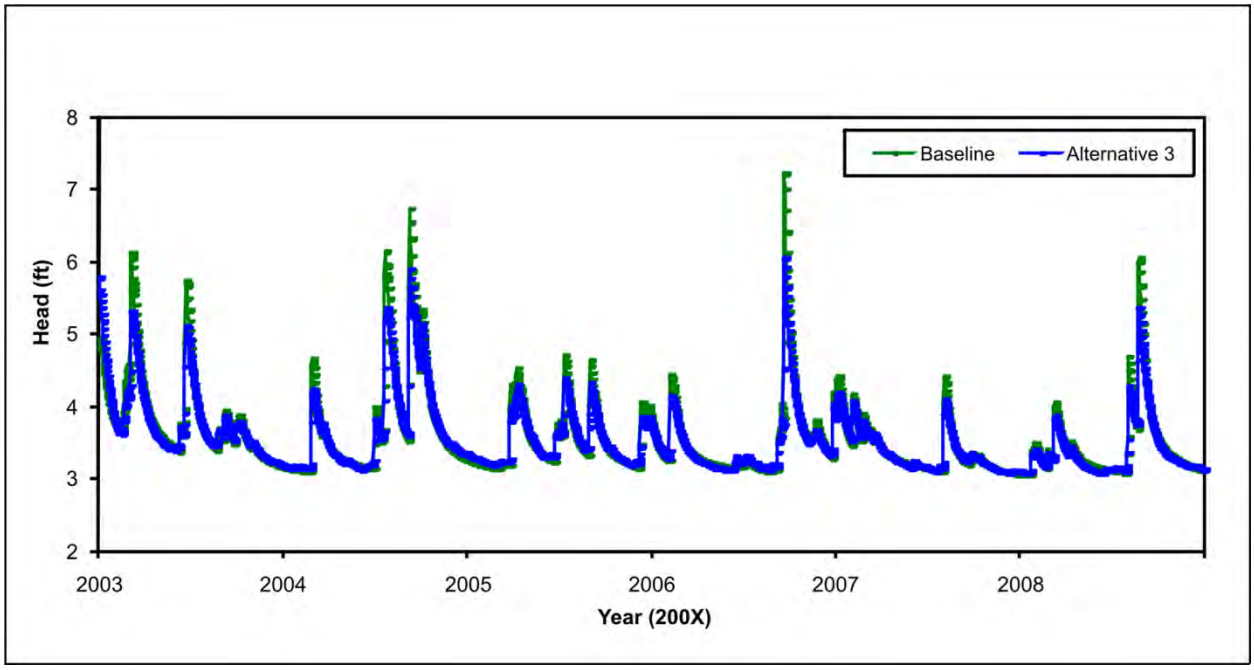

Figure A–46. Monitoring Station Transect Well 2snk – Baseline vs. Alternative 3

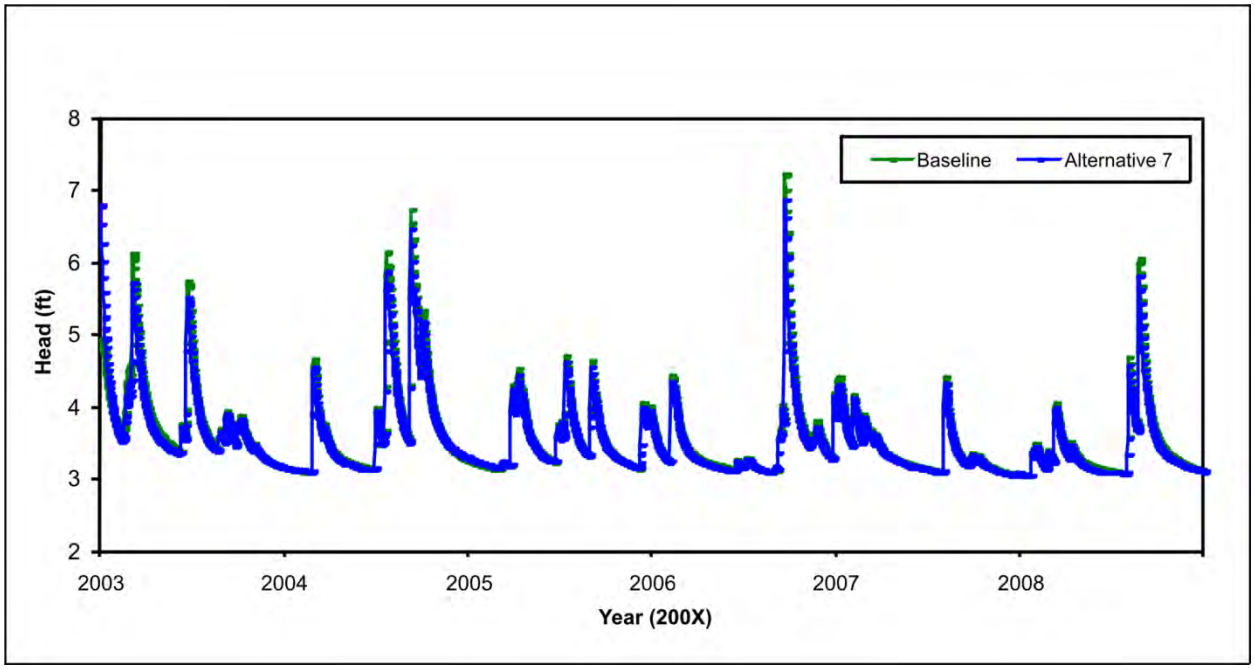

Figure A–47. Monitoring Station Transect Well 2snk – Baseline vs. Alternative 7

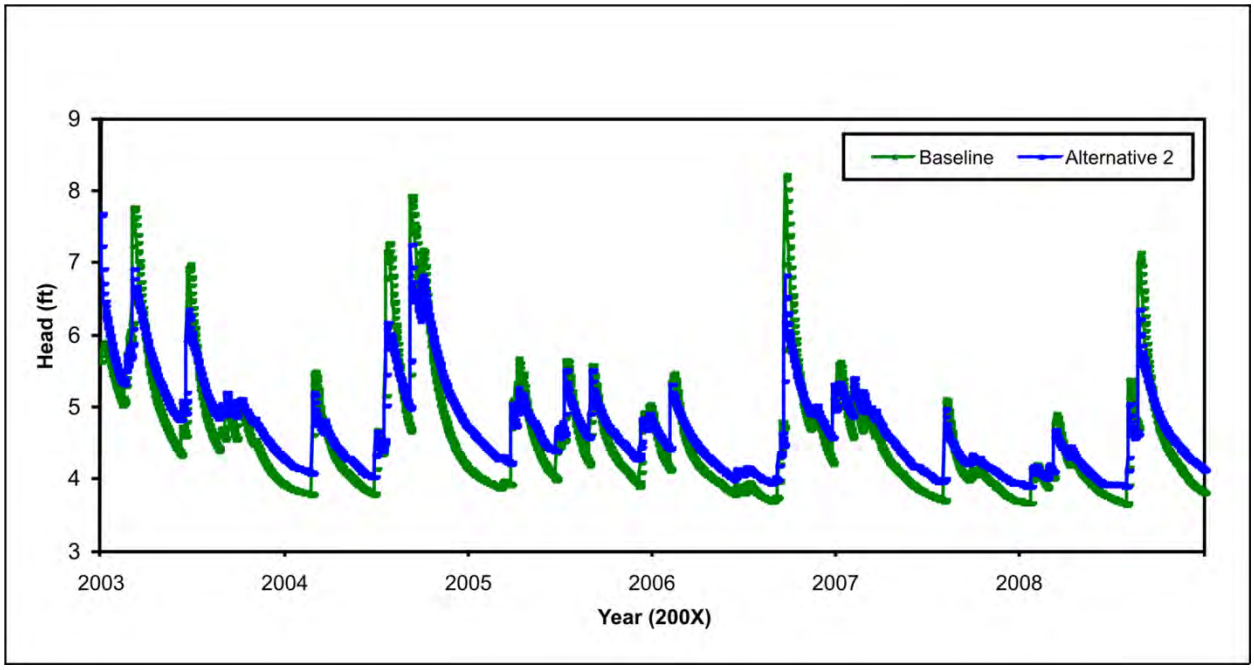

Figure A–48. Monitoring Station Transect Well 6snk – Baseline vs. Alternative 2

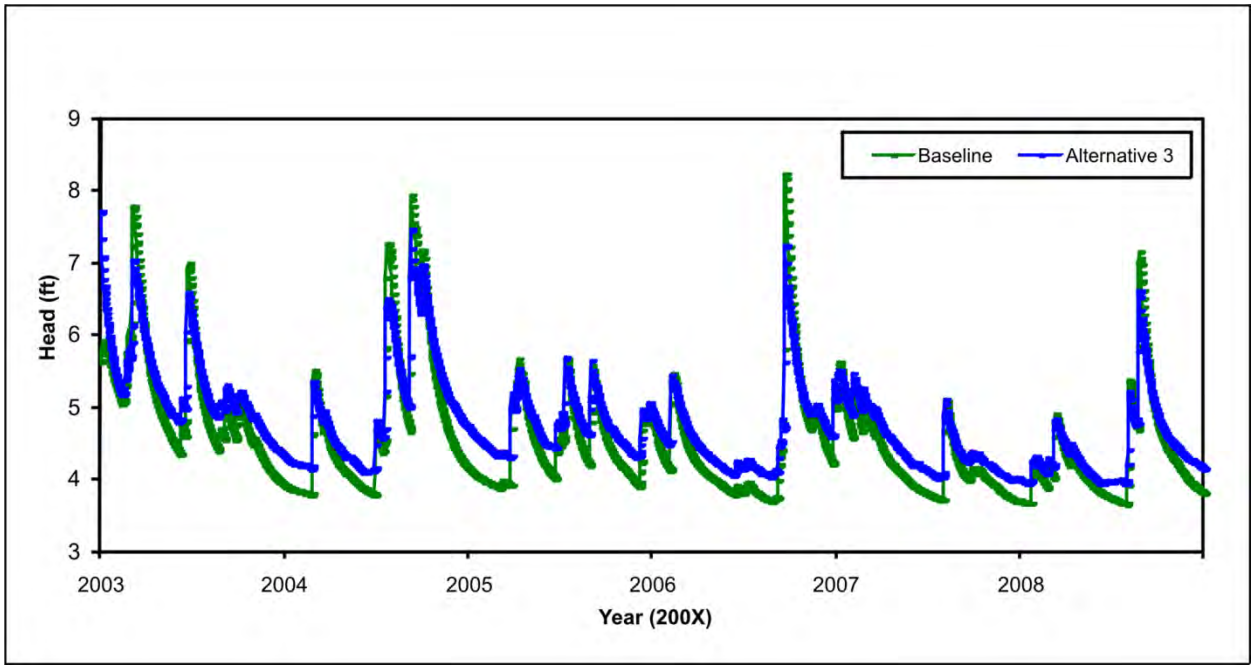

Figure A–49. Monitoring Station Transect Well 6snk – Baseline vs. Alternative 3

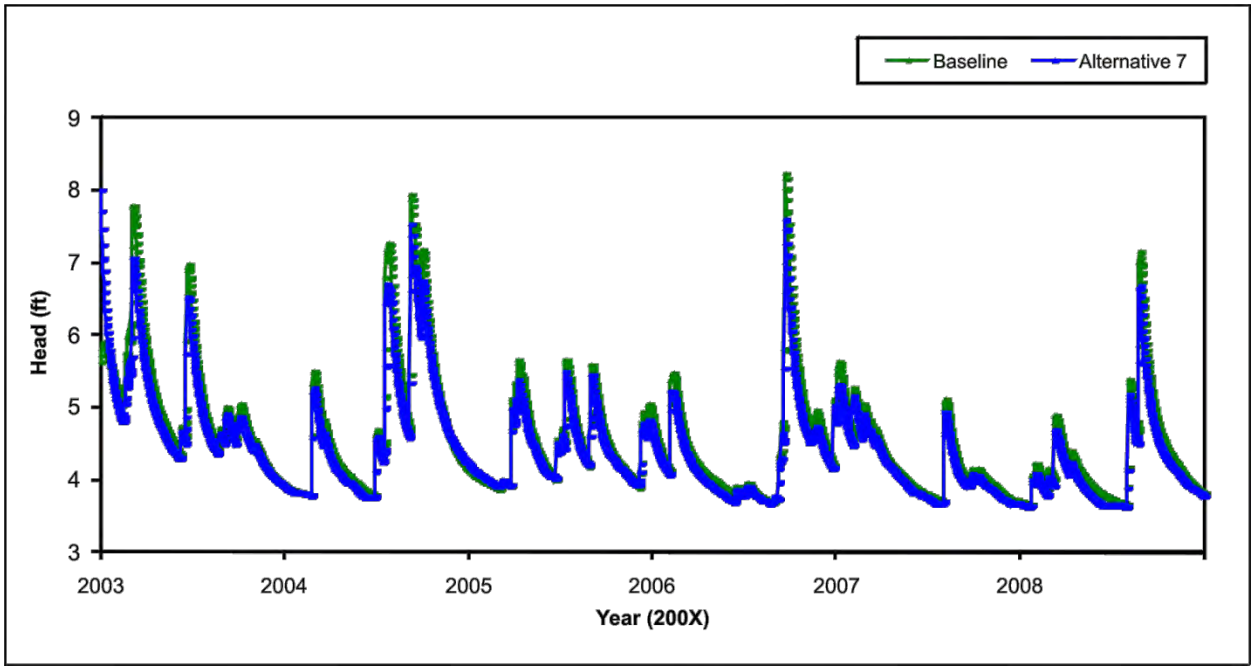

Figure A–50. Monitoring Station Transect Well 6snk – Baseline vs. Alternative 7

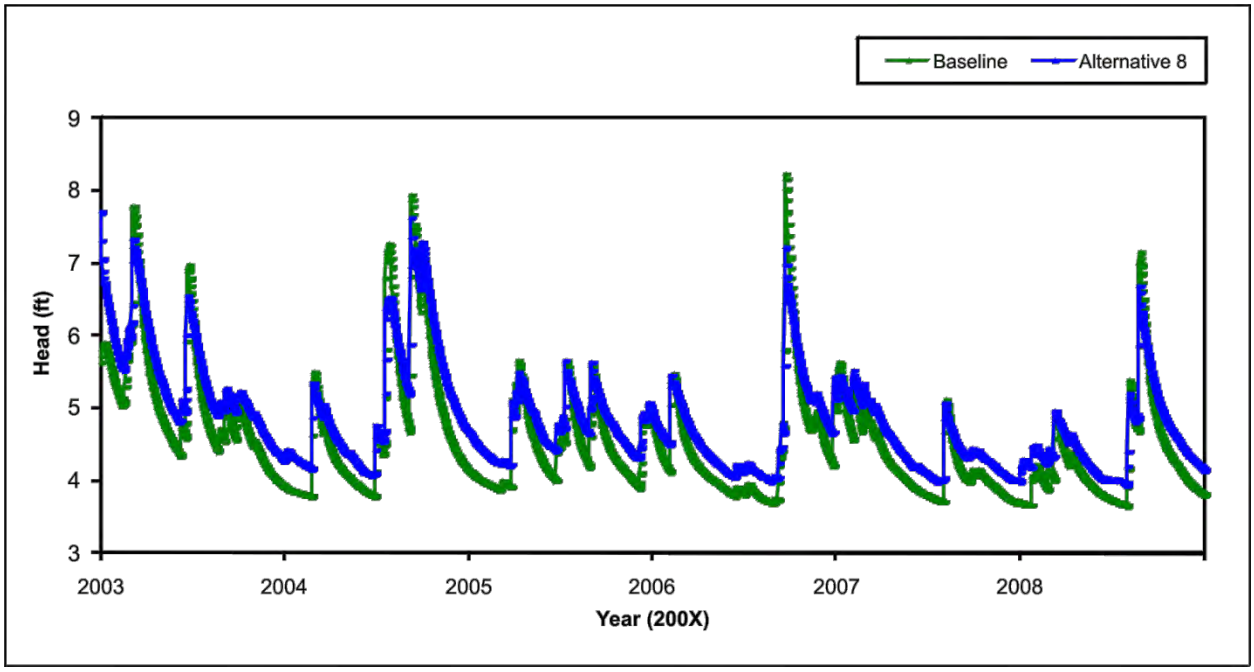

Figure A–51. Monitoring Station Transect Well 6snk – Baseline vs. Alternative 8

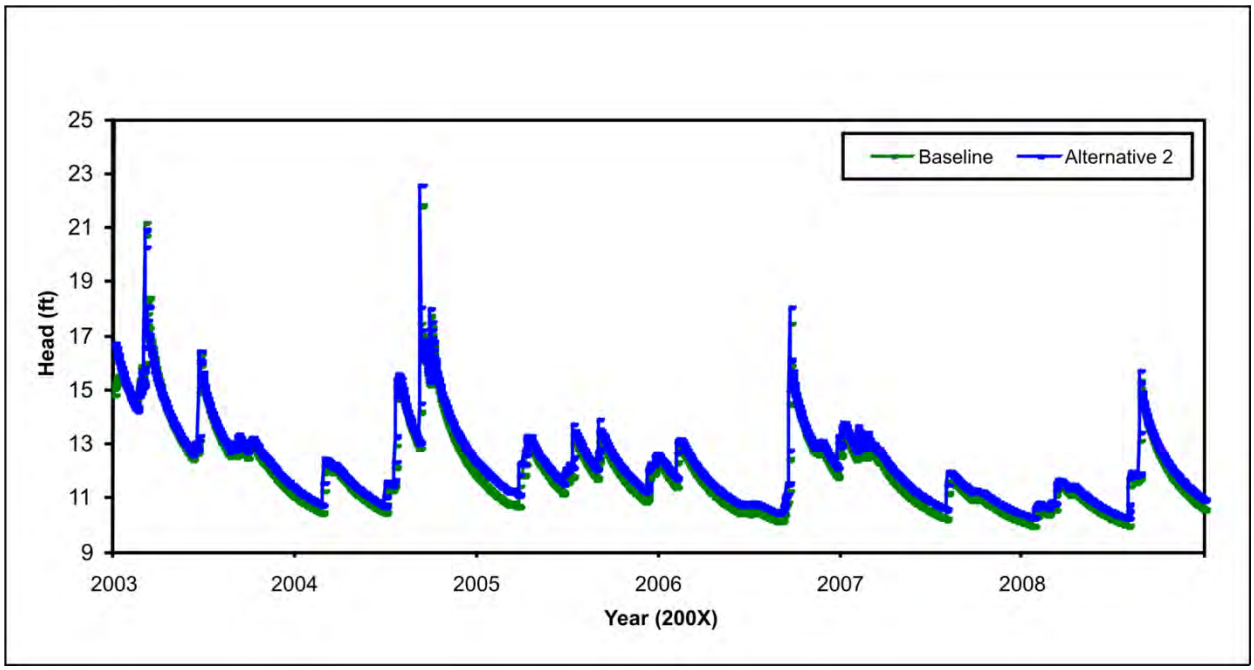

Figure A–52. Monitoring Station Transect Well 7snk – Baseline vs. Alternative 2

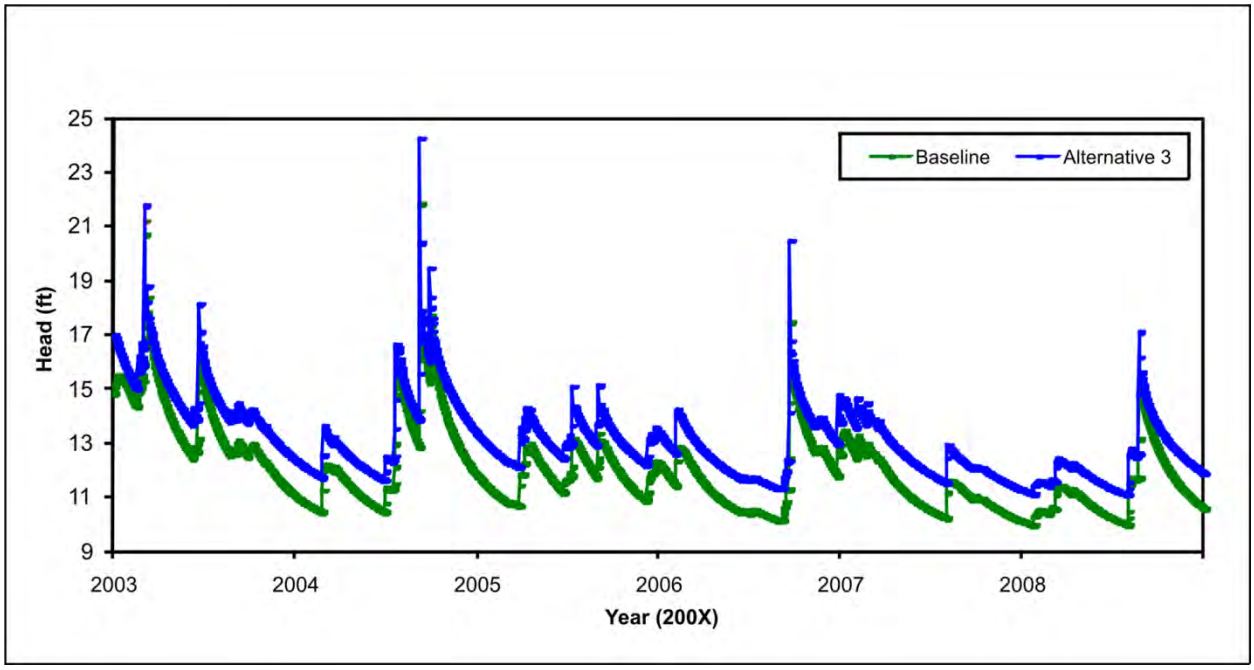

Figure A–53. Monitoring Station Transect Well 7snk – Baseline vs. Alternative 3

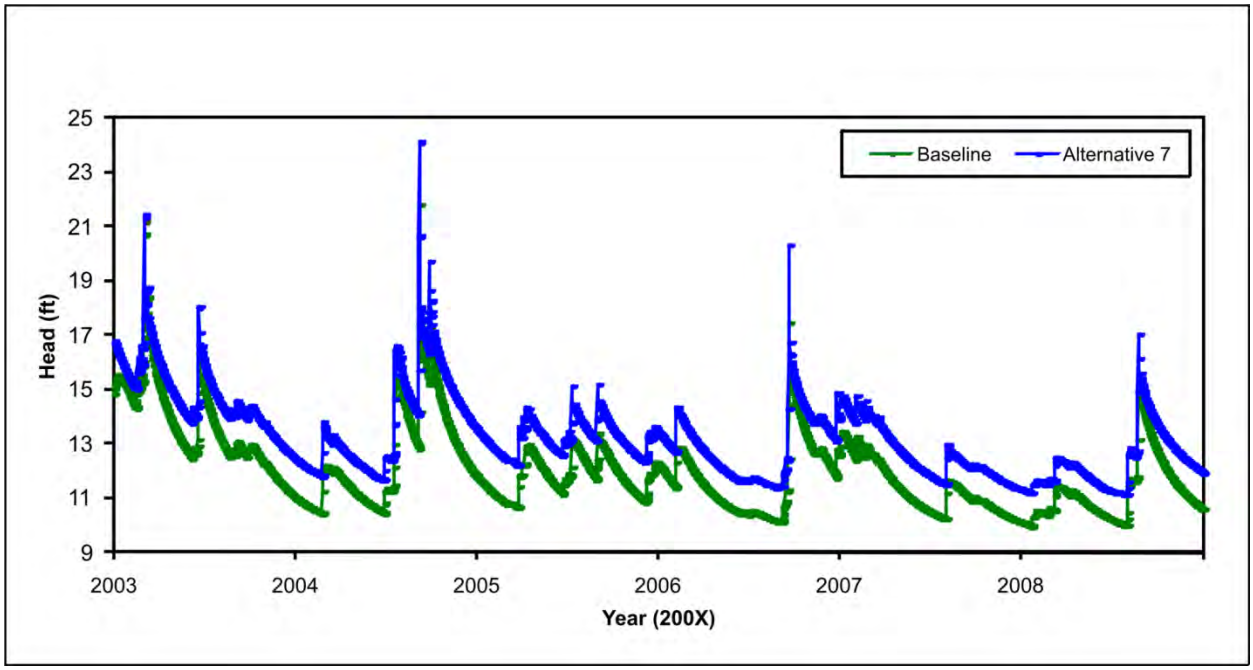

Figure A–54. Monitoring Station Transect Well 7snk – Baseline vs. Alternative 7

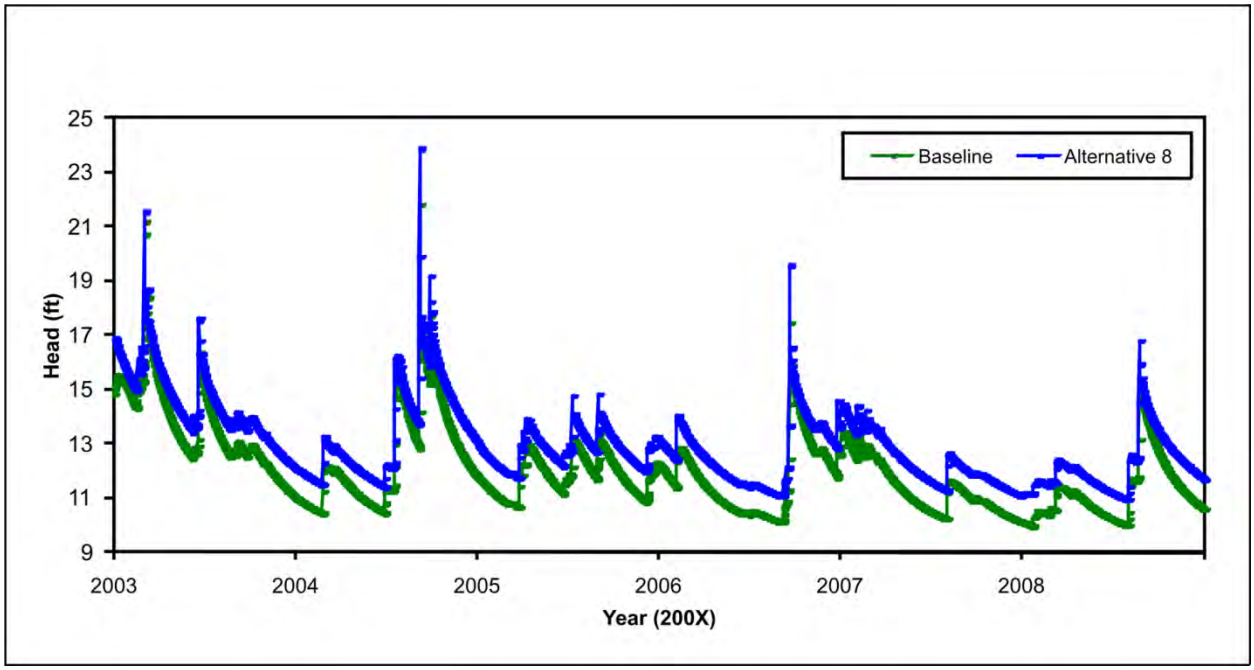

Figure A–55. Monitoring Station Transect Well 7snk – Baseline vs. Alternative 8

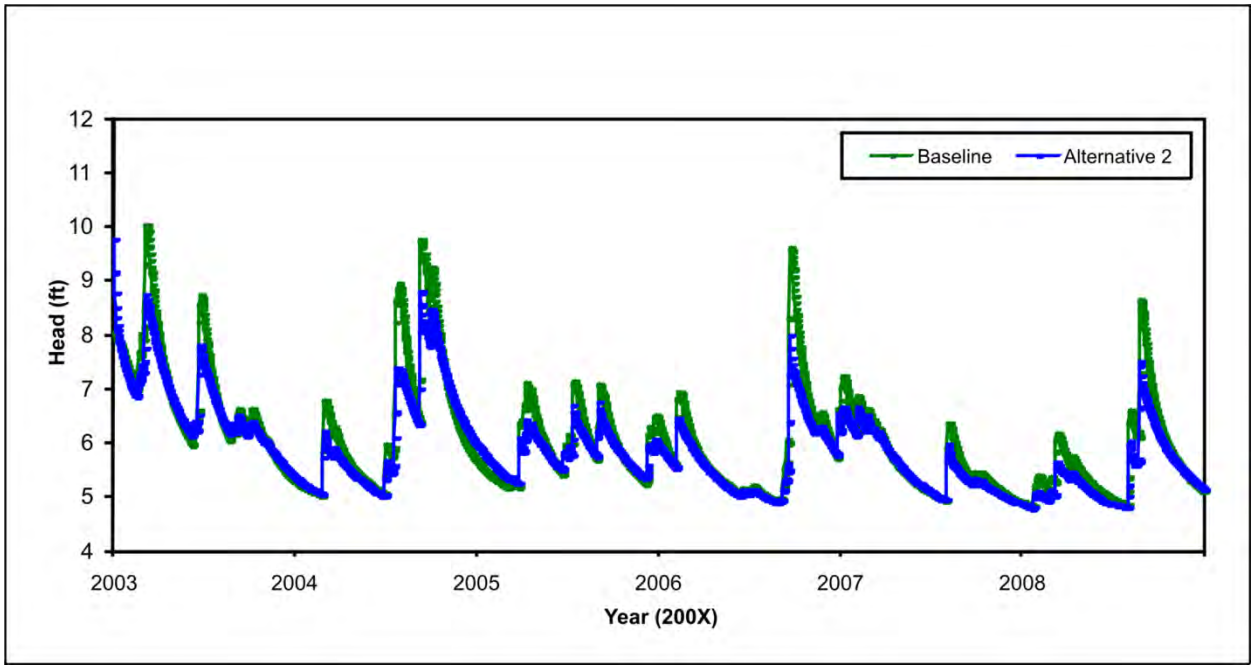

Figure A–56. Monitoring Station Transect Well 8snk – Baseline vs. Alternative 2

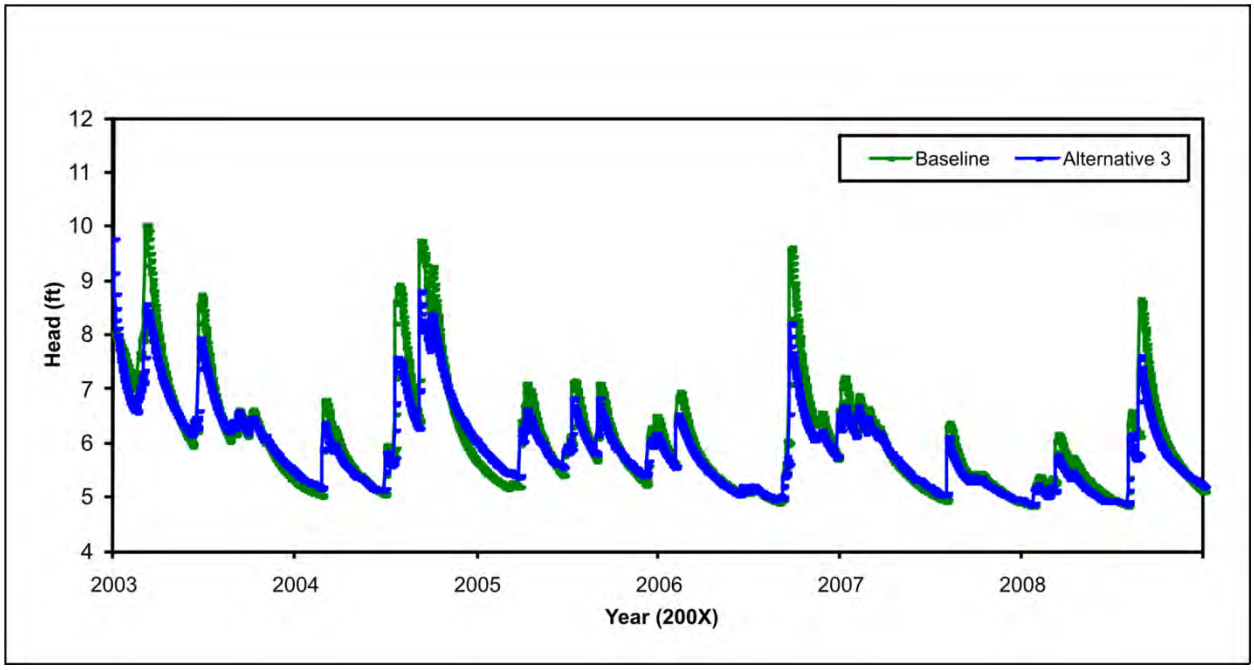

Figure A–57. Monitoring Station Transect Well 8snk – Baseline vs. Alternative 3

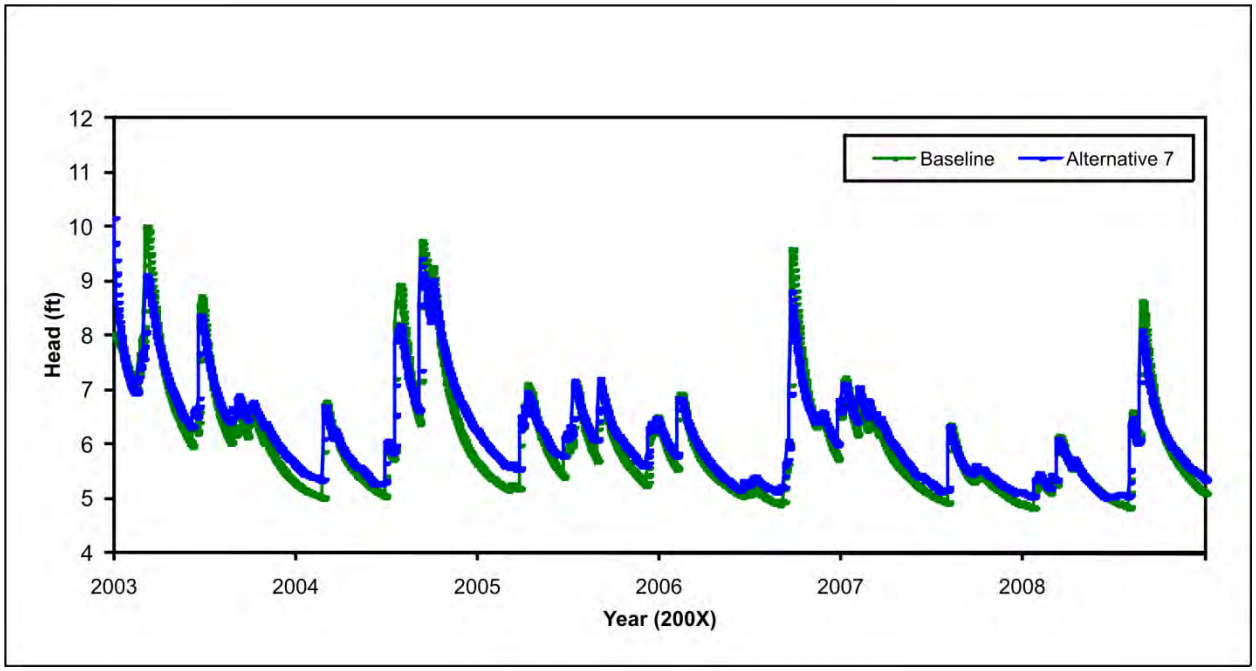

Figure A–58. Monitoring Station Transect Well 8snk – Baseline vs. Alternative 7

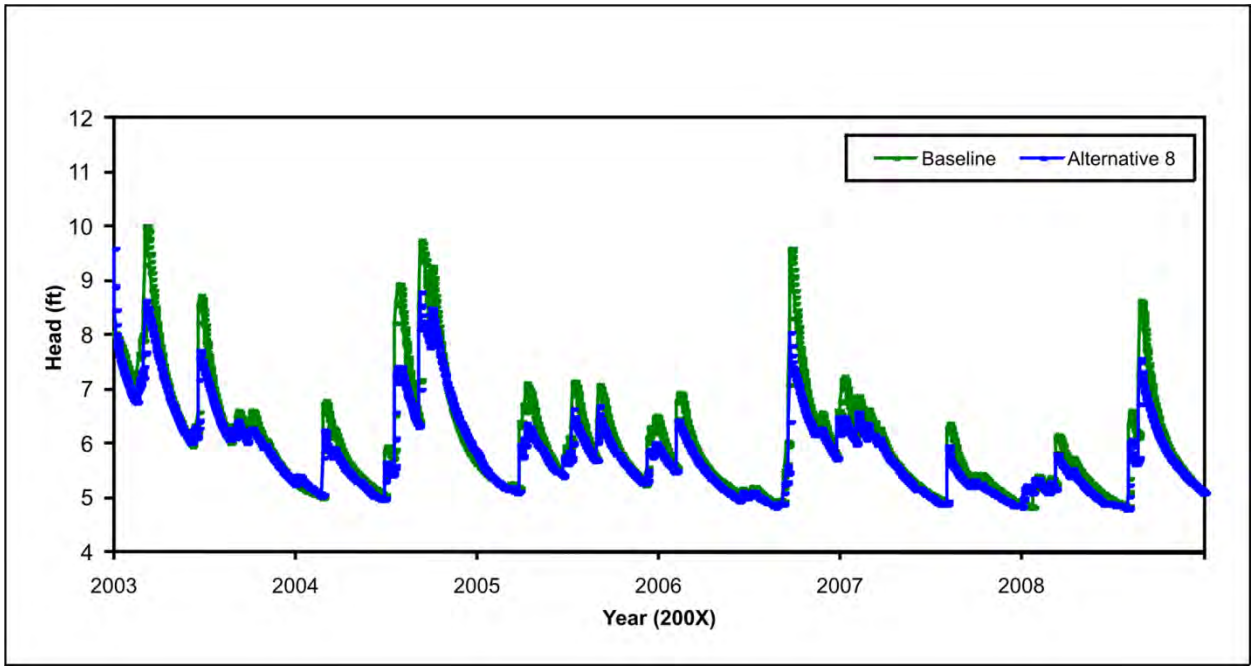

Figure A–59. Monitoring Station Transect Well 8snk – Baseline vs. Alternative 8

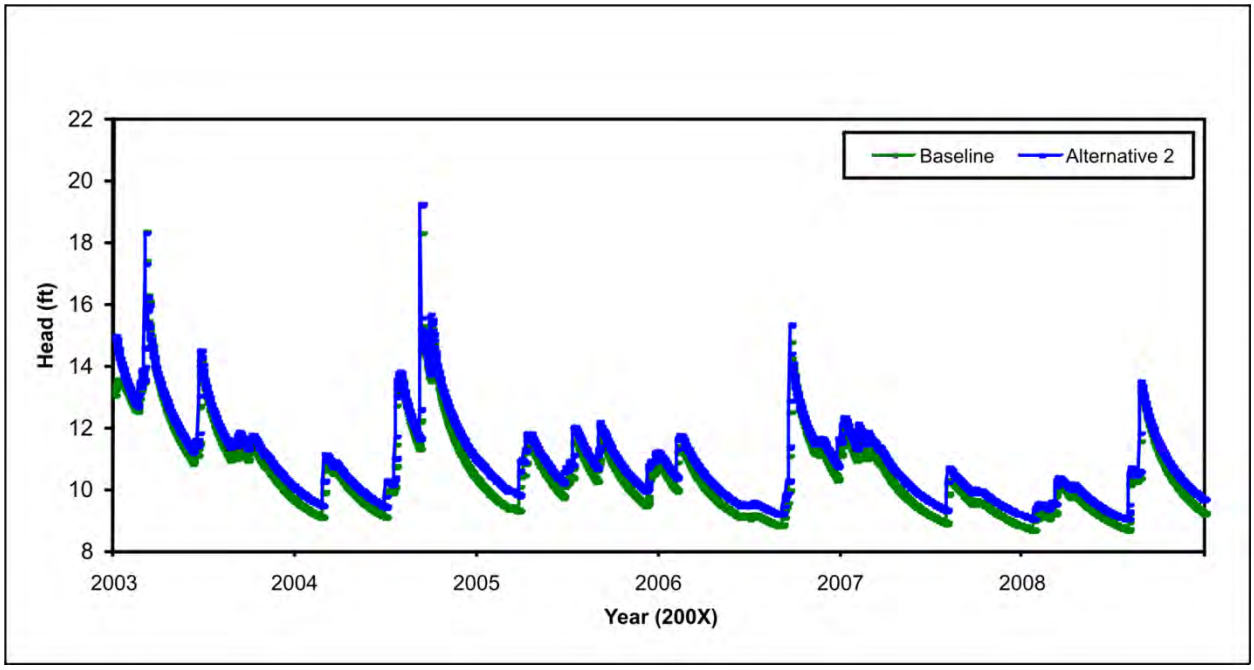

Figure A–60. Monitoring Station Transect Well 9snk – Baseline vs. Alternative 2

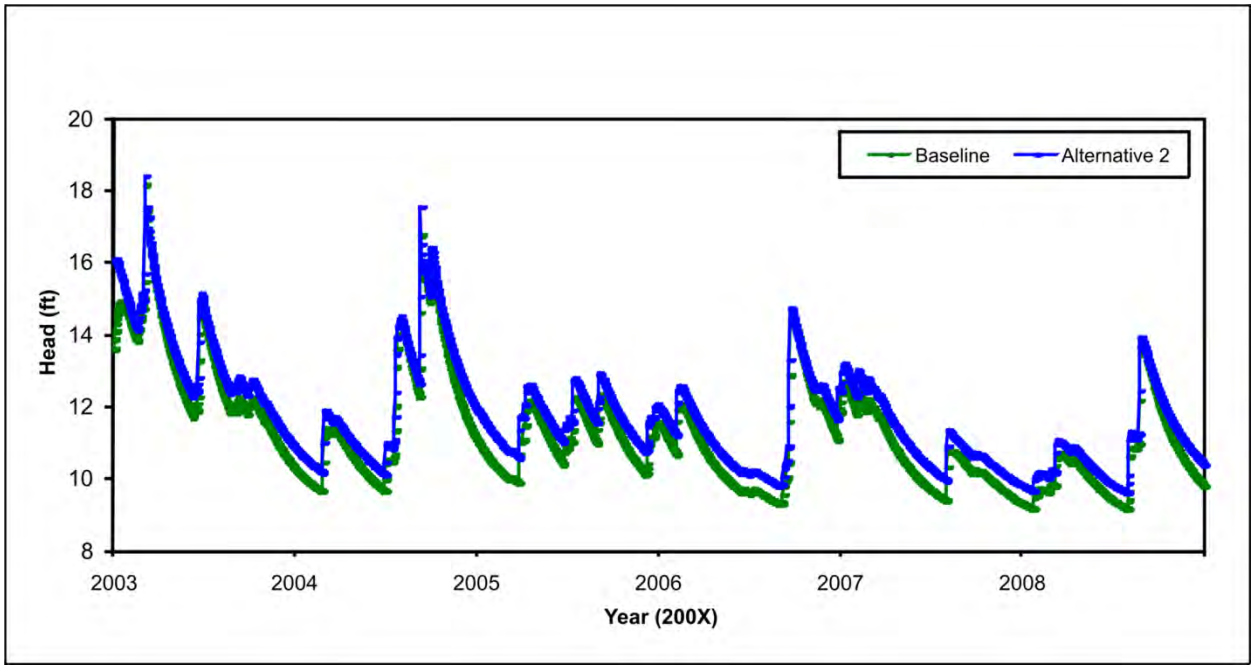

Figure A–61. Monitoring Station Transect Well 10snk – Baseline vs. Alternative 2

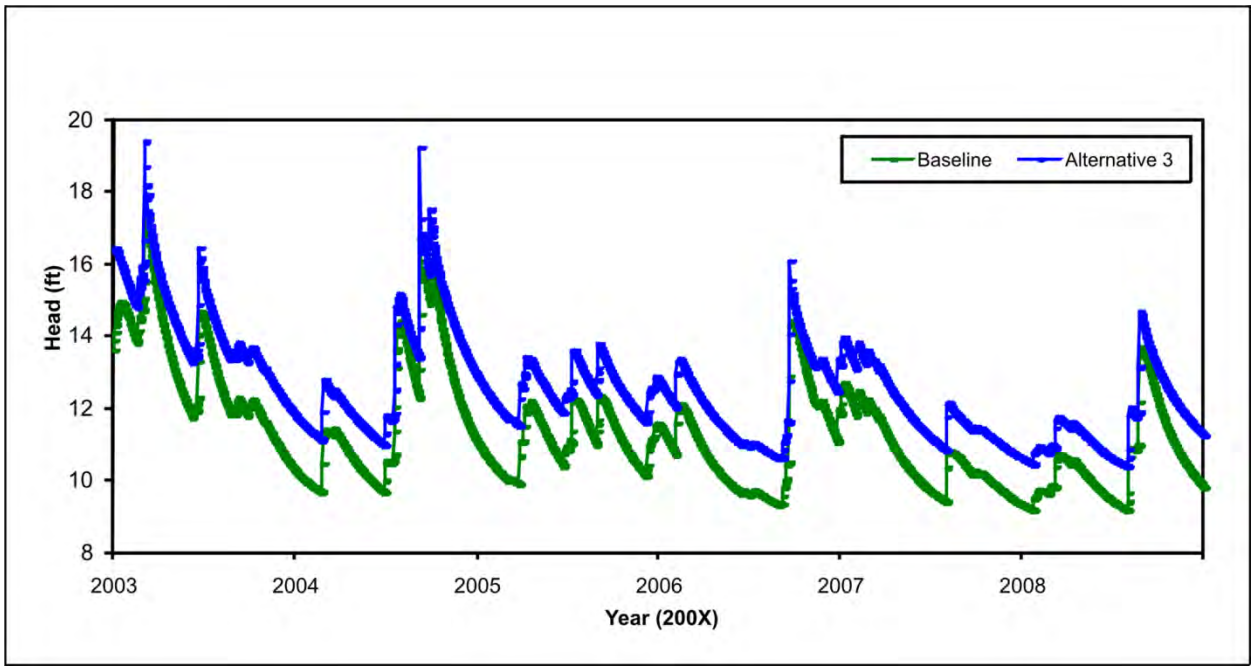

Figure A–62. Monitoring Station Transect Well 10snk – Baseline vs. Alternative 3

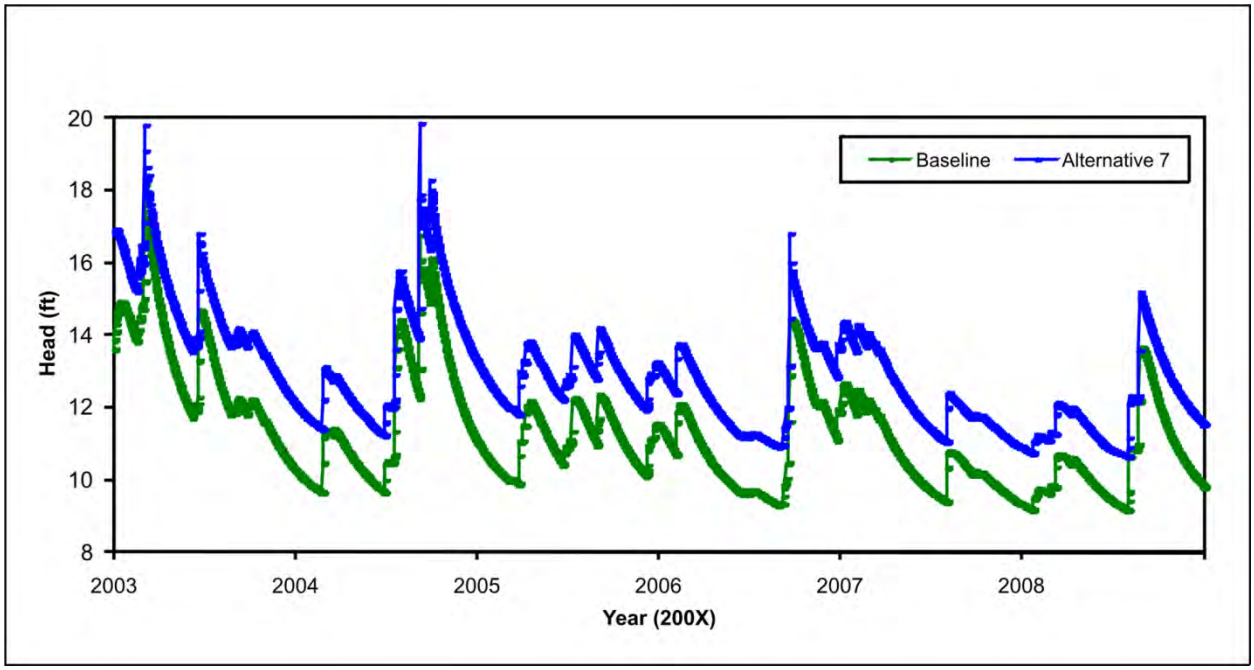

Figure A–63. Monitoring Station Transect Well 10snk – Baseline vs. Alternative 7

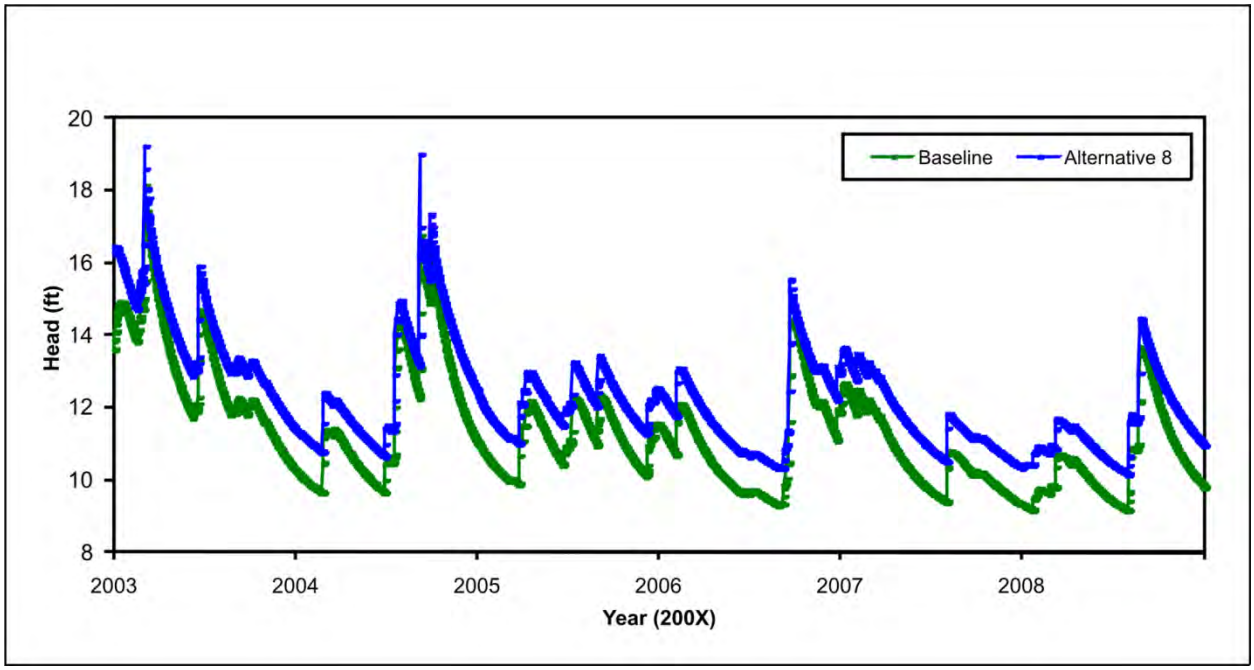

Figure A–64. Monitoring Station Transect Well 10snk – Baseline vs. Alternative 8

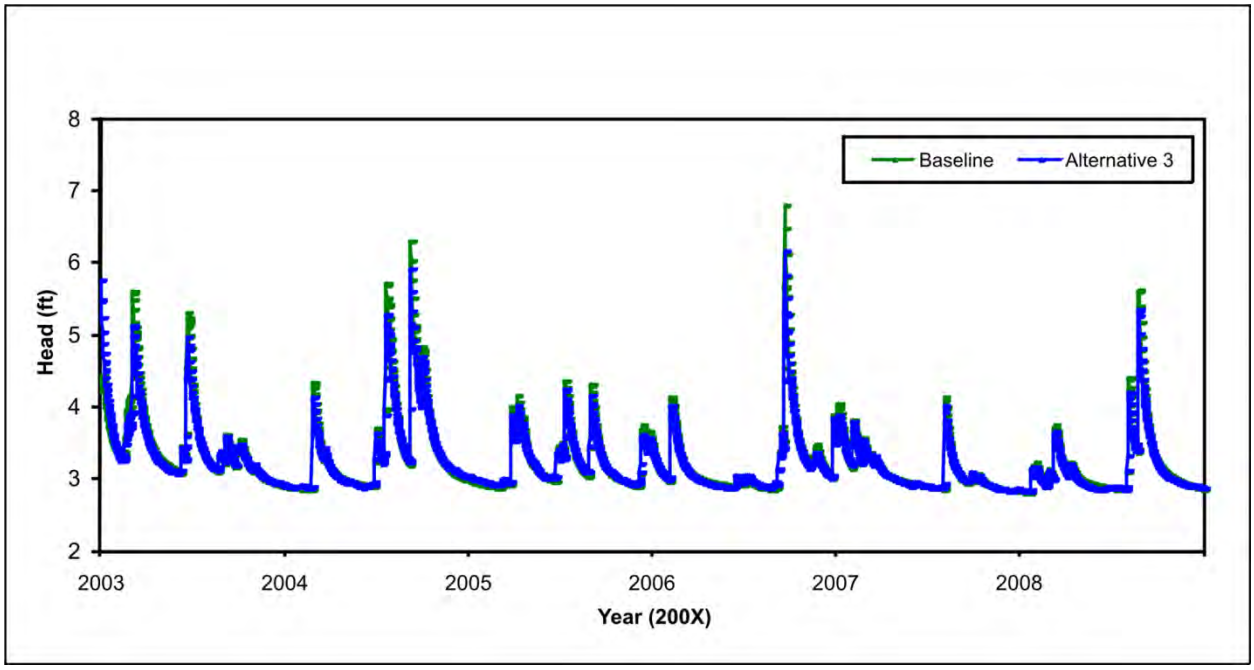

Figure A–65. Monitoring Station Transect Well 11snk – Baseline vs. Alternative 3

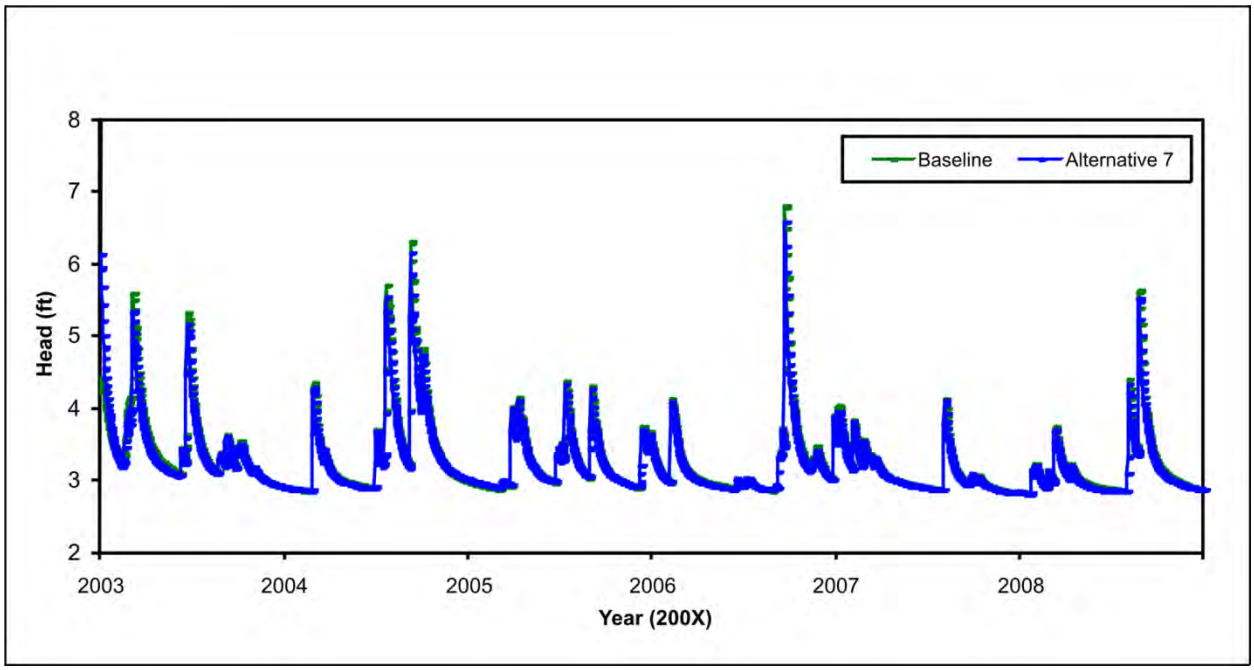

Figure A–66. Monitoring Station Transect Well 11snk – Baseline vs. Alternative 7

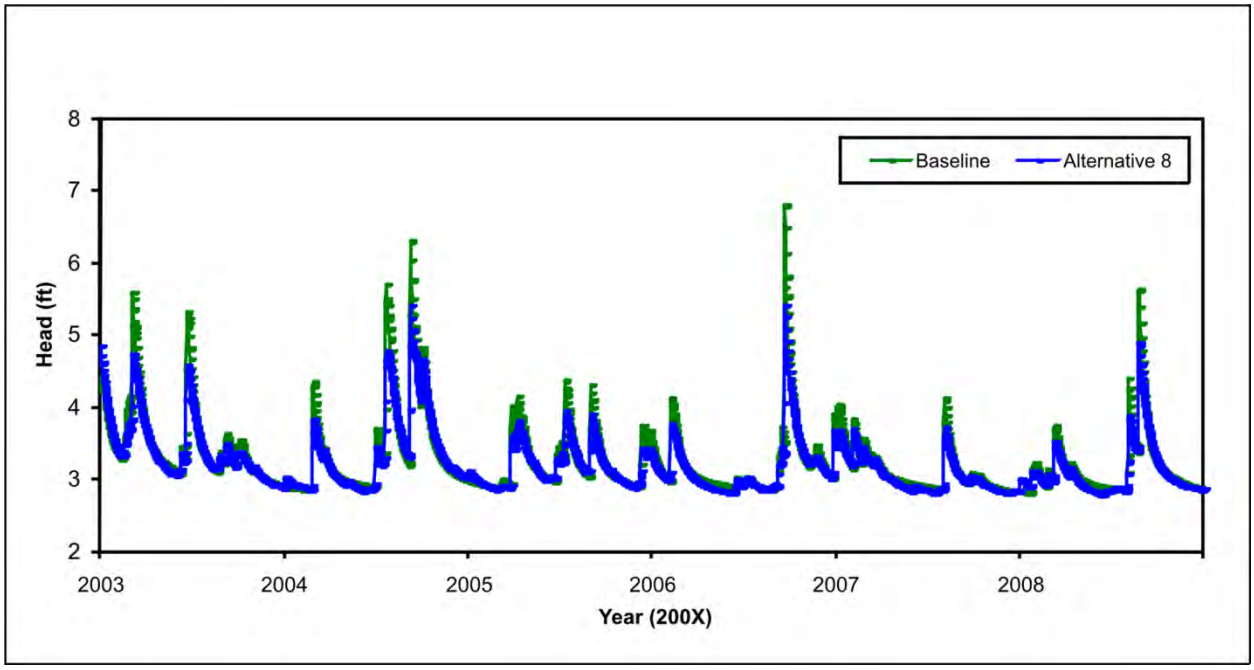

Figure A–67. Monitoring Station Transect Well 11snk – Baseline vs. Alternative 8

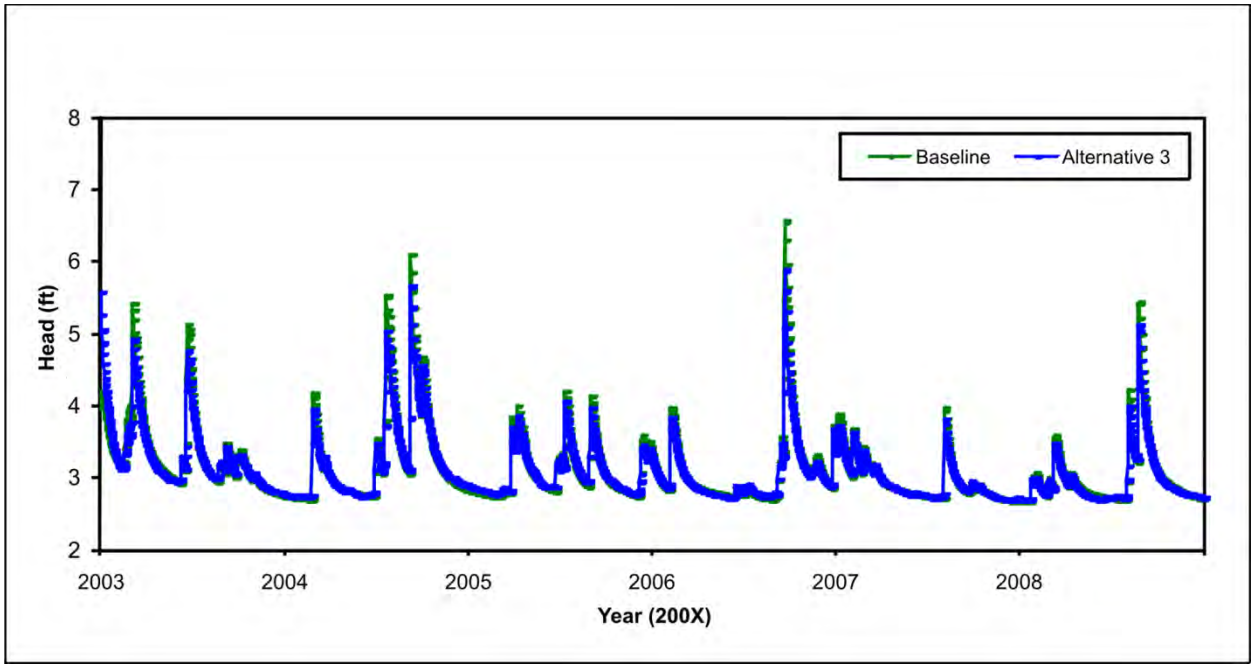

Figure A–68. Monitoring Station Transect Well 12snk – Baseline vs. Alternative 3

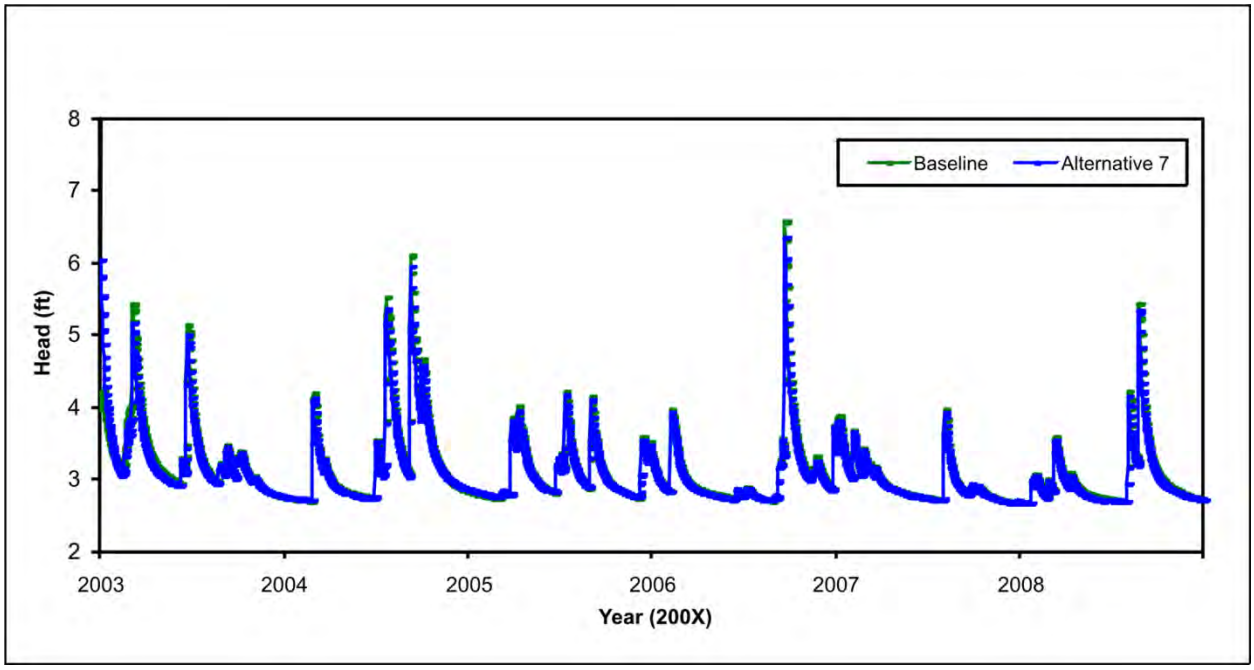

Figure A–69. Monitoring Station Transect Well 12snk – Baseline vs. Alternative 7

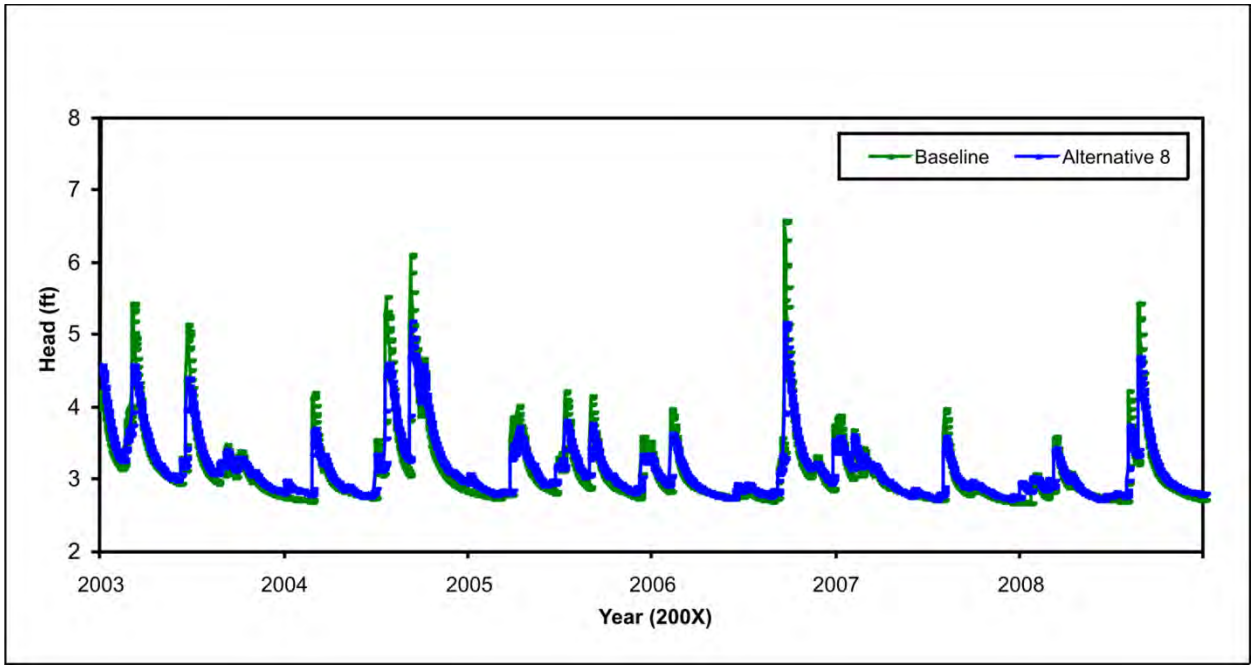

Figure A–70. Monitoring Station Transect Well 12snk – Baseline vs. Alternative 8