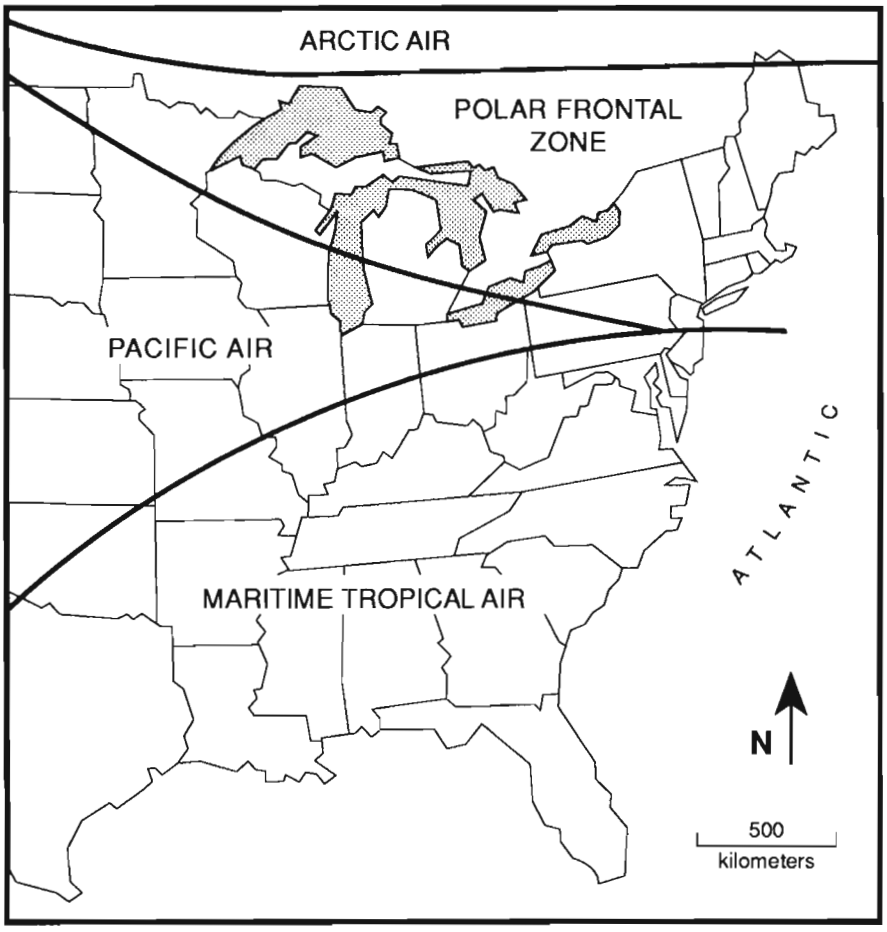
Paleoenvironmental Studies of the State Route 1 Corridor: Contexts for Prehistoric Settlement, New Castle and Kent Counties, Delaware



Edited by

Douglas C. Kellogg and Jay F. Custer

UNIVERSITY OF DELAWARE
Department of Anthropology
Center for Archaeological Research

Delaware Department of Transportation Archaeology Series No. 114

Eugene E. Abbott
Director of Planning

1994

Delaware
Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

Delaware Department of Transportation's Cultural Resource Bibliography for the State Route 1 Corridor

Custer, Jay F., Patricia A. Jehle, Thomas Klatka, and Timothy Eveleigh

1984 **A Cultural Resources Reconnaissance Planning Study of the Proposed Route 13 Relief Corridor, New Castle and Kent Counties, Delaware.** Edited by J. F. Custer and K. C. Cunningham. Delaware Department of Transportation Archaeology Series No. 30. Dover.

1986 **Cultural Resources of the Proposed Route 13 Corridor: An Overview Prepared for the Draft Environmental Impact Statement.** Delaware Department of Transportation Archaeology Series No. 40. Dover.

Custer, Jay F. and David C. Bachman

1986 **An Archaeological Planning Survey of Selected Portions of the Proposed Route 13 Corridor, New Castle County, Delaware.** Delaware Department of Transportation Archaeology Series No. 44. Dover.

Custer, Jay F., David C. Bachman, and David J. Grettler

1986 **An Archaeological Planning Survey of Selected Portions of the Proposed Route 13 Corridor, Kent County, Delaware.** Delaware Department of Transportation Archaeology Series No. 45. Dover.

1987 **Phase I/II Archaeological Research Plan, U.S. 13 Relief Route, Kent and New Castle Counties, Delaware.** Delaware Department of Transportation Archaeology Series No. 54. Dover.

Benenson, Carol A. and Mark A. Bower

1987 **Architectural Investigation of the U.S. Route 13 Relief Route. Route 7 to U.S. Route 113, New Castle and Kent Counties, Delaware.** Delaware Department of Transportation Archaeology Series No. 55. Dover.

Bachman, David C., David J. Grettler, and Jay F. Custer

1988 **Phase I Archaeological Survey of the Early Action Segment of the Route 13 Corridor, Delaware.** Delaware Department of Transportation Archaeology Series No. 69. Dover.

Hodny, Jay, David C. Bachman and Jay F. Custer

1988 **Phase I Archaeological Survey of the Chesapeake and Delaware Canal Section, Odessa Segment, of the U.S. Route 13 Corridor, New Castle County, Delaware.** Delaware Department of Transportation Archaeology Series No. 73. Dover.

Bachman, David C. and Wade P. Catts

1990 **Final Archaeological Investigations of the Lafferty Lane Cemetery, 7K-D-111, State Route 1 Relief Corridor, Dover, Kent County, Delaware.** Delaware Department of Transportation Archaeology Series No. 80. Dover.

Grettler, David J., David C. Bachman, Jay F. Custer, and JoAnn Jamison

1991 **Phase II Archaeological Survey of All Historic Sites in the Early Action Segment of the State Route 1 Relief Route, Delaware.** Delaware Department of Transportation Archaeology Series No. 87. Dover.

1991 **Phase I and II Archaeological Survey of the Kent Road 88 (Dover to Leipsic Road) and Kent Road 337 (Persimmon Tree Lane) Realignments, and Final Archaeological Excavations at the W. Eager Site for the Delaware Route 1 - Relief Corridor, Dover, Kent County, Delaware.** Delaware Department of Transportation Archaeology Series No. 90. Dover.

De Cunzo, Lu Ann, Angela Hoseth, Jay Hodny, JoAnn E. Jamison, Wade P. Catts and David C. Bachman

1992 **Final Archaeological Investigations at the John Darrach Store Site, Delaware Route 6-Woodland Beach Road, Smyrna Section, Delaware Route 1 Corridor, Kent County, Delaware.** Delaware Department of Transportation Archaeology Series No. 93. Dover.

Riley, Lynn, David C. Bachman, Glen Mellin, JoAnn E. Jamison, Barbara Hsiao Silber, Jay F. Custer, and David J. Grettler

1994 **Phase II Archaeological Excavation of all Prehistoric Sites in the Early Action Segment of the Delaware Route 1 Corridor, New Castle and Kent Counties, Delaware.** Delaware Department of Transportation Archaeology Series No. 101. Dover.

Kellogg, Douglas C., Robert Varisco, David J. Grettler, and Jay F. Custer

1994 **Phase II Archaeological Discoveries in the Chesapeake and Delaware Canal Section of the State Route 1 Corridor, New Castle County, Delaware.** Delaware Department of Transportation Archaeology Series No.102. Dover.

Riley, Lynn, Scott C. Watson, and Jay F. Custer

1994 **Final Archaeological Investigations at Prehistoric Sites 7K-C-360 and Dover Downs (7K-C-365A and B), State Route 1 Corridor, Kent County, Delaware.** Delaware Department of Transportation Archaeology Series No. 105. Dover.

Scholl, Michael D., Angela Hoseth, and David J. Grettler

1994 **Transportation and Argricultural Changes in Blackbird Hundred: Final Archaeological Investigations at the Buchanan-Savin Farmstead, State Route 1 Corridor, Green Spring, New Castle County, Delaware.** Delaware Department of Transportation Archaeology Series No. 106. Dover.

Grettler, David J., Brian H. Seidel, and Jack F. Kraft

1994 **Phase I and II Archaeological Survey of Five Proposed Borrow Pits and Wetland Replacement Areas for the State Route 1 Corridor, Kent County, Delaware.** Delaware Department of Transportation Archaeology Series No. 111. Dover.

PALEOENVIRONMENTAL STUDIES OF THE STATE ROUTE 1 CORRIDOR: CONTEXTS FOR PREHISTORIC SETTLEMENT, NEW CASTLE AND KENT COUNTIES, DELAWARE

DELDOT PROJECT 83-110-01 DELDOT ARCHAEOLOGY SERIES NO. 114

FHWA FEDERAL AID PROJECT F-1001(16)

Edited by

Douglas C. Kellogg and Jay F. Custer

UNIVERSITY OF DELAWARE
Department of Anthropology
Center for Archaeological Research

Submitted To

U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration

and

DELAWARE DEPARTMENT OF STATE
Division of Historical and Cultural Affairs
State Historic Preservation Office

Prepared For

DELAWARE DEPARTMENT OF TRANSPORTATION
Division of Planning
Location and Environmental Studies Office

Eugene E. Abbott
Director of Planning

1994

Doc. Con. No.
55-03/94/8/18

Reprint

ABSTRACT

Results of four environmental studies undertaken to help recreate the landscape inhabited by prehistoric people along the State Route 1 corridor are presented. The paleoenvironmental and geological studies were conducted at key locations adjacent to significant archaeological sites that will be impacted by highway construction. The introduction reviews the methods used in the studies and provides the regional paleoenvironmental context. Pollen and hydrological studies of bay/basin ponds show that climate was extremely dry in central Delaware between approximately 11,000 and 6000 years ago. Geological investigations of wetlands in streams valleys adjacent to archaeological sites show the impacts of changing stream flow and relative sea-level rise on wetland environments. Analysis of the pollen and seed contents of cores taken in the wetlands show changes in local environments, climate, and potential food resources. The conclusions discuss the implications of the studies for interpreting how people lived in central Delaware in prehistoric times.

DelDOT Archaeological Series Index Information

This form is intended to provide information on the contents of this volume for indexing. It is also intended for researchers to use to check the research methods and topics included in this volume.

Report Title: **PALEOENVIRONMENTAL STUDIES OF THE STATE ROUTE 1 CORRIDOR: CONTEXTS FOR PREHISTORIC SETTLEMENT, NEW CASTLE AND KENT COUNTIES, DELAWARE**

DelDOT Report Number: **114**

Level of Investigations: [Phase I, II, III, Planning Survey, Specialized Study]

SPECIALIZED STUDY

Basic Time Periods Covered:

__X__ All prehistoric
_____ Mainly prehistoric, some historic
_____ Equal coverage of prehistoric and historic
_____ Mainly historic, some prehistoric
_____ All historic

Site Contexts: **NOT APPLICABLE**

	Prehistoric	Historic
Plow zone/disturbed surface soils	**NOT APPLICABLE**	**NOT APPLICABLE**
Intact features	**NOT APPLICABLE**	**NOT APPLICABLE**
Buried artifact-bearing strata	**NOT APPLICABLE**	**NOT APPLICABLE**

List up to five major time periods or site types

1. **ALL PREHISTORIC TIME PERIODS**

List up to eight major topics covered in Conclusions and Discussions of Results

1. **BAY/BASIN FEATURES**
2. **REGIONAL CLIMATE**
3. **LOCAL ENVIRONMENTS**
4. **SEA LEVEL RISE**
5. **REGIONAL SETTLEMENT PATTERNS**

Specialized Analyses Undertaken

	Prehistoric	Historic
Blood Residue		
Ceramic Chronology		
Ceramic Vessel Surface Alterations		
Cordage Twists from Ceramic Impressions		
Faunal Analysis		
Flake Attributes		
Floral Analysis	X	
Flotation	X	
Geomorphology and Pedology	X	
Glass Analysis		
HABS Documentation		
HAER Documentation		
Historic Architecture		
Informant Interviews		
Leather Analysis		
Miller Ceramic Index		
Mortar Analysis		
Palynology	X	
Projectile Point Chronology		
Projectile Point Function		
Radiocarbon Dates	X	
Soil Chemistry		
Spatial Distribution of Artifacts		
Stone Tool Functional Analysis		
Wood Identification	X	

List up to 5 other specialized analyses not listed above:

NOT APPLICABLE

Geographic Area Covered

__X__ New Castle County
__X__ Kent County
_____ Sussex County
_____ All State

ACKNOWLEDGEMENTS

Appreciation for their support, administration, research, and services is extended to all of the following individuals:

From the Division of Highways: Raymond M. Harbeson, Jr., Chief Engineer/Director, Division of Highways; Raymond D. Richter, Assistant Director, Preconstruction; Joseph T. Wutka, Jr., Location Studies and Environmental Engineer; Kevin W. Cunningham, DelDOT Archaeologist; Carol L. Kates, Secretary; Joanna Likens, Project Scheduling and Support.

From the Federal Highway Administration: John J. Gilbert, Division Administrator.

From the Division of Historical and Cultural Affairs: Daniel R. Griffith, Director and State Historic Preservation Officer.

From the Delaware State Historic Preservation Office: Joan Larrivee, Deputy State Historic Preservation Officer; and Alice H. Guerrant, Faye L. Stocum, and Gwen Davis Coffin, Archaeologists.

From the University of Delaware: Juan Villamarin, Chairman, Department of Anthropology; Carolyn Fierro, Administrative Assistant; and Joanne Faulls, Secretary, Department of Anthropology.

From the University of Delaware Center for Archaeological Research: Robert Schultz, Graphic Artist; Angela Hoseth, Eileen McMahon Schultz, Colleen De Santis Leithren, Barbara Hsiao Silber, and Susan Gentile, Report Preparation; Leslie Currie and Brian Seidel, Internal Review.

Paige Newby and James Pizutto provided editorial assistance and additional figures and information needed to integrate the reports, as well as valuable discussions of the studies.

From the Division of Support Operations: Bill Yerkes, Graphics and Printing Manager; John Bordley, Printer III, Dorothy Hutchins, Photo Reproduction Technician, Jim Sylvester, Printer III, Ed Wilkinson, Printer II.

Cover Illustration: Map showing present climate zones in Eastern North America. The zones are identified by the dominant air masses that determine weather. The Delmarva Penninsula is in a transition zone, thus our weather is highly variable and susceptible to climate change.

TABLE OF CONTENTS

Page

Abstract i

DelDOT Archaeological Series Index Information ii

Acknowledgements iv

Table of Contents v
List of Figures xi
List of Tables xiv
List of Plates xv

Introduction 1

Douglas C. Kellogg and Jay F. Custer

The State Route 1 Project 2
Paleoenvironmental Method and Theory 5
Sedimentary Analysis 5
Geological Cross Sections 7
Pollen Analysis 8
Plant Macrofossils 12

Regional Paleoenvironmental and Climate Change 12
The Last Glacial Maximum and Deglaciation 14
Holocene Environments 17
Post-Glacial: 14,000 - 10,000 BP 21
Early Holocene: 10,000 - 6,000 BP 21
Middle and Late Holocene: 6,000 BP - Present 24

Pollen and Sediment Records From Walter's Puddle in Central Delaware 27

Paige Newby, Robert S. Webb, and Thompson Webb, III

Introduction 27

Methods 28
Field Operations 28
Laboratory Processing 28

Page

Results 31
Stratigraphy 31
The Pollen Diagram 32
Walter's Puddle - 3 32
Walter's Puddle - 2 33
Walter's Puddle - 1 33

Discussion 34

Summary 35

Palynology and Paleohydrology of Delaware 36

Robert S. Webb, Paige Newby, and Thompson Webb, III

Introduction 36

Study Descriptions 37
Longhauser Pond 37
Nowakowski Pond 37
Prison Pond 37
Walter's Puddle 37

Methods 41
Field Work 41
Laboratory Analyses 41

Results 41
Sediment Stratigraphy 41
Longhauser Pond 42
Nowakowski Pond 43
Prison Pond 43
Walter's Puddle 43
Radiocarbon Dates 45

Discussion 45
Regional Stratigraphy 45
Archaeological Implications 47

Summary 47

Page

The Holocene Stratigraphy of Three Freshwater to Brackish Wetlands, Kent County, Delaware 48

Elizabeth E. (Whallon) Rogers and James E. Pizzuto

Introduction 48
Objectives 48
Location and Geologic Setting of the Study Area 49
Modern Wetland Environments 49
Wetlands 49

Methods 51
Field Methods 51
Methods for Determining Lithologies 51
Laboratory Analyses 53
Grain Size Analysis 53
Analysis of the Organic Content of Sediments 53
Supplemental Analyses 55
Determining Paleoenvironments 55

Results 55
The Duck Creek Locality 55
Description of Lithologies 55
Cross-Section 58
The St. Jones River Locality 61
Description of Lithologies 61
The Leipsic River Locality 65
Description of Lithologies 65

The Holocene Evolution of the Wetlands of the Study Area 68
Determining the Time of Tidal Incursion 68
Sediment Accumulation Rates 69
Duck Creek on the Smyrna River 69
Pre-Holocene Time 69
Pre-5750 to 2250 BP 71
2250 to 1300 BP 71
1300 to 500 BP 71
500 BP to Present 71
Summary 72
The St. Jones River Locality 72
Pre-Holocene 72
Mid-Holocene 72
Cross-Section A 74

Cross-Section B 74
Pre-2000 BP 74
2000 to 1250 BP 74
1250 to 1000 BP 74
1000 BP to Present 75
Summary 75
The Leipsic River Locality 75
Pre-Holocene 76
8000 to 6250 BP 76
6250 to 5250 BP 77
5250 to 3250 BP 78
3250 to 1500 BP 78
1500 to 500 BP 78
500 BP to Present 78
Summary 79

Summary Comparisons of the Three Wetland Localities 79
Channel Migration Rates 79
The Pollen Record 79
Rates of Sediment Accumulation 79

Conclusions 79
The Loss-On-Ignition Method 79
Holocene History 80

Paleobotanical Analyses of Three Tidal Stream Valleys Along the Proposed State Route 1 Corridor, Kent County Delaware 82

Grace S. Brush

Introduction 82

Methods 82
Dating of Cores 83
Extraction of Pollen 85
Extraction of Charcoal 86
Extraction of Seeds 86
Analysis of Data 86
Results 87
Duck Creek Core DC-3 87
Sedimentation Rates 87
Charcoal 88
Pollen 88

Page

Seeds 89
Interpretation of Core DC-3 89
Saint Jones Creek Core SJ-3 90
Sedimentation Rates 90
Charcoal 90
Pollen 90
Seeds 91
Interpretation of Core SJ-3 91
Leipsic River Core LR-1 92
Sedimentation Rates 92
Pollen 92
Interpretation of Core LR-1 93

Discussion and Conclusions 93

Integration and Interpretation: Prehistoric Environments of Eastern Delaware 96

Douglas C. Kellogg and Jay F. Custer

General Summary and Review 96
Bay/Basins and Regional Climate 96
Riverine Marshes: Local Environments and Sea-Level Rise 97

Technical Comments and Implications for Prehistoric Archaeology 98
Archaeology of the State Route 1 Corridor: Preliminary Results 100
Walter's Puddle 100
Duck Creek 100
Leipsic River 101
St. Jones River 102

Conclusions 104

References Cited 106

Notes on Contributors 118

Appendices 119

I: Pollen Percentages for Walter's Puddle 120
II: Core Diagrams and Loss-On-Ignition Curves for Bay/Basin Study Localities .. 122
III: Grain Size Analysis Data for Wetland Cores 127
IV: Loss-on-Ignition Data for Wetland Cores 128

Page

V: Wetland Core Logs 131
VI: Pollen and Seed Taxa in Wetland Cores 144
VII: Glossary 147

List of Figures

Page

Figure 1: Location of State Route 1 Study Area 1

Figure 2: State Route 1 Corridor and Paleoenvironmental Study Localities 3

Figure 3: Prehistoric Archaeological Sites along the State Route 1 Corridor 4

Figure 4: Factors Affecting Water Levels in Lakes 6

Figure 5: Sediment Sampling and Sediment Accumulation Rates 7

Figure 6: Typical Pollen Grains 8

Figure 7: Production and Dispersal of Pollen Grains 9

Figure 8: Livingstone Piston Corer 10

Figure 9: Variations in the Earth's Orbit 13

Figure 10: The Extent of Ice During the Last Glacial Maximum and Vegetation Zones ... 14

Figure 11: Delaware and Susquehanna River Drainages 14

Figure 12: Vegetation Zones 7000 Years Ago 15

Figure 13: Present Vegetation Zones 16

Figure 14: Climate Fluctuations Over the Last 10,000 Years 17

Figure 15: Eastern U.S. Pollen Study Localities 18

Figure 16: Pollen Study Localities in the Mid-Atlantic Region 19

Figure 17: Evolution of a Small Lake into a Bog or a Marsh 19

Figure 18: Extinct Mastodon 22

Figure 19: Paleo-Indian Site Distribution on the Delmarva Peninsula 23

Figure 20: Present Climate Zones in the Mid-Atlantic 24

Figure 21: Location of Bay/Basin Ponds Studied 27

Figure 22: Loss-On-Ignition Plot for Walter's Puddle Core 31

Page

Figure 23: Walter's Puddle Pollen Diagram 33

Figure 24: Indeterminate Pollen Counts for Walter's Puddle 34

Figure 25: Pollen Concentration for Walter's Puddle 35

Figure 26: Sketch Maps of Bay/Basin Study Localities 39

Figure 27: Stratigraphic Profile of Longhauser Pond 40

Figure 28: Stratigraphic Profile of Nowakowski Pond 40

Figure 29: Stratigraphic Profile of Prison Pond 43

Figure 30: Stratigraphic Profile of Walter's Puddle 44

Figure 31: Age vs. Depth Plots for the Bay/Basin Cores 44

Figure 32: Relationship Between Wetlands and Salinity 51

Figure 33: Characteristic Loss-On-Ignition Curves for Different Types of Environments 54

Figure 34: Duck Creek Study Locality 57

Figure 35: Representative Core from Duck Creek 57

Figure 36: Stratigraphic Cross-Section of Duck Creek 57

Figure 37: St. Jones River Study Locality 61

Figure 38: Representative Core from St. Jones River 62

Figure 39: Stratigraphic Cross-Section of St. Jones River 64

Figure 40: Leipsic River Study Locality 64

Figure 41: Representative Core from Leipsic River 66

Figure 42: Stratigraphic Cross-Section of Leipsic River 66

Figure 43: Delaware Coast Relative Sea-Level Curve 68

Figure 44: Development of Wetlands at Duck Creek 69

Page

Figure 45: Summary Pollen Diagram for Duck Creek 70

Figure 46: Development of Wetlands at St. Jones River 73

Figure 47: Summary Pollen Diagram for St. Jones River 75

Figure 48: Development of Wetlands at Leipsic River 76

Figure 49: Summary Pollen Diagram for Leipsic River 77

Figure 50: Generalized Development of Wetlands in Delaware 81

Figure 51: Stratigraphy of Cores Studied for Pollen 83

Figure 52: Camp Century, Greenland Ice Core Profile 86

Figure 53: Pollen Diagram for Duck Creek Core DC-3 87

Figure 54: Seed Diagram for Duck Creek Core DC-3 88

Figure 55: Pollen Diagram for St. Jones River Core SJ-3 89

Figure 56: Seed Diagram for St. Jones River Core SJ-3 90

Figure 57: Pollen Diagram for Leipsic River Core LR-1 91

Figure 58: Regional Vegetation Correlation Chart 92

Figure 59: Summary of Vegetation and Climate 93

List of Tables

Page

Table 1: Geologic Time Scale 12

Table 2: Cultural Complexes and Time Periods of Delaware 20

Table 3: Description of Core B: Walter's Puddle, Townsend, Delaware 30

Table 4: Radiocarbon Dates from Bay/Basin Cores 42

Table 5: Regional Lake Sediment Chronology Chart for Central Delaware 46

Table 6: Radiocarbon Dates for Wetland Cores 54

Table 7: Analysis of Variance Data for the Duck Creek Study Locality 59

Table 8: Analysis of Variance Data for the St. Jones River Study Locality 63

Table 9: Analysis of Variance Data for the Leipsic River Study Locality 67

Table 10: Sediment Accumulation Rates for Radiocarbon Dated Wetland Cores 80

Table 11: Sedimentation Rates for Pollen Cores 84

Table 12: Vegetation and Climate Inferred from the Pollen Cores 94

List of Plates

Page

Plate 1: Coring Walter's Puddle 29

Plate 2: Stratigraphy of a Bay/Basin Core 32

Plate 3: Aerial Photograph of Bay/Basin Ponds 38

Plate 4: Vibracoring a Wetland Study Locality 52

Plate 5: Aerial Photograph of the Duck Study Locality 56

Plate 6: Aerial Photograph of the St. Jones River Study Locality 60

Plate 7: Aerial Photograph of the Leipsic River Study Locality 65

Plate 8: Archaeological Field Work at the Pollock Site 99

Plate 9: Excavating a Prehistoric Feature 102

Plate 10: Flotation of Feature Fill to Recover Plant Fragments and Seeds 103

Plate 11: Plant Fragments and Seeds Recovered from a Feature 103