Iowa's Historic Automobile Roads

A National Register Study of Pre-1948 Arterial Highways

Marlin R. Ingalls

Highway Archaeology Program
The University of Iowa **Iowa City, Iowa 52242**

Report Photographs

Photographs used in this study may have been cropped or corrected for moiré, color, tone, sharpness, size, or clarity.

Front Cover Photograph

Aerial view of the routes of the railroad (1889), old U.S. 218 (1928 to present, formerly The Red Ball Route 1910 to 1925), and current four-lane U.S. 218 all paralleling the Iowa River near Indian Lookout bluff, Iowa City, Johnson County. Note dark railroad corridor is in upper left corner.
Photographer: Marlin R. Ingalls, September 20, 2006

Back Cover Photograph

View of ca. 1922 painted sign for old Iowa 2 (1922 to 1926), located in downtown Ainsworth, Washington County.
Photographer: Maria F. Schroeder, April 6, 2003

Iowa’s Historic Automobile Roads
A National Register Study of Pre-1948 Arterial Highways

Prepared for Primary Roads Project NHS-61-4(55)--19-70
Muscatine County, Iowa

by

Marlin R. Ingalls
Project Architectural Historian

Submitted to the

Office of Location & Environment
Iowa Department of Transportation
Ames, Iowa 50010

Carl A. Merry and Stephen C. Lensink
Co-Principal Investigators

Project Completion Report
Volume 32, Number 16

2009

Highway Archaeology Program
The University of Iowa
700 Clinton Street Building
Iowa City, Iowa 52242-1030

Table of Contents

List Of Figures

List Of Tables

This study of Iowa's Historic Automobile Roads was completed as part of a Memorandum of Agreement (MOA) between the Iowa DOT and Iowa SHPO in 2002 stemming from the mitigation of the removal of archaeological site 13MC133, an early automobile road segment. The complexity of the study elements as outlined in the MOA required intensive research and fieldwork in order to meet its requirements. As a result, after consultation with the Iowa DOT and SHPO, the content of the study was expanded in the scope of work in order to fulfill a need for a more thematic study of the components of historic roads and cut-off arterial highway segments related to technology and engineering, materials, construction, identification, and evaluation for Section 106 review and compliance purposes. The study chose two highway corridors of multi-county length and opposite directions. The focus of the study was to stay within the right-of-way and not include ancillary elements except where pertinent. During the statewide reconnaissance part of the project, following a total of 7,334 miles were driven for the survey. For the intensive level survey of the two chosen study routes, U.S. 34 and U.S. 218, 4,507 miles were driven. A total of 1,452 highway-related structures were identified, analyzed, and evaluated. Eleven principal historic themes related to arterial highway construction in Iowa were identified. These overlapping themes outline specific historical, technological, and political periods, trends, and eras specifically related to highway context evaluation. These themes provide the baseline means for applying contexts during the study's period of investigation that dates from 1900 to 1948. Using the two study routes as background examples, the study presents information on how to identify, survey, and document historic roads in Iowa, and evaluate their significance under the criteria of the National Register of Historic Places.

Introduction

This study of Iowa's Historic Automobile Roads has been prepared by the Highway Archaeology Program under the terms of an annual cultural resource surveys contract between the Iowa DOT and The University of Iowa. Under this agreement, state transportation funds are appropriated by the Iowa DOT for The University of Iowa Highway Archaeology Program to locate and determine the significance of cultural resources in the area of proposed highway and transportation improvement work. Cultural resources include archaeological, historical, and architectural sites. The study of Iowa's Historic Automobile Roads reported herein, including archival research and survey, was conducted between June 2002 and June 2007, by Marlin R. Ingalls and Maria F. Schroeder. The University of Iowa Highway Archaeology Program is solely responsible for the content and accuracy of these reports with respect to site location description, interpretation, and recommendations. Duplicate project reports are filed at the State Historic Preservation Office (SHPO), Community Programs Bureau in Des Moines. Illustrations in this report may have been altered for clarity and sized to fit the page.

Project Description

This historic roads study was developed as a result of findings reported in an archaeological report (Artz 1995a). This study presented the results of the Phase II archaeological investigation of a cut-off highway section on U.S. 61 south of Muscatine, in Muscatine County. As a result of that report an agreement was reached between the SHPO and the Iowa DOT outlining the current project. This project's initial objectives were two fold. The first was to locate two prospective study routes within the state containing abandoned or cut-off highway segments for analysis. The second was to devise a method to identify, outline, and define the criteria for evaluation of the potential National Register eligibility of such cut-off highway segments. One primary result of the project was to enable cut-off segments of Iowa highways and related historic resources to be consistently evaluated. The criteria for evaluation were to involve only the route's engineered cross-sections between the right-of-way boundaries. Only engineering elements, which include design, material acquisition, and the construction methods of the study highways, were to be evaluated. Roadside architecture beyond the highway right-of-way was to be generally excluded from this study.

The Memorandum of Agreement (MOA) (see Scope of Work: Appendix A) outlined both the approach to be taken and the means by which data would be obtained and evaluated. The basic premise was for the research to identify two Iowa highways as study routes. These were to meet two basic conditions. The first was that one north–south and one east–west running arterial highway were to be identified as the study routes. Additionally, it was recommended that the routes be multi-county in length to incorporate a number of topographic features, construction periods, and structures covering the recommended temporal period from 1900 to 1948. The second aspect was to identify and evaluate cut-off segments within these study sections, to compare the engineering and construction histories of the two highways, and to provide a historic context for their evaluation using the historical elements and current aspects of local communities. Lastly, the study was to apply the proposed evaluation criteria to the identified highway alignments, suggesting the potential National Register eligibility for each of the study routes and the cut-off segments derived from the evolution of the routes (Iowa Department of Cultural Affairs 2005).

Methods

INTRODUCTION

Due to the relatively large scale of the project two initial objectives were to be developed. The first was to identify the two subject highway study routes. This involved a two part approach with the first element being a review of period literature, historical plats, maps, and early travel guides in order to determine where the first automobile routes were in the state, what they looked like, and if any still survived. The second part of the initial reconnaissance phase was to drive the prospective routes and see what remained in order to determine if they met the requirements for the study routes to be chosen. The MOA called for "arterial highways" to be a component of the study routes so the main federal and state highways were concentrated upon. However, secondary road systems that had once been arterials were also investigated.

RECONNAISSANCE SURVEY

After preliminary archival review and the collection of pertinent archival data were completed; the historic routes were transferred onto a 2001 Iowa Atlas and Gazetteer (DeLorme 2001). The gazetteer provided a format that covered the entire state in a scale that was both accurate enough to trace the roads but also conveniently sized and shaped to be usable in a car during survey. This gazetteer is also an inexpensive and readily available map with relatively up to date information.

The reconnaissance survey of potential study routes consisted of driving the actual historic routes of the highway and taking basic notes and sometimes pictures of surviving engineering elements. The focus of the survey generally included the date of a route's period of significance, the pavement type, width, construction materials, and surviving engineering elements such as culverts, bridges, grades, and overall cross-section and width or the right-of-way. Engineering elements were observed for both in-use and abandoned alignments. Lastly, a general evaluation of whether the roadway exhibited low, medium, or high preservation of such elements was considered along with the types and numbers of cut-off segments.

The reconnaissance period of the project survey consisted of both archival research and road survey. Research and survey lasted 11 months and a total of 7,334 miles of Iowa highways were driven and evaluated. All regions of Iowa were visited with the major early highways located and driven. Local archival resources were also consulted and evaluated, interviews conducted, digital photographs taken and articles scanned, and aerial photos reviewed (Drury 1955a, 1955b, 1956). An assessment of the state of survival of the highways present in various regions of the state and their potential for study units was considered. For those segments found having high integrity or significance a field form was filled out.

Reconnaissance Survey. With the majority of Iowa's historic highways located and evaluated through either actual travel over the route or through a combination of travel and archival resources, the two Iowa study routes consisting of arterial highways meeting the requirements of the MOA were chosen. These two routes were picked for several reasons. The first was that they met the basic Iowa DOT and SHPO requirements for being multi-county in length, dated from the period of significance or study period of 1900–1948, had extant cut-off segments for analysis, and had a reasonable amount of documentary sources available so that a historic context could be developed. The second criteria was that the study routes needed to exhibit a certain level of surviving engineering elements dating from the study period. The survival of datable, quantifiable, and potentially significant construction features of the original highway engineering and construction elements included cross-sections, paving sections, culverts and bridges, various livestock and vehicular crossings, and drainage constructions significant in terms of the identification, interpretation, and evaluation of cut-off highway segments for eligibility to the National Register of Historic Places.

Intensive Survey. The intensive survey concentrated on the two study routes chosen. These were U.S. 34 from Mount Pleasant to Albia and U.S. 218 from Mount Pleasant to Cedar Rapids. Intensive survey consisted of all or most of the following: local and regional in-depth archival research, oral histories and interviews, mapping of highway routes and cut-off segment, GPS locations of all significant features and structures (culverts, bridges, and segments), photo-documentation, survey notes and site form(s), and onsite evaluation. Of the 11,843 miles driven for the entire project a total of 4,217 miles were driven during the intensive survey of the two study routes.

However, within the intensive survey area various levels or degrees of survey, recordation, analysis, and evaluation were conducted in regard to the level of investigation and documentation needed to record and evaluate a particular segment or section. Survey was more limited along segments which were recently cut-off, had been intensively reconstructed along its whole length since the end of the study period (1948), had poor integrity, or post-dated the study period. However, these segments were evaluated within the overall context of the highway's evolution and what remained of their original engineering. In some cases these were late or reconstructed sections of a study route that dated after the study period, but either paralleled or contained older segments or elements dating to the study period or connected surviving sections or segments. These features or elements relating to the evolution of cut-off segments of varying length were also recorded and evaluated in some cases because they in turn will soon reach the 50 year cut-off date for National Register significance, or slightly post-dated an earlier significant section.

For the highest level of intensive survey the end and beginning points of each road section, and every culvert, bridge, and drain with the road section was digitally photo-documented, a field form filled out, and mapped using GPS coordinates. These points were correlated with changes in concrete type and materials, width, construction methods, time period, cross-section, archival data, and pertinent oral history information. Additionally, each individual engineering structure was photographed as well as viewsheds of stretches of the road exhibiting particular characteristics.

Preserving Historic Roads. It can be said that preservation is the frontier between history and development. In terms of the historical significance of Iowa roads the following declaration states their importance most succinctly. The Omaha Declaration was adopted at the third *Preserving the Historic Road in America Conference,* Omaha, Nebraska, April 11–14, 2002.

The Omaha Declaration

Historic roads are vitally important cultural resources that embody significant developments in engineering, design and social history.

Recognizing the important role that roads have played in our nation's history, we believe it is essential to develop strategies for managing historic road resources that combine a firm commitment to historic preservation with due respect for public safety and utility.

Preserving historic roads enhances our understanding of the American experience, enriches our transportation system, and promotes beneficial social, economic, and practical goals.

One purpose of the present study is to help formulate means and methods by which segments of such roads can be consistently evaluated. To fulfill that purpose it is necessary to first answer the big who, what, when, where, how, and why questions. Importantly, the goal of this study was not only the big picture but how to understand and evaluate the little pieces, the parts that survive from the bigger picture, which is now lost or even forgotten. These remnants of Iowa's road building past retain information about themselves and their purposes that can be quantified by understanding their three primary individual components or elements: design, materials, and construction. The interplay and integration of numerous possible contexts ranging from Iowa's road laws, to engineering and design, state and federal politics, and construction equipment and materials provide the historic contexts. While all these elements and contexts are interwoven they are discernable when the various processes are known and understood.

Evaluation Criteria for Cut-Off Highway Segments

RECOGNITION OF HISTORICAL SIGNIFICANCE

While highways are among the most difficult elements of the built environment to evaluate for historical significance, cut-off segments of arterial highways are even more difficult. In general highways are extremely common as a structure type, and with rare exception, highways are similar in materials, design, and general appearance. However, cut-off segments on historic highways are disappearing at an increasing rate. Highways are also exceptionally vulnerable to alteration over time as a result of maintenance and modernization and cut-off segments are a product of this. A highway segment cannot be expected to retain all of its original materials and design elements for more than a few years after initial construction due to pressure to improve or replace it.

Cut-off highway segments have generally survived longer than their overall design elements, especially those built prior to 1940, and those that have survived the longest are often the most removed from their original setting. Those that do retain their original materials are even more uncommon historic resources. Those highways exhibiting the highest integrity are those retaining their original settings and historic fabric. How much the settings have changed over time is a large part of defining a highway's integrity. The nature of a cut-off highway section, which by definition implies the loss of some areas of function and overall integrity, are even harder to evaluate than a completely intact route. This is especially true when the physical environment and setting change dramatically over time. For many cut-off segments the original purpose, route, setting, and function are often no longer clearly evident. Highways are also among the largest man-made structures, in some cases hundreds of miles long, with various materials, features, environmental and cultural settings, and integrity. The cut-off segments of such highways may be as long as tens of miles or as short as a few feet. The historical significance of a highway, like that of a railroad, trail, or river, may have a number of associated sites in the form of cut-off segments with varying levels of integrity (Associated Cultural Resource Experts 2002, Section 10:1; National Register Branch 1997:29).

Because of the commonness of highways few modern highways are likely to be considered historically significant simply because they exist. Historic highways are often evaluated as such because they usually have significance related to human activities considered important to our past. Some highways may have had particularly interesting construction histories, especially those over difficult terrain or that used unusual materials or structures, but in general highways are historically important because of their role or effect in economic and social changes in our society. While long segments may be related more to the broad historical patterns associated with their use and design, short cut-off highway segments more closely relate to early local construction patterns. There appears to be a correlation between length and a context related to overall transportation history, and shortness with the process of design, technology, and construction. A very few will be associated with significant individuals or specific historical events.

While the historical context of a highway is usually the key element in determining historical significance the same context is more difficult to apply to cut-off highway segments. When looking at significance strictly applied to only those elements within the right-of-way the number of a roadway's or cut-off segment's contextual considerations and associations are lessened. The Criteria for Evaluation of properties for nomination to the National Register of Historic Places (36CFR60) provide general guidance for determining whether a highway, cut-off highway segment, or other property has historical significance but application of these criteria for the sake of evaluation of eligibility can be difficult (Associated Cultural Resource Experts 2002, Section 10:12; National Register Branch 1997:28).

The level of significance in American history, architecture, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship feeling, association, and the following criteria:

> (A) That are associated with events that have made a significant contribution to the broad pattern of our history: or
>
> (B) That area associated with the lives of persons significant in our past: or
>
> (C) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose subcomponents may lack individual distinction: or
>
> (D) That have yielded or may be likely to yield, information important in prehistory or history.

Criterion A addresses the importance of a property within the broad pattern of history. Lengthy cut-off highway segments are most likely to be eligible for nomination to the National Register under this criterion. Occasionally, a highway may have been the scene of a particular event important in local history but may be associated (or retain its association) with statewide patterns. In most such cases, a cut-off highway segment, or disconnected elements are contributing elements to a road as a heritage corridor or route (Associated Cultural Resource Experts 2002, Section 10:2; National Register Branch 1997:28).

Highways and cut-off highway segments in Iowa may be eligible for nomination to the National Register under Criterion B; Criterion B requires that a property must be directly associated with a person important in history, and be directly associated with the events or work for which the person is important. A cut-off segment such as the Coleman Road's Half-Slab in Lee County, or segment with the Marsh Bridge in Hardin County fall under this criterion. While later highways are usually government projects, designed by teams of engineers according to established standards and constructed by government agencies or under government contracts, early roads and trails in Iowa followed a different historical patterning. A highway, road, or structure when it is related to a significant designer or builder, unique in design or execution, or that became part of a later road may have significant Criterion B elements (Associated Cultural Resource Experts 2002, Section 10:2; National Register Branch 1997:28–29).

A cut-off highway segment can be eligible for nomination to the National Register under Criterion C on the basis of engineering or construction features embodied in the highway. A highway can include distinctive characteristics of a type, period, or method of construction, such as cross-section or surface. Or it may represent social movements such as those involved in their construction by the WPA, CCC, or even convict-built road segments. While a highway can (rarely) represent the work of a master or posses high artistic values, this is more common on structures. Examples such as the Fredonia to Columbus Junction convict-built road in Louisa, whose whole length shows exceptional materials, construction, and time period relevant design and conception, presents characteristics that, are usually confined to specific structures. At one level of interpretation most of Iowa's historic highways can be evaluated as "…significant and distinguishable entity whose components may lack individual distinction." However, individual sections or cut-off segments may meet this criterion. Historic highway segments are usually eligible for nomination to the National Register under a combination Criteria A and C, where physical features of the highway or the highway as a whole entity can be understood in terms of its relationship to important broad historical patterns. Some highways and highway segments can be associated with B and C. Such examples were found and evaluated within the study corridors (Associated Cultural Resource Experts 2002, Section 10:2, 3; National Register Branch 1997:28–29).

Highways are unlikely to be eligible for nomination to the National Register under Criterion D but a cut-off segment of very early roads may have such potential under certain circumstances. However, while it will remain uncommon, archaeology can be the best method for determining age, construction type, or materials for highways prior to 1915. At present, archaeological study of a cut-off highway segment, beyond its physical recognition and preliminary survey, is unlikely to yield information important in expanding our understanding of surviving structures that can be directly related to significant past technologies. Study and documentation of the physical features of a highway are more likely to be applicable to Criterion C consideration (Associated Cultural Resource Experts 2002, Section 10:3).

NATIONAL REGISTER SIGNIFICANCE OF HISTORIC AND CUT-OFF HIGHWAY SEGMENTS

Introduction

The lengths of historic highways and cut-off highway or road segments vary from a few feet to many miles. Simply, some historic roads and their cut-off segments have high integrity and significance while others do not. The historic road, its integrity, and its significance are related to several factors. Two primary factors are the period in which it was built, and for cut-off segments, the period in which it was cut-off. A second important factor for historic roads, and the various segment types associated with it was, for this study, if the route has continued in use as a secondary or county road, farm lane or field access, or abandoned. Some historic highways may still be used for the county road system. Their sub-segments, which were cut-off by later construction, may be either still in place, overlain but otherwise unchanged, or abandoned. In the past some segments or segment elements such as bridges, where purposefully destroyed by the Iowa DOT, or its precursor the Iowa State Highway Commission (ISHC), when abandoned to prevent their possible use. This affects the overall integrity and interpretation of such segments as they cannot be part of or linked to larger preservation efforts such as a heritage corridor that can be driven.

For the comparison and evaluation of historic roads and their cut-off segment sizes, integrity, and contexts see the discussion of types of cut-off segments below. For the purpose of this study the four basic criteria for the evaluation of cut-off arterial highway segments to determine National Register eligibility by focusing only on aspects strictly within the right-of-way are 1) integrity, 2) length, 3) interpretive value, and 4) significance. It should be noted that the fourth criteria "significance" is related to or contains the other three elements. There can be exceptions in some cases for rarity, unique examples of engineering or construction, and for segments being contributing elements to larger contexts or to unique individuals or communities' enterprise. A very important aspect of the study's route evaluation was if it was drivable, or could be, and how much that cross-section, pavement, and structures represented the period of significance.

The historic contexts and the historic significance for any of Iowa's roads should be established using the Secretary of the Interiors standards and guidelines. It is largely the purpose of those standards and this document to help investigative researchers to do three things: 1) recognize and record cut-off road segments. 2) evaluate their context and integrity taking into account their multi-dimensional engineering aspects and sociopolitical contexts that influenced their design and construction, 3) and be able to form and render an informed preliminary opinion on the potential eligibility of cut-off road segments encountered during historic preservation survey work, road design, or construction. There are many overviews or route-centric articles that relate to this topic (Koster 1997; Schlereth 1997).

Other Considerations in Evaluation of Historic Highways

There has been a nationwide campaign to preserve historic highways over the past decade. This movement first gathered national attention in 1995, when the National Trust for Historic Preservation placed the Bronx River Parkway–the first modern motor parkway–on its list of "America's Eleven Most Endangered Historic Places." The subsequent struggle to maintain the historic integrity of the Bronx River Parkway (constructed 1907–1924) inspired other local preservationists to fight to maintain the integrity of the Lincoln Highway in Nebraska, the Arroyo Seco Parkway in California, and the Merritt Parkway in Connecticut (Associated Cultural Resource Experts 2002, Sec. 10:8–9; Marriot 2004).

The National Task Force for Historic Roads (NTFHR) was formed in the mid-1990s as an ad hoc organization seeking the participation of anyone interested in historic roads (Marriot 1997, 2004). The NTFHR is part of the Rural Heritage Program of the National Trust for Historic Preservation in Washington, D.C. The NTFHR's mission is to maintain the integrity, design, purpose, and use of historic highways in ways appropriate and responsive to modern safety needs. The primary purpose of the NTHFR is to promote the recognition of historic roads. To better identify the historical use of the nation's roads, the NTFHR established four classifications of historic roads: aesthetic, routes, engineered routes, cultural routes

1. Aesthetic routes are roads designed for a specific interaction with the natural or built environment.
2. Engineered routes are roads designed for a specific transportation goal. The movement of drivers and their vehicles is the principal underlying force behind the design of an engineered route. Engineered routes, like aesthetic routes, have a documented origin or authorization and construction date.
3. Cultural routes are legacies handed down from the first people to venture through a mountain pass or who trekked over a prairie. Cultural routes represent routes adapted over time by that evolved through necessity or tradition.
4. Heritage Corridors are a combination of the above that embody significant historical activities.

Consideration of Age and Period of Significance

The National Register Criteria for Evaluation requires that a highway must ordinarily be 50 years old or older to qualify for eligibility for nomination to the National Register, in addition to qualifying under at least one of the primary significance criteria and having sufficient integrity to convey its significance. The Criteria for Evaluation contains three possible exceptions to the 50 year age rule and many highways are approaching or have passed the fifty year date (Associated Cultural Resource Experts 2002, Section 10:7; National Register Branch 1997:31–32):

1. The highway is an integral part of an historic district that other wise qualifies for nomination. Rural historic districts and other cultural landscapes are also often anchored by a road or highway. Many historic districts, and central business districts, were built along highways or roads that became highways.

2. The highway has been reconstructed, and the reconstruction has been accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived. This situation is extremely rare, but theoretically a faithful restoration of any highway could qualify under this consideration.

3. The highway is of exceptional historical importance. For example, the highway built to carry the space shuttle from the assembly building to the launch site is of exceptional historical importance. In Iowa, the convict-built Fredonia to Columbus Junction segment of the Blue Grass Road (U.S. 34) or the Eddyville Cemetery Road in Mahaska County might qualify under this consideration.

Most highways in Iowa originated in some form more than 50 years ago, and therefore most of the state's highways technically meet the ordinary age requirement. A more useful application of age in the evaluation of significance involves assignment of a highway to one or more of the principal historic periods of automobile highway construction in the state, and then assessment of the integrity of the highway to that period (Associated Cultural Resource Experts 2002, Section 10:7–8; National Park Service 1997:31–32). As discussed in detail elsewhere in this document, a number of the principal applicable historic contexts and their related periods of highway construction in Iowa are noted below.

Evaluation Themes

It was recognized during survey and evaluation that any number of different contexts could relate to a particular road, route, or evaluation situation. These could relate to location, period, technology, historical events, politics, geography, individuals, and various widely recognized eras, periods, and themes. The following themes were designed to help investigators and researchers pick applicable historic contexts that best fit the resource or project. Some themes overlap with others. Thematic studies with multifaceted resources and survey methodologies need a basic timeline of events.

1. 1900–1905--Pre-Concrete Era
   1906–1913--12 ft to 16 ft Roads and Highways
   1914–1925--18 ft Gravel Highways
   1925–1930--18 ft Curbed Concrete Highways
   1931–1940--20 ft Concrete Highway
   1945–1948--22 ft Concrete Highway

2. 1890–1930--Pioneer Automobiles
   1930–1945--Depression and World War II
   1945–1973--Postwar Boom and the Interstate System
   1973–2000--Completion and Expansion of the Highway System

3. 1900–1912--Formative Time Strong on Local Issues and Boosterism
   1913–1928--State and Federal Funding Take Control
   1929–1939--Intensive Highway Improvement
   1940–1948--Concentration on War and Immediate Post War Recovery

4. 1900–1912--Formative and Experimental Period
   1913–1925--Technology and Engineering
   1925–1939--Cement Paving of Iowa Period
   1940–1948--Continuation of Old Policy and Waiting for New Beginning

5. 1900–1905--Pre-Iowa State Highway Commission
   1906–1912--Local and Private Road, County Control, and Pre-Highway Commission Review Era
   1913–1923--Grading, Bridging, and Paving (Iowa's Brought-to-Grade and Graveling Period)

1924–1939--Major Accomplishments on Primary Roads
1939–1948--Iowa Engineers Get Experience Overseas

6. 1900–1904--Pre-Highway Commission and Good Roads literature
1905–1918--Iowa Highway Commission Handbook for Iowa Road Engineers and Road Schools
1919–1930--Primary Roads and End of Experimentation (The Increased Standardization Era)
1930–1948--Infilling and Secondary Roads

7. 1900–1909--Iowa Experimental Era
1910–1916--Machinery Improvement and Increased Mechanization
1913–1923--Connecting County Seats and Elimination of At-Grade Railroad Crossing
1923–1933--Primary Roads vs. Secondary Road Systems
1934–1939--Completion of Primary Roads
1940–1945--World War II

8. Pre-1900–1903--Good Roads Era and prior to the Iowa State Highway Commission
1904–1913--Early State Highway Commission
1914–1927--State Plan Review and Registered Highway
1918–1939--State and Federal Partnership
1940–1948--WWII and Post-War Period

9. 1900–1918--Road Drag and Minor Equipment
1905–1915--Experimental Concrete Road and Brought-to-Grade Era
1900–1930--Concrete Culverts Dominate Construction
1900–1938--Horse-Drawn Equipment
1918–1948--Mechanized Trucks, Graders, and Major Equipment

10. 1900–1910--Dirt Roads
1911–1920--Gravel Roads
1920–1930--18 ft Concrete Roads
1930–1945--20 ft Concrete Roads
1945–1948--The Fix What's Tore Up Time

11. 1900–1912--Experimental and Good Roads
1913–1925--Safety, Safety, Safety, Cooperation with Railroads, and Bringing Roads to Grade
1925–1935--Concrete Paving the Primary Roads
1935–1948--Heavy Mechanization

Nearly all highways in Iowa have been in use during more than one of these periods or eras. Some sections of the earliest highways have segments that have been in continuous use though all of the periods while other segments have been abandoned. The focal period for historical significance of most highways is the period which they were constructed and first used. In that initial period, the highway met the need for which it was built, and in that period the highway probably had its most definable effects on the economy and culture of the highway's service area. Use of the initial construction period as the beginning point of a highway's period of significance also establishes a basis for identifying change and assessing integrity of the physical characteristics of the highway. For highways that are significant primarily for their engineering and construction features, the period of significance may appropriately end with the completion of the highway or a particular segment of the highway (Associated Cultural Resource Experts 2002, Section 10:8).

The ending point for the period of significance is more problematic for most highways, because most highways continue to be vital to the transportation, commerce, and general culture of their service areas. The period of significance is the time in which the highway performed the special function of role that distinguishes it from other highways. The initial construction of a highway will correspond to one of the principal historic period listed above, but the period of significance for a particular highway may be only a few short years or may span more than one of the principal historic periods, depending on the particular historical context of that highway (Associated Cultural Resource Experts 2002, Section 10:8, Marriot 2004).

CUT-OFF SEGMENTS: GENERAL GUIDELINES FOR EVALUATION

The four elements below comprise the basic categories for evaluation of historical significance. It is a combination of these elements that determine the potential significance of any cut-off road segment. The National Register criteria for evaluation provide for just such a basic approach. The following discussions on the history of road's design, construction, materials, and period of use are designed to help evaluate and determine the importance of individual route on the cultural landscape, especially in the field.

Integrity. Auto transportation roads have their highest integrity when they open and their integrity changes from that time forward. Segments that retain the combination of original length and route, cross-section, paving surface, and integral structures have the highest integrity. In many cases however one or more of these aspects have been modified. Usually, the greater a road's modifications the greater are the losses of its integrity. This study suggest that as roads change over time the two elements of original route and original cross-section are the most important. While bridges, culverts, and the pavement itself often are replaced they can be viewed as somewhat secondary to a larger view of the road's function as a route exhibiting the products of the time and place in which it was first constructed, improved or repaired, and then abandoned. Cut-off segments can remain part of the context of an overall route (see Consideration of Integrity below).

Length. The length of a cut-off highway segment is very important and sometimes crucial to the interpretive process. As outlined in the National Register criteria the sense of time and place is inherently connected to the length. In many cases, the longer the cut-off highway segment the greater its visual, physical, and social impact. Straight route segments less than one-quarter mile in length have a diminished interpretive value. Curved routes often have greater visual continuity and sense of time and place. Short cut-off segments that connect to, contribute to, or make up longer routes may have to be interpreted and evaluated as part of a total route's length rather than as a single disconnected element.

Interpretive Value. For most people, and many professionals, interpreting and evaluating the significance of historic cut-off highway segment can be challenging. On the other hand the pleasure derived from traveling an old route with its sinuosity of curves, more narrow cross-section and pavement, relationship to the topography and landscape, and the old bridges and other structures are part of an esthetic experience we all can participate in and appreciate. Travelers don't have to know why they like something to enjoy it. However, for preservation professionals much of a roadway's interpretive importance is about the details. Cut-off segments are the remnant pieces of this larger experience. Preservation professionals need to determine how such roads and cut-off road segments can best be located and identified, recorded, correctly evaluated, and preserved.

Significance (Contexts). The significance of a road, segment, or structure largely depends on the applicable contexts and takes into account its integrity, length, and interpretive value. The greater its integrity, length, and interpretive value the more significant it can be considered. Historical road contexts may be simple or many layered and multi-dimensional. As developed in this study the construction of a road involves the dynamic interactions between the landscape, state and local politics, individuals, economics, engineering, and technology. It is the interplay of these elements, applicable contexts, and occasionally a specific aspect or individual that primarily determines the significance. With so many possible contexts to choose from one can generally find the firmest footing for evaluation by concentrating on what stands out most or that which has survived the longest. Numerous contexts may be applicable to a particular segment or route with several applicable periods of significance. This is especially true for either the earliest roads or the longest surviving routes. However, only one element needs to be evaluated as historically significant to meet National Register criteria.

Evaluation. Examination of a road's construction elements and features can usually define what is characteristic, important, or unusual about a particular road segment. Often the goal is to understand how and when the road was built and by doing so be able to evaluate what was common or uncommon along a particular segment. With a basic understanding of road construction highway segments can often be tied to a particular context and time period. As with the interpretation and evaluation of other architectural or technological features of the built environment simple survival or age may not directly correlate with a level of significance that makes them eligible to the National Register.

To evaluate a cut-off highway or road segment or section on a first appraisal or Phase I investigation the following criteria may be used. It should be noted whether it is a cut-off segment or continuous section of roadway that:

1. Exhibits typical early (handmade) or later (machine made) construction methods and materials.
2. Was the first such road or structure to be built and used in a locality, area, or region.
3. Was of a material, design, construction method, or placement that was new, atypical or unusual, unique, or very economically or socially significant to that area.
4. Exhibits high or master craftsmanship.
5. Exhibits a design, material, or construction method that is typical for a time period or area, or that is uncommon or rare for an area or time period.
6. That exhibits some specific use or function, extraction or construction method, unique or innovative design for use.
7. Extracted from an adjacent quarry along side of a highway from which materials were derived that date to its period of significance and whose materials source can be positively identified.
8. Identify the work of local, regionally, or national designers, builders, contractors, and suppliers.
9. Exhibits signature dates, names, or other markers.
10. Is related to significant individuals involved in road construction, design, or funding.
11. Gives an overall impression whether standards for the period were being followed or if poor supervision resulted in degraded products. Experiments and experimental failures were usually rebuilt and surviving examples are rare.
12. Shows the composition and application of the materials used; especially in the concrete aggregate itself.
13. Allows a determination as to what period the road segment was built and to what period(s) that it was altered, abandoned, or reduced to local use status.
14. Exhibits the transition or evolution from early trail or railroad construction methods and abandonment, to its reuse as a highway and incorporating the previous routes, grades, and structures.
15. A section, segment, or element of a continental route, state highway, local connecting stub road, or other.
16. Is attributable to a specific individual in terms of design, construction, or funding.
17. Related to early Primary Roads or registered roads whose routes changed over time.
18. Is wider or narrower than 18 ft as after 1922 almost all roads were designed to that width or wider.
19. Dates before or after the establishment of the Iowa State Highway Commission (ISHC) in 1905 or their era of plan review (1913–1940).
20. Was funded privately, by the county or state, or through federal programs.
21. Was abandoned or is still in use.

These criteria all may have wide applications to understanding and evaluating a highway's evolution and resultant cut-off segments. The evaluation of contexts concerning evolution, construction, and maintenance can help determine the significance level of a cut-off road segment or larger continuous section from low to high. It also influences the evaluation of the road's or route's overall historic significance. The importance of the structural elements within the overall segments is outlined below.

Consideration of Integrity

The National Register Criteria for Evaluation require that, in order for a property to be eligible for nomination to the National Register, it must possess integrity of location, design, setting, materials, workmanship, feeling, and association. As indicated above, highways are very susceptible to change over time, to the extent that a "pristine" historic highway is extremely unlikely to exist in Iowa. In addition, due to the constraints of the study to stay within the right-of-way markers its "association" with any events other than its construction and use over time was not major a consideration of the evaluation (Associated Cultural Resource Experts 2002, Section 10:3; National Park Service 1997:28–29).

Analysis and evaluation begins by establishing the road's significance in relation to broader themes in American history. While the general historical section traces the road's entire evolution a more selective and analytical approach, identifying the most important aspects of the road's design, use, and development are considered. Cut-off highway segments are most likely to qualify for the National Register under Criterion A for its association with events that have made significant contribution to the broad patterns of out past or Criterion C for important design and construction. Instances will be found that make it eligible under Criterion B for a significant individual.

A number of historic themes and contexts have been developed. Establishing the period of significance is a crucial element of the evaluation process and should reflect historically based dates of development or use. The fifty year cut-off date is not an absolute rule and most roads contain elements from many periods up to the present day. Roads that are approaching the fifty year threshold should be considered and the evaluation of routes and their significance should keep this in mind.

After identifying the context and significance a delimitation of character defining features is the next step. Not all existing features are necessarily historic and not all historic elements qualify as character-defining features. Character-defining features are those aspects of a historic resource that are essential for conveying its identity and significance. Engineering factors such a pavement width, composition, curvature, cross-section, and structural elements fall within the parameters of this document's mission.

Their integrity allows for the conveyance of historic significance and is often related to physical condition. However, high integrity is not synonymous with significance. The measures intended to improve practical performance frequently compromises historic fabric and experiential character. This dichotomy should be remembered when interpreting materials that apply modern engineering standards to historic resources. By National Register standards, a resource must retain sufficient physical evidence of its appearance during its period of significance to understand its historical character and significance. The following seven qualities must be evaluated in order to assess the integrity of a historic road.

Location. The place where the historic highway was constructed and is a fundamental aspect of a road's integrity. To possess integrity a road should occupy its original location, and generally provide the same sights and experiences that prevailed during the period of significance. Some minor variations may be permissible when they do not markedly alter the experience. Highways may have been re-routed or changed so that the current route may bear little or no resemblance to the historic route. The principal consideration of integrity of location are (1) the extent to which a highway corresponds to the general route followed during the period in which the highway attained its historical significance, and (2) the relative importance of the route as and element of the significance of the historic highway. Relatively minor variations of route, such as relocation slightly higher on a slope or road straightening, are usually more appropriately addressed under consideration of integrity of design (Associated Cultural Resource Experts 2002, Section 10:3, 4; National Park Service 1997:29).

*Desig*n. The combination of elements that create the form, plan, space, structure, and style of a property. It incorporates the entire corpus of engineering, architectural, and landscape architectural techniques that established a road's physical structure and experiential character, from the technical and aesthetic attributes of individual components to the appearance of distinctive sections to the general character of the road as a whole. Elements of highway design include the height and width of the road bed, surfacing methods, shoulder width and sloping, ditching and other drainage features, alignments, intersections, pullouts, retaining walls, guardrails and other safety features, bridges and culverts, and signs and signals (National Park Service 1997:30).

The principal consideration of integrity of design for a highway is the extent to which the highway retains the features that defined the physical nature of the highway during the period of its significance. The condition of individual elements and the overall appearance of the road should be evaluated. It is recommended that evaluation be location-based and time-specific. Selective alterations to individual components do not necessarily impair the integrity of the road or route as a whole, but the overall impression should remain consistent. However, the cumulative effect of seemingly minor alterations can severely compromise a road's historic integrity (National Park Service 1997:30).

All elements of original (or period of significance) design do not have to be present for a highway to retain its essential physical nature. For example, most signs and many culverts may have been replaced, but these are usually relatively minor elements of a highway as a whole. However, if a highway's surface material has been replaced or completely covered, its profile and cross-section re-graded and substantially widened or altered, the highway has lost important element of design.

Setting. The physical surrounding of a highway, including the topographic, vegetative, and cultural character of the location of the highway. Cultural character primarily refers to the built environment, including buildings and other structures, but it can also refer to ethnic and other social factors. Every highway was designed to accommodate its setting, whether the highway is in a narrow river valley, a city, or a wide open rural environment. Setting is closely tied to the landform upon which the road was built. This landform may be in turn tied to agricultural practices, forests, or materials or acquired from it. The principal consideration of integrity of setting is the extent that the general environment affected location, design, construction and use of the highway remain intact from the highway's period of significance. While natural environments tend to remain basically unchanged unless disturbed, cultural environments are much more prone to change. For example, a clearing of trees near a highway would not substantially alter the setting of a highway, but construction and urban sprawl in the same area might significantly degrade the setting in that locality. Redevelopment of a 1930s commercial area adjacent to a highway would very likely adversely affect the historic setting of the highway (Associated Cultural Resource Experts 2002, Section 10:5; National Park Service 1997:30).

While not a major element in the evaluation of the project study routes, which kept within the right-of-way as much as possibly, the extent of the effective setting of a highway varies according to all of the elements that comprise the setting. The effective setting is usually the viewshed from a highway, meaning all natural and cultural features that can be clearly discerned with the naked eye. Regardless of the extent of the viewshed's setting, the key integrity consideration is the retention of salient features from the period of significance of that highway. A length of intact highway snaking its way across the landscape to the distance is an important factor in this assessment as without the highway that view may not exist in the same way. In many instances highways forever change the landscapes that they pass through (Associated Cultural Resource Experts 2002, Section 10:5; National Park Service 1997:30).

Materials. These clearly play a prominent role in establishing a road's appearance and communicating its historical character. Materials are the physical elements that were combined or deposited to form a highway and its associated structures and objects. Materials are the aspect of highways most likely to have been changed during and after the period of significance, particularly the materials comprising the driving surface. The acquisition of materials is an important component of the construction process. The principal integrity consideration for materials is the extent to which the highway retains the same general types of materials that were present during the highway's period of significance (Koster 1997:1–15; Cultural Resource Experts 2002; National Park Service 1997:30).

Assessing the degree to which the repair or replacement of original construction materials affects a road's integrity can be difficult to judge. Most roads have been periodically resurfaced, so as long as the new surface retains the historic character by having similar color, texture and basic composition such alterations should probably be accepted. The issue becomes more complex when evaluating masonry features such as guard walls, gutters, curbs, culverts and bridges, and retaining walls, For example, a highway that had a concrete driving surface has lost some integrity of materials if the driving surface is now asphalt. A highway that had an early concrete driving surface has lost less integrity of materials if the highway has been resurfaced with similar concrete materials, rather than asphalt, and retains it original width and cross-section (assuming the resurfacing was similar in area and location) (Associated Cultural Resource Experts 2002, Section 10:6; National Park Service 1997:30).

Workmanship. The visible evidence of group or individual craftsmanship is another factor in evaluating the integrity of roads. It is the evidence of the particular skill of an artisan(s) in building features of an entire highway, specific structures, and it can include applications of technology well as aesthetic principles. Examples might include ancillary structures of concrete or stone or the dry-laid stone retaining walls built by the Works Progress Administration. Again, the principal integrity consideration for workmanship is the extent of retention of distinctive artistry from the highway's period of significance. Workmanship is rarely a primary integrity consideration in evaluation of highways, except for portions of highways built mostly by hand by Works Progress Administration, Public Works Administration, and Civilian Conservation Corps programs workers during the Great Depression. Exceptions to this are probably rare. Modern grading and construction practices can produce either a cruder or a more regular appearance than was historically achieved through hand labor. Replacing slightly irregular field-designed constructions with highly engineered ones could also be seen as diminishing evidence of historic construction techniques and workmanship (Associated Cultural Resource Experts 2002, Section 10: 6; National Park Service 1997:31).

Feeling. A highway's expression of a particular period of time. In essence, feeling is the quality of a highway that results from combination of location, design, setting, materials, and workmanship. Feeling is a critical factor in evaluating the integrity of historic roads. In order to possess integrity of feeling, existing physical features must convey the road's historically significant character. While some modifications to original materials, workmanship, and location are permissible and perhaps inevitable, the overall impression conveyed by the road should enable modern viewers to partake in the same sensations that defined the road experience during the period of significance. Cumulative impact of incremental changes and speed limit and scale are important variables to consider along with more obvious changes. Minor increases in the width of the pavement and the rate of travel dramatically impact perceptions of the surrounding landscape. If a road's significance is tied to a specific period, design standard, and mode of experience, the historic impression as interpreted from plans, photographs, and contemporary accounts should form the basis of evaluation; the fact that a modernized road follows a more or less historic alignment and is more attractively configured than a earlier highway is not sufficient ground to ascribe integrity of feeling (Associated Cultural Resource Experts 2002, Section 10:6; National Park Service 1997:31).

These aspects of integrity are more subjective than other aspects, but clearly a solitary ribbon of highway through the rolling southern Iowa topography elicits a feeling that would be diminished if any of the component qualities were compromised. Although they have lost integrity of design and materials in some areas, cut-off segments of old U.S. 34 and old U.S. 218 generally elicit the feeling of the period of initial automobile tourism into southern and eastern Iowa. This connectivity with the past is an important part or the experience that ties the past with the present and makes history tangible.

Association. The direct link between an important historical event or person and a highway, usually meaning that distinctive physical features exist as part of the highway that clearly demonstrates the connection to the event or person. The ability of historic resources to provide a mental link to an event, period, or person requires the presence of physical attributes that retain the ability to evoke past experiences. Location and setting may be more significant in this regard than materials and specific design attributes, but existing features must still communicate the essential character of the road's historic identity. Both the nature of the road's significance and the condition of character defining features should be considered. As with the evaluation of feeling, the overall impression afforded by the road as a whole, rather than the status of individual features, should guide the ultimate determination. A road need not demonstrate integrity in every aspect to merit an overall positive evaluation. A road that is listed primarily for its design and construction would be expected to exhibit considerable continuity in form, materials, and workmanship, while the integrity of a road that is linked to a specific event or individual may be evaluated more in terms of its location, setting, association, and feeling.

The identification of contributing and non-contributing road elements and features is a critical part of the overall evaluation for significance. Aspects of a road or its associated landscape that have been significantly altered or that postdate the period of significance will not be considered contributing features. Nor will period-correct elements that do not play significant roles in defining the resource's essential historic character.

For example, the remaining dry-laid retaining walls representative of the Works Progress Administration era construction can visually connect the current road with the past road. Thus, the historic highway segment or element can still be recognizable as a distinctive entity and retain interpretive value. Likewise, a culvert, bridge, or road bed related to an older but abandoned and parallel route that is no longer part of the current highway, may still have essential historical association and interpretive value if the structure is visible from the current road and the former route to the culvert, bridge, or road bed is evident (Associated Cultural Resource Experts 2002, Section 10:6; National Park Service 1997:31–32).

Historical Background

INTRODUCTION

It is fundamental to understand that road construction and road destruction are parts of larger processes: technological, sociopolitical, and economic. Roads relate to the general convergence of need, funding, design and engineering, construction, and perception. The interpretation of a road or cut-off road segment is connected to three basic elements: 1) the period up to the inception of the ISHC, 2) an understanding of the beginning and end periods for types of design, testing, construction, and materials used interconnected with how they relate to state and local politics and the evolution of the ISHC, and 3) how these different but interrelated aspects were executed during construction. Each of these three basic elements have sub-elements whose time periods are both distinctive and which often overlap to form the historic contexts for Iowa's roads. These overlapping contextual aspects will be discussed below.

The purpose of the following sections are to both help orient the reader to general historic periods and movements and to provide contexts for the overall political, social, and technical dynamics involved in highway construction and destruction, from the local and state to national level. These contexts are critical to the understanding of highway funding, design, and execution. It is through an understanding of these contexts that it will be possible to evaluate when and how state or federal laws and funding impacted Iowa's highway construction and to determine if such are historically significant to a particular early automobile highways. All of Iowa's roads were built within these larger movements and contexts and it is just such complex interactions that results in the production of cut-off highway segments.

NATIONAL CONTEXTS

It always seemed that even in the earliest days space was abundant in Iowa and travel time was at a premium. If travelers could reduce the amount of time required for communication and transportation then Iowa's vastness lost its disadvantages. In such a situation, roads can become more than simply a means for moving goods and traffic. They became an important factor of American political life. In the 21st century, most people are not very aware of the roads around them unless they somehow impede their movements or impinge on their space. However, they play the same role in the present as in the past.

In the 19th century Iowa's roads were acknowledged to be a sorry affair. Most pre-1900 Iowa roads were like trails. They were somehow "given" by the landscape. In the study areas the routes took their early courses from natural grades between watersheds and ridges. The idea of "building" roads was strange in a nation of trails and traces. Often an early road was made by cutting off all trees for 60 ft or more and having no stumps over 18 in, the height of a standard wagon axle of the time. The earliest roads in Iowa were 70 ft wide. Later, extending from the Territorial Era's trail system they were 60 ft wide after 1840 (Fisher 1978:189). The famous Dillon's Furrow Road ran from Dubuque to Iowa City and followed survey stakes set by R. C. Tilghman, of the Army Corps of Engineers, in 1839 and was the start of several route sections of old and current U.S. 218 (Tilghman 1839). Even at that early time Tilghman followed an existing trace. The beginnings of current U.S. 34 and U.S. 218 have their origins in both native trails and the path of the Indian Agency road built westward from Iowa's first territorial capital at Burlington. Both of these routes evolved from earlier trails but were conceived of as "built roads" as they had improvements such as bridges and clearing. Built roads were thought of as "made roads" even until a relatively late time in Iowa (Patton 1986:26).

In 19th century America the word *road* took on a highly abstract, almost idealized meaning: it referred to any line of transport, on land or on water. In early Iowa the rivers were the transportation routes. Like the Romantic period from which "road building" evolved the road was an organic thing, often changeable. Almost romantically one recent author related:

> A road, like a plough, aided in the cultivation of the new territories. The natural roads and waterways of America could be assisted by cultivation: improving the "natural" course of…trails, linking waterways…building freight roads. Road building was a successive stage to the reconnaissance of new territories…It would deploy the first patterns of the furrow across the land [Patton 1986:31].

That roads were seen as the natural succession of the taming of the land, of the conquest of the plough over the soil, and thus the theme of civilization conquering the wilderness had strong roots in the thinking of early national 19th century thinkers, and such views applied to Iowa's various Territorial Era planners and politicians. The men who surveyed these roads were often self-taught and relied on the Gunter Chain (22 yards long) (Sloan 1992:145). The earliest territorial roads in the state were devised somewhere else. Iowa's late territorial and early statehood roads of the 1840s and 1850s were decided by acts of the territorial legislatures (Brindley 1912:1–28, 29–56, 57–76). Even these roads ran from "pillar to post" or from spot-to-spot past a known residence or pre-established landmark in rural areas.

That a more rational view of the road's role in civilization existed along side such persistent romantic sentiment has been attributed mostly to the mind of Thomas Jefferson. Jefferson was largely responsible for the grid organization of American land, which provided the basic framework for the development of all Midwestern roads. The "grid" shaped almost all of the American landscape outside the thirteen original colonies. The grid was an abstract device imposed on the landscape. The American grid system was institutionalized in the Land Ordinance of 1785 and the Land Act of 1796, which laid out procedures for the sale of government lands in the territories. That law required that section lines were reserved for roads (Patton 1986:27). In Iowa, only after the 1850s did roads run between communities and not mills.

Within the townships and counties it created, the American grid provided a physical structure for generating new political structures and ideas. One of which was the "abstract road" such as expressed below.

> The grid took years to be built but they existed as plans, as potentials, as future roads. They helped us get used to the idea of road systems whose pieces are filled in one by one, but which exist, in plan and potential, long before their physical pavement–the abstract road [Patton 1986:31–32].

The grid and resulting section roads involved the rights of land ownership. Among the property rights of the landowner was that of access to adjacent roads. The later creation of limited access highways necessarily involved the use of eminent domain. It was the grid, however reshaped by the competing influences of politics, economics, and geography that served as a basis for all the versions of such networks, down to the final interstate map (Patton 1986:33). We are in many ways still following this early mandate.

Grid patterns in the city and over the country dictated a necessary connection between urban street and rural highway. The grid, as the organizing principle for most cities, also ties the cities directly to the national highways. The identity of American urban geometry with rural geometry, the connections of all the grids, in conception linked the great and the small, the far and the near, with Jefferson's Northwest Ordinance and Jeffersonian ideals of a national road system.

Only the elderly of those in Iowa today remember the way roads used to be prior to World War II. In the documentary research involved in the preparation of this report the researchers found themselves returning to those long past days in Iowa, starting with the first experimental automobiles and a road network in its infancy along side a rail network unknowingly just past its peak. In a way the automobile may be viewed as having arrived in a world already settled by the railroad. In a transportation sense the railroad opened and then closed the frontier. However, no common citizen owned a railroad. They were the province of the Gilded Age aristocracy.

In 1900 the automobile was the domain of the rich. It was a form of recreation and conspicuous consumption as much as a transportation device. As car ownership later spread beyond the very rich to the simply well-off, the automobile began its transformation into an object for mass leisure. It took a long time for the automobile to become egalitarian and associated with good roads. With the arrival of the Ford Model T, the automobile offered another hope: that of restoring the social mobility and economic opportunity of the frontier by tying country and town together. The auto was quickly taken up as a means to keep open the frontier the railroad had been perceived to have closed.

For the automobile, in a sense, the frontier reopened. The history of early motoring seems to glory in the mud holes and hazards. The auto had its own frontier and travel was compared to a sporting trip (Harlan 1912:20). These hardships offered a ready-made set of arguments for improved roads (Patton 1986:33–34, 41–43). At the same time advances in engineering and construction, along with some progressive thinking of economics, put in place both the forces and the materials necessary to pave the frontier of the unmade road.

As a result of these large-scale processes, during the first two decades of the 20th century the "auto frontier" quickly began to end rural isolation. As the affordability of automobiles increased so did the need for better roads. From farm-to-market roads to transcontinental routes Iowa began to fill in the grid with improved roads and the beginnings of a state road system. Starting slowly but proceeding at an ever increasing pace, good roads meant mobility and mobility meant improved commerce. Commerce meant more money from licensing, sales, and gas taxes; and other sources, including tourism, and brought revenue that helped pay for Iowa's roads in the years before the federal government became involved.

As the automobile trails gave way to numbered routes, the frontier seemed to close once more. Roads became the dominant element of many maps, and road maps the most familiar kind of map. Physical features were downplayed in a road map; highways made them less significant. Seldom before had the average citizen needed any sort of map at all. The automobile tourist/traveler was venturing into unfamiliar terrain, where highway's routes were constantly changing. For these reasons the road map has been expounded as "the first democratic map" (Patton 1986:46).

One of the most overlooked national movements was the founding in 1914 of The American Association of State Highway Officials (AASHO) (Patton 1986:45). Ratified by the states and the Bureau of Public Roads, AASHO's standardized signs and numbering system marked a change in the rationalization of the highway, the shift from thinking of individual routes to thinking of whole systems. Beginning in 1916, with the first federal highway aid (not implemented in Iowa until 1918), the topic of a national network of highways arose (Iowa Magazine 1918a–d; Patton 1986:47). It was an Iowan, Thomas MacDonald, who through his early experience in Iowa road engineering, hands-on building and boosterism, and inclusion of materials testing at Iowa State University, in Ames, took the reins of the formative national transportation system and made it a reality by the end of the study period in 1948.

IOWA CONTEXTS

While the great rivers along Iowa's eastern and western borders are natural divisions its northern and southern boundaries are products of the extension of the Northwest Ordinance grid system. Iowa was once a vast and open territory with only general topographic divisions, which were mostly based on river drainages and not political boundaries. In order to meet the qualification for statehood Iowa passed through several territorial and political gestation periods where it was progressively part of the Missouri (1812–1821), Michigan (1835), and Wisconsin (1836–1838) territories. It didn't become its own territory until July 4, 1838, with a population of 22,859. As population increased a movement was started for statehood. This was finally achieved in 1846 (Drury 1955:215).

With the area's recognition as "The Territory of Iowa" the first surveys for structuring the new lands firmly on the grid commenced. Beginning with two then three giant counties in the eastern part remaining from its early political subdivision, and over time its expansion and growth subject to the cession of Indian titles, the early Iowa Territory saw few roads and none were as yet "on the grid." Even Iowa's early eastern cities of Dubuque, Burlington, and Fort Madison were laid out according to geographic needs. They were the entry points to Iowa and the location of the first land sale offices. It was much easier to draw a line across hill and dale on a survey map then it was to travel it, let alone build a road along. If it hadn't been nearly impossible to get a steamboat up the Iowa River to Iowa City, few roads would have been built in the newly acquired Black Hawk Territory. The state needed roads to its new territorial capital and so one of Iowa's first major roads, Dillon's Furrow (Old Military Road), was begun in 1839 so that legislators could get to the capital from the north.

In Territorial Iowa a simple formative road network evolved along the western side of the Mississippi River. Running generally from north to south and skirting the river, only the few and isolated military roads or trails set up by acts of Congress tentatively penetrated into its heartland. This meant that the newly acquired area had to first be surveyed into Jefferson's township and range divisions, which had already checkerboarded the states to the east. Townships and ranges made up counties and counties made up states and states needed roads to both encourage settlement and to conduct commerce by facilitating mobility. Sections surveyed within townships allowed the grid to be applied and to make possible land division in order to facilitate land sales, to fill state and federal coffers, and to provide and assure land ownership for new settlers.

Both the right to own and the right to have that land were linked to the grid for legal location, and for transportation, were hallmarks of Iowa's linkage to the East. The individuality of parcels and the importance of the Jacksonian-type yeoman farmer made early Iowa and its roads the virtual application of

Jacksonian democracy at work (Bartlett 1967). The priority of the individual, the value and majority of the farmer, along with a sense of expansionist destiny and unlimited resources all set the stage for Iowa's roads and the two study route's origins in particular. Roads may be as abstract as an imposed grid but their purpose is to lead people somewhere. The trails of Native Americans and fur traders, the Dragoons and Mormons, the 49ers and the Gold Rush, access to the Oregon Trail, Iowa's utopian and/or religious communities, and the countless settlers from Eastern communities and European nations all traveled to and through Iowa during its formative period. Their routeways, with accompanying settlement patterns, architecture, and history, which they left behind all helped form the basis of both the roads themselves and the historical and current views and policies held about Iowa's roads.

IOWA'S ROADS

Early road building in Iowa was an extension of America's Colonial and Federal practices. In the East such endeavors were generally left to private corporations. Toll roads and plank roads had spread from east to west with settlement. Even a section of current U.S. 34 had its history in the mid-1850s as Iowa's only plank road. Running from Burlington to Mount Pleasant the plank road served travelers for only a short time (1853–1856). Weathering, maintenance problems from poor design and construction, and money problems plagued the plank road until the railroad replaced it (Patton 1986:29–30). Most of this early road's bed lies under the current Chicago, Rock Island, and Pacific railroad tracks built along that same course. Current U.S. 34 directly parallels the path of the original plank road and lies atop of the post-1856 road.

One needs to look no further than the number of abandoned railroad grades in Iowa to see that transportation features, which seem so permanent on the landscape, expand and contract, and even die. Transportation routes are in a constant state of flux for several reasons, but it appears that the overarching reason for their fluidity on the landscape is that they simply wear out; environmentally, economically, and socially. Iowa's variety of topographies and the often rugged yearly climatic cycle weathers materials quickly. Iowa was forced to meet almost all types of construction needs from drought to icy conditions, and steep rocky escarpments, to bridging large rivers or crossing multitudinous small drainages. In some areas it had both a lack of good road building materials and a lack of understanding about the necessity of good roads for social change.

Iowa's roads are studies in progression. They are political, economic, social, and engineering entities all evolving, interacting, and progressing at the same time. The road itself is the product of all these interrelated processes. In so many instances Iowa's early foot trails next became horse and wagon trails. With the introduction of the horse mail in the 1830s–1840s and the establishment of local post offices, overland transportation became increasing coeval with the early mail routes (United States Congress 1854). In 1838 the first official road in the Iowa Territory, a route from Keokuk to Iowa City, was plotted. In that same year the first regular stagecoach line, which was operated from Burlington, Iowa, to St. Francisville, Missouri, was begun. As early Iowa's stage coaching was also greatly influenced by its federal postal contracts, these mail routes became increasingly the most highly traveled and developed arterial roadways, and eventually state and federal highways. As the stage coaching era waned with the expansion of the railroad in the mid-1870s, much of Iowa's road system was in place but was undeveloped or unimproved (Kirkpatrick 1975:1–10). Concurrently, Iowa's rural population was at its peak.

In the 1880s most Iowans felt there was little need for good roads as the railroad would soon meet all the state's transportation needs. It was pointed out at the time that no matter how many rail lines converged on a town, if people couldn't get the goods from the farm to the market economically then it didn't matter how many railroads there were. It cost more to get the goods from the farm to the depot than from the depot over thousands of miles to the markets.

This relationship between the market and bad roads was illustrated for Woodbury County in 1902–1903 when it was expressed in the much quoted statement that "the price of hogs reached the highest level at the same time or during the same period that the roads were impassable" (Thompson 1989:97). When hard-surfaced roads were built, it was predicted that a farmer would be able to reach town markets during any season, and communities could diffuse their business throughout the year. Good Roads were considered a "Progressive" idea at the beginning of the 20th century.

Conclusion. Almost all of Iowa's current arterial highways evolved from earlier roads and many have followed, over some sections, exactly the same route over long periods of time. As a result, the location of these highway's routes can carry numerous and overlapping elements of historical significance. Both of the study routes have long evolutionary histories as arterial highways. They can help relate and interpret the story of our road system's evolution through early transportation and building technologies to these present day routes. Roads have been and always will be impermanent things. Fred White clearly stated both the frustration and vision of Iowa road builders in 1920. He conceded the obvious when in 1920 he related that:

> By the time we get the roads paved, the first of them will be worn out and we will be ready to start again. So let's go forward into it with our eyes wide open that we are starting something that we shall never finish [quoted in Thompson 1989:213].

Statewide and Local Sociopolitical Highway Development

IOWA'S ROAD STRATEGY

Introduction

The years 1880 to 1904 saw the political beginnings and eventual creation of Iowa's state highway and road policies culminating in the administration of the Iowa State Highway Commission (ISHC). This occurred both by conscious actions of public and progressive politicians towards road improvements alongside progressive local individuals dedicated to improving public roads and highways. Road legislation and progress towards improving Iowa's road network had long been an issue in the state but little concerted work was seen until the 1880s when Iowa's separation of county and state road development began to lessen. In the old district system the road funds were only accountable to county officials themselves and some graft and bid rigging was found. The Stark construction firm was seriously impacted by its suspected collusion with several northeast Iowa counties. This is where the majority of Stark's bridges are to be found. Bid rigging and kick backs were possibly fairly common business at the time. The ISHC increasingly used this oversight as a means of controlling county road funds. Township supervisors and county officials became increasingly accountable for local tax funds to state officials. This was largely due to the state's administration of newly accessible federal transportation funds. The state's administrative powers culminated in 1916 and were then further enhanced in 1918 with its control of the Federal Road Aid Act funds (Brindley 1912:184–264; Childs 1916:49; May 1965b:84–85).

Both changes in Iowa's road laws and administrative improvement over the often defective county road systems were slow in coming. In 1884 a law was passed that marked a turning point in Iowa road history. In it the county supervisors were authorized to levy a property tax to be paid only in cash. The tax's proceeds would form a county road fund to be spent under the order of the board of supervisors. In 1894 the county tax was made mandatory in all counties, but aside from this change road administration in 1900 remained little or no different than it was prior to 1884. As a result of increased pressure the Anderson Act of 1902 made the adoption of the township system and the payment of property taxes in cash compulsory. The old district system was partially restored in 1909 but was abolished for good in

1913. Until 1929 it was still possible in some townships for a man to "work out his five-dollar poll tax" on roads (May 1965b:84–85).

The ISHC had been founded on April 13, 1904, by the 30th Iowa State General Assembly. This established the formal adoption of a statewide roads policy and began both Iowa's educational and economic struggle to get out of the mud. At that time the ISHC and the state college in Ames were linked. This linkage would in many ways last until the present.

The 35th General Assembly of 1913 formally established the ISHC as a separate entity from Iowa State University, and permanent standards for road construction, especially bridges and culverts, were established. The Brockway-Balkema Law provided for a resident bridge engineer to administer statewide bridge design and construction. By September of 1913 permanent road standards based on materials, design, and size were established. After 1913 all further Iowa bridge construction conformed to those standards. However, much political growth was yet to come (May 1965b:85).

County System. In 1913 the powers of the county supervisors were greatly increased with the establishment of the county road system, which was to include "not less than ten percent nor more than fifteen percent" of the total road mileage in the county. These were to be the main traveled roads that linked the principal market towns. Administration of this system was placed in the county supervisors' hands. They also held complete control over all bridges and culverts in the county (May 1965a:84–85).

In 1921 the legislature provided that upon a majority vote of the people in any township its road work could be turned over entirely to the county supervisors. The days of road work on the township level were limited, and in 1927 a bill eliminated the office of township supervisor and further organized the road system. In 1929 the Bergman Act eliminated the township as a road administration district by January 1, 1930, and gave engineers more responsibility over county projects. All secondary roads came under control of the county supervisors. By this means the number of officials in charge of the state's secondary roads was reduced from 5,500 to about 400 (May 1965b:86).

The most important reform promoting efficient and expert supervision of the roads on the county level was undoubtedly the creation of the office of county engineer. It was proposed as early as 1883 during initial phases of the Good Roads Movement. By 1911 county supervisors could employ a competent person to draw up plans and specifications for county road work. The office of county engineer was created in 1913. Not until the late 1920s was the position of county engineer well accepted (May 1965c:65–115).

During this period county and township officials had great effect on registered routes, Primary Roads, or any arterials passing through their counties. From 1900 to 1913 county officials were involved in and their crews often constructed sections, or structures on future state Primary Roads. Some designs were made locally, and outside review of such plans prior to 1913 was limited. Surviving road segments or sections relating to Primary Roads from this era are uncommon. In addition, the plans for Primary Roads work prior to 1913, and sometimes much later, are still available only in county and other local offices in Iowa.

Iowa State Highway Commission (ISHC)

A commission was proposed as early as 1883 but not until 1904, at the suggestion of the Good Roads Association, did Iowa consider setting up a state highway department at Iowa State College where experimental road work had been conducted for several years. Although a separate entity was not formed the college was directed to act as an ISHC and serve as an information center for road officials of the state. Anson Marston, dean of the college of engineering, served as one of the commissioners, with Professor Thomas H. MacDonald as full-time assistant. Part of their earliest mission was that proper road "working" methods or "schools" were to be conducted at least once a year. Despite limited funds the Commission during the early years conducted annual road schools for county and township road officers, launched several important investigations and a general survey of Iowa's road conditions, and provided information and advice (May 1965a:89). The publication of *The Manual for Iowa Highway Officers*, published in 1905 and reprinted in 1906, was a landmark in codifying Iowa's road design, engineering, and application in the field along with the intent of making it available, understandable, and usable by local officials (ISHC 1905a).

The exposure in 1912 of wasteful and even corrupt expenditure of funds, particularly in Polk and Clinton counties, forced the resignation or removal of several county and township supervisors and aroused greater public support for a stronger ISHC. Politically, the ISHC contended that if its powers and funds were increased it could correct "the record of incompetent and frequently flagrantly dishonest handling of contracts, special bridge contracts, pools and agreements in restraint of competition and the erection of flimsy and inefficient structures and disorganized methods of work, which existed in the state" (Norris 1915:3–5; May 1965a:89). As a result, the commission was reorganized in 1913 and its power increased. It remained at its location in Ames. For the first time the ISHC was granted the power to remove county engineers for reasons of incompetence. All plans for improvements of county roads had to receive its approval before work could begin (ISHC 1913a; May 1965:89, 91).

The ISHC's power was consolidated when, in 1918, Congress enacted the Federal Road Aid Act, which provided funding as assistance in important road building projects. This had been preceded by earlier acts that had varying levels of effect in Iowa. The Federal government had had little to do with state road work until 1912 when money was appropriated to aid in the construction of post roads (Spencer 1912:5). Initially, there was some reluctance in Iowa to accept federal monies. This was partly because the act of 1916 required states to equally match federal aid monies. Each state had to have a state highway department capable of disbursing and overseeing the monies and Iowa had no such oversight department at the time. In Iowa the General Assembly in 1917 agreed to accept the aid and matched it with motor vehicle license fees (May 1965a:91). Iowa's first Federal Road Aid Act funded project was the Mason City road in 1913. The second was a segment of the Blue Grass Route's North Diagonal at Columbus Junction in 1914 (see the Fredonia to Columbus Junction Road below). The third was the Dubuque to Dyersville gravel road in 1915 (May 1965a:96). As Iowa did not accept full Federal highway funding for the first few years only the three large projects noted above were undertaken during that period. Between 1916 and 1918 Iowa increased its matching funds through increased tax revenues (gasoline and licensing) and by 1918 they were able to fully meet their dollar match under the Federal programs instituted in 1918.

In 1918 the new ISHC was directed to select a system of roads on which federal aid would be used. In 1919 this became the Primary Roads System under the provisions of the Primary Roads law (Hileman 1965:inside of front cover). This created a dual division of the state's roads. At that time the Primary Roads system comprised about 6,400 miles of road connecting every city and town of more than 1,000 inhabitants in the state. The secondary road system at that time was made up of both the county (10,000 mi) and the township road systems (87,000 mi) (ISHC 1913a, 1914a, 1914b).

The ISHC and state government both wrested control of the major state road network (post roads) and (as noted above) left county and township local control continuing to stand but with building plans under the scrutiny of the ISHC and a competent engineer. The following relates how the system worked:

> With regard to the Primary Roads, although the counties initiated and carried out all construction work, the Commission now exercised control over the purse strings as well as over construction plans. A Primary Roads fund was established, composed of Iowa's share of federal aid and the proceeds from the motor vehicle license tax. Counties did not receive the money, but submitted bills for approved projects, which, if passed by the Commission, where then paid by the state [May 1965:92–93].

The result of this combination of political and engineering processes resulted in the condition that road work done even on Primary Roads was often chiefly done by county level personnel until 1919. This situation was not to continue long although county influence persisted into the 1920s.

Emergence of State Control and Federal Aid

The dominance of state control over local systems and politics was further strengthened when Congress passed a new highway act in 1921 forcing drastic changes in Iowa's road administration. The ISHC was required to take complete control of the construction and maintenance of all federal aid roads before aid would be granted. Single counties were no longer permitted to block the establishment of continuous paved roads. The states had five years to comply (May 1965b:95). Some southern counties blocked road construction so they didn't have to pay.

Both local and state politicians, with the governor included, deplored the need to accept federal aid but most saw no way around it. In 1925 they came up with a compromise that met the minimum federal requirements. A Primary Roads development fund was established composed only of federal aid funds and the matching amount in state funds. Two years later this short lived measure was replaced with a comprehensive administrative reform. Complete control of the entire Primary Roads system was to be given to the ISHC.

Politically, the good roads forces had to agree to changes in the ISHC. It went from a three to five man appointive system. May relates that "By 1929 the process of centralization begun in 1884 was completed" (May 1965:95). The change had resulted in the shift of control from the many to the few, who could more easily be held accountable. Authority over the roads was clearly defined between state and county with the ISHC exercising general supervision over all the roads, and direct control over the state's primary highways. These actions, when combined with the federal programs noted below, led Iowa into a new era of road construction.

Federal Programs

Federal Road Aid Act of 1916. This act had the greatest single effect of any legislation in the history of Iowa's road construction until the 1956 Interstate Highway Act. By 1916 several factors had gradually altered the state's reluctance to implement the federal-aid concept. First, the growing involvement of farmers in the Good Roads Movement reinforced the importance of roads in everyday life. Farmers who initially resisted being taxed to pay for good roads so wealthy city "peacocks" could ride their bicycles became enthusiastic advocates of good roads with the introduction of Rural Free Delivery, which depended on the existence of passable roads for home delivery of mail (Thompson 1989:70; Wiengroff 2002a:2).

Second, the rise of the automobile in the early 20th century altered the picture, particularly after 1908, when Henry Ford introduced the low-priced Model T that the average person–not just the wealthy–could afford. The growing power of motorists was reflected in the American Automobile Association (AAA), which became one of the strongest backers of federal action on roads (Wiengroff 2002a:2).

Third, the Supreme Court settled a constitutional question. In a 1907 case, Wilson vs. Shaw, Justice David Brewer wrote that Congress had the power "to construct interstate highways" under the constitutional right to regulate interstate commerce (Wiengroff 2002a:2). This was a significant advance.

Fourth, with the founding of the American Association of State Highway Officials (AASHO) in December 1914 states had an effective voice for advocating a national road improvement program. When AASHO was founded, the first order of business was the drafting of a federal-aid bill to be submitted to Congress. Initial efforts by AASHO were stalled because of conflicting interests among the heavily populated states that had already developed highway networks and the less populated states that had not yet done so. In September 1915, during the Pan-American Road Congress in Oakland, California, a small group of AASHO members met to draft a federal-aid bill that struck a balance among the interests. Thomas H. MacDonald, chief engineer of the ISHC, headed this small group and established a strong Iowa influence on the national movement (Wiengroff 2002a:2).

The Federal Road Aid Act of 1916 stated that each state would have a highway agency with engineering professionals to carry out the federal-aid projects. State highway engineers had approval authority so they could ensure the projects were designed and constructed properly. The 1916 Act also served the social function of enhancing life in rural America by focusing on rural post roads rather than the long-distance roads advocated by AAA, auto associations, and others. The nation's first highway policy combined the Progressive goals of economic efficiency and social betterment (Weingroff 2002a:4).

The Federal/State Partnership at Work: 1916–1939. The Federal Aid Highway Program, which was initiated by the Federal Road Aid Act of 1916, got off to a slow start. The biggest initial problem occurred in April 1917, when America entered World War I. Personnel shortages were compounded by shortages of road-building material and railroad cars to ship materials to project sites (Weingroff 2002b:1). Because the railroads were unable to keep up with military shipping, the fledgling trucking industry seized its opportunity to secure interstate shipping. As a result, the roads that the states did not have the resources to improve were deteriorating under the unexpected weight of the loaded trucks (Thompson 1989:78, 98, 136, 144, 178–180, 211; Weingroff 2002b:21).

After the war ended in November 1918, the need for changes in the federal-aid highway program became evident. The program's definition of "rural post road" and the "$10,000 per mile" limitation were a hindrance in many states. The decision to leave project selection in the hands of state highway officials resulted in widely dispersed improvement, spread among political subdivisions and not connected with each other or roads in adjoining states (Weingroff 2002b:1–2).

Iowa's Thomas H. MacDonald, who had played a key role in developing AASHO's federal-aid highway bill, became the new chief in early 1919. With his technical background and his experience as a state highway official, he proved to be the ideal successor in this new phase of highway development (Weingroff 2002b:2). The most difficult problem facing MacDonald was the gap between advocates of long-distance roads and advocates of farm-to-market roads. The answer developed by MacDonald, in close cooperation with AASHO, was contained in the Federal Highway Act of 1921 (Weingroff 2002b:2).

The 1921 Act rejected the view of long-distance road advocates who wanted the federal government to build a national highway network (Weingroff 2002b:2). To satisfy them, the act limited federal aid to a system of federal-aid highways, not to exceed seven percent of all roads in the state. Three-sevenths of this system must consist of roads that are "interstate in character." Up to 60 percent of federal-aid funds could be used on the interstate routes.

The 1920s were a "Golden Age" for road building nationally and especially in Iowa. In 1922 alone, federal-aid projects totaling 10,313 miles (16,500 km) were completed at a cost of $189 million, three times as much roadway as has been improved since the start of the federal-aid highway program in 1916. The projects usually involved providing graded earth, sand-clay, or gravel surfaces (Weingroff 2002b:3).

By retaining the federal aid concept, the act also satisfied advocates of farm-to-market roads. The state highway agencies could be counted on to consider local concerns in deciding the mix of projects. In cooperation with the state highway agencies, the Bureau of Public Roads completed designation of the federal-aid system in November 1923. It totaled around 169,000 miles or 5.9 percent of all public roads. The federal-aid system would expand as states completed work on their original system (Weingroff 2002b:2–3).

In the 1930s, the federal-aid highway program felt the impact of the Great Depression. Federal funds were diverted from projects that served transportation needs to projects that could provide work for the unemployed. At the same time, calls were increasingly heard, in and out of Congress, for transcontinental superhighways often coupled with calls for toll financing to accommodate the powerful new automobiles of the day (Weingroff 2002b:3).

The German "Autobahn" had given American highway officials an object lesson in superhighways after the first section opened in May 1935. Many officials and engineers visited Germany to see the autobahns in operation, and all came away impressed. MacDonald, for example, described the highways as “wonderful examples of the best modern road building.” He was, however, less impressed from an economic standpoint. The autobahns were being built well in advance of traffic needs and before Germany was able to realize the likely economic benefits that he thought should justify such projects. Moreover, the autobahns bypassed the cities. MacDonald believed that the primary need for freeways in the United States was in the cities, where traffic jams were an increasing problem (Weingroff 2002b:3).

MacDonald, by this time, had concluded that the time had come for America to begin the next stage of highway development. The federal-aid system would be “completed” by the late 1930s. Although many segments of the rural network had not been paved, virtually all had received initial treatment. As MacDonald said in a 1935 article: “We have reached a point in our development where we can no longer ignore the needs of traffic flowing from the main highways into and through cities and from feeder roads to the main highways” (Weingroff 2002b:3).

Based on statewide paving surveys and analysis MacDonald’s report became the basis of a master plan in 1939 for a system of interregional highways. This plan laid the groundwork for the future interstate highway system (Weingroff 2002b:3). However, initiation of this interstate highway system in the 1940s would be greatly affected by World War II. It was reorganized and energized through 1948 but it took the Federal Highway Act of 1956 to jump start the Interstate Highway System.

THE IOWA STATE HIGHWAY COMMISSION: DESIGN AND TESTING

The Iowa State Highway Commission (1904–1912). The formative ISHC was started on April 13, 1904. It was mostly an advisory group rather than a legislative enforcing agency. A number of people involved with it, along with the engineering program at Iowa State University (ISU) in Ames, had an unusually great effect on highway design and testing both in Iowa and nationally. Charles F. Curtis, Dean of Agriculture, and Anson Marston, Dean of Engineering, Iowa State College helped lead the state and college towards the formation of an ISHC. The college had provided research for road problems and had amassed some of the earliest statistical data on road surfaces, market process, and statewide road conditions. At its inception Curtis and Marston were appointed commissioners and Thomas H. MacDonald was the assistant in charge of field operations. MacDonald published *The Good Roads Problem* in Iowa in 1905. The *Manual for Iowa Highway Officers* was also published in 1905 and revised in 1906 (ISHC 1905a, 1906). Both Marston and MacDonald traveled the state studying road construction and conducting road schools that ran from 1905 to 1918 when they became too large and were disbanded.

The Iowa State Highway Commission (1913–1948). The ISHC’s start as an authoritative power was begun in 1913. Anton Marston became an ex-officio member and MacDonald became chief highway engineer. He held this post until being appointed Director of the U.S. Bureau of Public Roads in 1919. Fred R. White succeeded him at his post in Iowa and helped consolidate commission control in Iowa with the passage of the Primary Roads Law in Iowa in 1927. This law transferred the powers of the county supervisors with respect to construction and maintenance of Primary Roads to the commission. This stopped the often long lag time between the commission’s design and the local supervisors or county’s approval. It also marked the end of county involvement with Primary Roads construction or maintenance.

MacDonald’s and Marston’s experiences with the formative ISHC over the previous decade demonstrated that the ISHC needed an organization with four departments: Office, Design, Field, and Education. This organization was developed solely on Iowa’s experience as there were no states that had made similar road laws or on state supervision or control of highways.

Anson Marston was with the ISHC for 23 years. With the establishment of the ISHC in 1913 he foresaw a period of great highway construction ahead and felt it was time to let others carry on. After he had led the battles on the political front for many years Marston stepped aside for Thomas MacDonald to carry out the construction phase of Iowa’s roads program (ISHC 1927c:front cover).

Thomas MacDonald was one of Iowa’s first three highway commissioners and had championed the cause of good roads in Iowa. Playing a key role in its inception and running the field operations until his appointment as commissioner led to his dominant role in the formation of AASHO in 1916. In 1919 MacDonald became AASHO's head. MacDonald's strong grassroots experience and firm field background in Iowa, along with his overall progressive and even visionary approach to highway construction, made him an ideal director of AASHO. From this position he was greatly responsible for the nation's primary route system and the introduction of America's interstate highway system and continued, through his national position, to influence Iowa's road programs until the end of the study period in 1948.

Additionally, it should be noted that the state college at Ames provided one of the nation's first highway engineering programs. Its program provided a whole generation of highway engineers and designers who spread around the country and widely influenced national road construction. Along with MacDonald and Marston, one such graduate from 1916 was Conde B. McCullough who became Oregon's state bridge engineer and designed several of Oregon's magnificent Pacific Coast Highway bridges.

IOWA HIGHWAYS: GENERAL DEVELOPMENT 1900–1920

As Thompson related in 1989, "The tide of transportation developments in Iowa between 1900 and 1920 preclude an in depth decade-by-decade approach at the state level" (Thompson 1989:69–70). However, the discussion of the study routes below allows for such an analysis in terms of their contextual and technological evolution. One of the early statewide roads issues was between the railroads and the ISHC. By 1900 the basic railroad network was largely in place. For some years, the railroad commission had called for improvement or elimination of highway and farm railroad crossings.

The ISHC had no jurisdiction in cases involving the railroads until 1913, after which cooperative efforts with the railroad commission were affected to make necessary changes in road design and location. The ISHC had made changes in the Primary Roads system, but where disagreements occurred, the railroad commission was asked to determine the type of crossing and apportionment of the cost. The increase in motor vehicles on public highways caused the deaths of 240 people in railroad grade crossing accidents between 1915 and 1920, which emphasized the problem. The elimination of grade crossings became a priority in 1915. Most of the accidents were at crossings where the view was unobstructed for hundreds of feet and appeared to have been caused by miscalculating the speed of oncoming trains. Recommendations were made for installation of gates, bells, and warning signs on the highways (ISHC 1915p, 1915q; Thompson 1989:84). In Iowa a large number of railroad related crossings, bridges, underpasses, overpasses, and other structures related to the automobile's emergence and dating from 1900 to the 1930s are still present in and along the study routes and across the state in general.

When the ISHC was formed in 1904, less than two percent of the state's 102,000 miles were improved with gravel or broken stone. Approximately 25 percent were classified as main traveled roads. On main traveled roads no household was to be situated more than two miles, or most less than one mile, from a main road running in each direction from centers of population (ISHC 1905a; Thompson 1989:93). The remaining 75 percent were considered as second class roads. These were in sparsely populated areas and kept passable. They received a low priority until the system of main roads was perfected. It was these second class roads that were blighting Iowa with the reputation of having one of the worst "mud road states" in the nation. In the annual report in 1912, road mileage of approved county systems certified by county engineers totaled 104,082 miles, outside of incorporated towns (ISHC 1914a:73; Thompson 1989:93).

Practically all of the 19th century public roads in the state were laid out on section lines, and new roads opened were located without much deviation from this practice. As a result, the road system was developed without regard to engineering efficiency or economy. It was more serious in some portions of the state than others. Topography required that the road had to be curved in plan or profile. Section line location prohibited the first and made necessary the second, which was worse. It was suggested that it would be more effective by building around rather than over the hills, and or buying new right-of-way around a series of hills. Often, the total cost of entirely relocating a road would be less of a problem than making even a faint start on a good road on a section line (ISHC 1905a, 1905c; Thompson 1989:94).

The early commission gave technical specifications to road builders for construction of earth roads in the first-class category. The width was to be 18 ft for the travel way, not too wide for easy maintenance, with ample space for ordinary traffic and with a rounding or parabolic contour. The most important initial consideration was efficient surfacing with side and sub-drainage. Next there came the elimination of steep grades and final surfacing with gravel, broken stone or some other wearing coat (Thompson 1989:94).

Experimental and permanent roads were planned and built during this early period. Scott County had built 5½ miles of broken stone base with gravel cover in 1907 at $7,670 per mile. At the same time Des Moines County was building three miles of limestone-based roads at around $5,000 per mile. In and around Keokuk, broken stone roads had been experimented with for many years and with a little maintenance would have lasted longer. The City of Des Moines built two experimental sections of pavement consisting of a mixture of asphaltic oil with earth, gravel or broken stone screenings which gave promise of good results as a new form of road construction in the state. These isolated, and in a sense experimental, developments again raised the question of state supervision over highways and letting the state cover the costs of experiment and development (ISHC 1905c, 1906, 1907; Thompson 1989:94).

During its first year of expansion (1913) ISHC personnel visited every county board of supervisors to explain provisions of the new road law, completed preliminary investigations, and approved 15,000 miles of county roads which eventually became a system of highways connecting every important market center. County roads were surveyed to make maps, plans, and specifications for permanent road building. The ISHC assisted in designing and approving plans for more than 800 structures in 86 counties and set up a uniform system of records (Thompson 1989:97–98; Fraser 1995, Section E:17).

By the end of 1913 their work brought a change in the public’s attitude and criticism of federally funding and the resultant new road laws gave way to a more fair consideration. The 1913 federal highway allocations to Iowa were quickly put to use by those already organized for highway improvement. Nine counties, situated along the Lincoln Highway (forerunner of U.S. 30), took quick advantage of the newly available federal funding. With the influx of federal monies for highway improvement they built more miles of permanently graded earth roads and more permanent bridges and culverts than in any previous year. The year 1914 saw improvements and many counties started road building on a broad scale with the quality of workmanship and materials constantly improving. Two problems remained. One problem was the employment of men to do the work in an efficient manner and a second was an adequate system of maintenance. Special attention was given to dangerous railroad crossings. In Iowa there was one crossing for every 12 miles of highway in rural areas. Nine hundred of the 8,676 miles of county and township road crossings were classified as dangerous. These were given first priority for improvement or elimination (ISHC 1915p–q; Thompson 1989:98). Safety had become the new major issue (ISHC 1914e).

Highway Funding and the Federal Aid Act of 1916. Historically, three general sources of funds have been used for Iowa highway improvements. Property taxes and county bond issues were an important revenue base up to 1920 and continued to provide revenues for counties and municipalities. A second source consisted of vehicle registration and title fees, operator licenses, gasoline taxes, taxes on tires and accessories, use tax on the purchase of vehicles, and special taxes on for-hire carriers or larger trucks. A third source was tolls collected directly from road users (ISHC 1917b:90; Thompson 1989:215).

Funds were available in 1916 through the Federal Aid Act of 1916. These were apportioned to counties on the basis of area. A program was organized to improve the “Inter-County Road System.” In 1918 the cost of structural steel was 250 percent higher than in 1915. Auto registrations rose from 799 in 1905 to 147,078 in 1915, and the increased usage brought renewed demands for hard surfaced roads. The early supporters of good roads considered macadam as an ideal surface, but it was hard to obtain the necessary materials. It was fortunate that Iowa could not build large numbers of macadam roads, for it would have been necessary to spend large sums to maintain them under heavy motor traffic. Gravel was more plentiful in northern and eastern Iowa and had already proved practical for surfacing less traveled roads (ISHC 1905a:7; Thompson 1989:99).

Early Hard-Surfaced Roads. While progress was being made in permanently grading earth roads generally they were not adequate for motorists. No hard surfacing materials had universal application. Traffic, soil, and financial conditions were the decisive factors in the selection of permanent surfacing, and the choice for one community was not necessarily good for another. By 1919, 26 counties had voted favorably on bond issues for hard-surfaced road systems and authorized construction of 1,700 miles of pavement (ISHC 1917b:90, 1919a:23, 1920a; 1921a:3–9, 1922c; 1925a, 1925d–e; Thompson 1989:100).

Brick roads were also making their way out of Des Moines, Davenport, Burlington, Sioux City, and Clinton short distances into the rural countryside. While brick made a very good hard road surface the preparation and the laying of the bricks themselves, especially over long distances, posed materials and labor problems that were later eliminated by the use of poured concrete. Brick roads continued to be built in urban areas through the 1930s and were often parts of the state's arterial highways through these communities. Many early brick roads still lie beneath an asphalt or concrete overlay (May 1965a:96). As early brick roads were not built in rural areas and as only one mile of brick road was within the study routes, which is now covered and the area urbanized, little attention was placed on brick roads for the purpose of this study.

Figure 1. The 1893 Lyon County bridge. The first reinforced concrete arch bridge in the country (ISHC 1915a:55).

The use of concrete as a road surface and for road related structures in Iowa appeared to have started with a half block in LeMars in 1904. A revolutionary masonry and concrete arch bridge had been built as early as 1893, using the Melan system, at Rock Rapids, in Lyon County (Figure 1) (Fraser 1995:25). A concrete slab bridge outside of Floyd, in Floyd County, on the old Red Ball Route was personally financed in 1905 by John Marsh, bridge designer and owner of the Marsh Bridge Company for the use of the Mason City Auto Club. In 1909, Mason City and Davenport laid 6,000 sq. yards of it within their cities. In 1908 and 1911, an over ¼ mile long stretch of concrete, 14 ft wide, was built in Eddyville, with materials, labor and cash supplied by local residents. By 1912, concrete, formerly relegated to a minor place in surfacing materials, began to achieve some prominence. A mile was built in 1913 west of Mason City as Iowa's first federal-aid project, extended into that community in 1915, and in 1917–1918 the 11 miles between Mason City and Clear Lake were completely paved, marking the first interurban highway in Iowa (Thompson 1989:100). Other early concrete roads were also being planned or built in the state.

These experimental roads, along with the 1918 Lincoln Highway "Seedling Mile" in Linn County (Rogers 2004), proved their ability to withstand heavy traffic and weather conditions and stimulated the demand for additional mileage. But while practical, construction expenses of $30,000 per mile in the

1920s was a deterrent (Thompson 1989:100). However, when the expenses for maintenance and motor vehicle operations on concrete roads were compared to those on gravel roads, such costs were cited by good roads advocates as evidence that concrete would be less expensive over long periods of time (ISHC 1914c, 1915n–q, 1916h; Crum 1915, Harvey 1916:6–7; Breed 1917:56; Road-Maker 1917b:56–60, 1917e 71; Concrete Highway Magazine 1924a–c; Conard 1992; National Park Service 2004).

In addition to the expenditures for construction and maintenance, an important item in highway transportation costs was that of vehicular operation. With increased volume, savings in operation made possible by improved roads became an irrefutable argument for construction of all-weather roads (Thompson 1989:141). All season roads economically saved fuel, tires, operating cost, affected crop marketability and distribution, and socially helped reduce rural isolation.

Iowa's County Seat Era. Iowa went through a whole era in the 1910s and 1920s when part of the state's Primary Roads building and improvement goal was to connect the capitol with the county seats and the county seats to each other. In general, although an important context in Iowa's road construction history these county seat roads were to be specifically excluded from this survey of arterial highways, as the MOA called for arterial highways preferably of multi-county length. Thus, while many of the roads built during the county seat era became parts of arterial highways they were not the focus of the investigation. While the two highways selected as the study routes for this project did connect county seats their significance was not primarily concerned with this context of Iowa's road construction.

The year 1919 should be remembered as a year of great achievement in Iowa's general road construction. It was a year in which the state embarked upon a program of "modern" highway construction. From 1913 to 1920, 3,216 miles had been improved to temporary grade, 13,660 miles were tractor graded, 2,035 miles were gravel surfaced, and 43 miles of the primary system were concrete surfaced. By the close of 1920, considerable progress had been made on highway improvements despite the interruptions caused by World War I. Road builders looked forward to 1919 and 1920 in keen anticipation of a return to normal conditions. Labor was still scarce and remained so until the mid-1920s. Highway officials had authority to build roads and could pay for them, but could not produce the products in a quantity, have labor available, or had the experience to do so (SHSI 1919b:cover; Thompson 1989:106).

The public's response to the roads program was both economic and social. How it was perceived and how it operated in fact were different issues to many Iowans. Money was always an issue but so were taxes, rural free delivery, education, mobility, rural isolation, and farming. The following 1918 editorial from the Iowan Magazine gives a good overview of both what Iowans had endured previously and what they expected from their roads by the 1920s.

> On the 220,000 farms in Iowa there are 194,000 automobiles…Between farm and market place the highways are filled with mud and dust–with ruts and holes and bumps, interfering–many times altogether obstructing–the passage of produce. In Iowa alone this is costing the producers and consumers of food thirty million dollars a year…our roads are not ready. Sooner or later they must be improved to improve our transportation system.
>
> The roads will be a benefit to the farmer from an educational and social standpoint also. It will mean consolidated schools with a better corps of teachers and better training for the children in the grades and the high schools. Better roads and automobiles will tend to keep the young people on the farms and to make the life of the older ones more enjoyable. They will help to do away with the line of demarcation between the city and the country. The farmer will take a more active part in the affairs of their neighborhood, which should include the city as well as the county. With dirt roads it is impossible to make an appointment in the city in advance without taking the weather into consideration.
>
> It would have taken a long time to get a complete system of state roads under the old piecemeal plan, but by this new system all the principal cities and nearly all the county seats will be connected. The roads will

> serve 85 percent of the people living within five miles of these roadways. If the farmer wants to go 50, 100, 200 or more miles away from home, all he has to do is to drive to the nearest hard road, not more than five mile away, and on that improved road he can go to any place in the state. Progressive communities will build local roads connecting with the state roads, and the farmer will become a thoroughly independent person [Iowan Magazine 1918a:46–47].

Highway Accidents. Increased use of automobiles resulted in railway crossing accidents and caused injury and fatalities on Iowa's highways. Speeding vehicles went over embankments, "turned turtle" or ended upside down, collided with each other and with bicycles and buggies, struck people, ran into trains and were hit by them (Table 1) (ISHC 1915h, 1915r–s, 1916b:3, 1917a:3–10). As early as 1915, there were proposals to prohibit the sale of high speed automobiles in Iowa (Thompson 1989:100). In 1916, there were 2,574 accidents which killed 199 people and injured 2,834 (Thompson 1989:105). Safety had become a primary goal for Iowa's road designers. Some cities flirted with establishing their own signage and speed limits (ISHC 1915:13). Table 1 gives the accident counts from 1916 (ISHC 1916b:3).

Table 1. Accident Counts taken from actual 1916 ISHC Bulletin

Can Appalling List of 1916 Highway Fatalities Shock Iowans Into Saner Driving in 1917?

Too Great Speed and Utter Disregard of All Sane Driving Precautions Cause Appalling Loss of Life—Speed frenzied drivers Smash Their Cars into Sides of Trains on Crossings.

1916 HIGHWAY FATALITIES
(Compilation based entirely upon newspaper clippings.)

Month	Total Deaths	On Highways	At Crossings
January	2	1	1
February	4	0	4
March	5	4	1
April	4	4	0
May	15	13	2
June	29	21	8
July	37	21	16
August	35	28	7
September	18	14	4
October	26	22	4
November	8	6	2
December	16	12	4
Totals	199	146	53

AUTO ACCIDENTS WHERE NO FATALITIES OCCURRED
Record for Seven Mcnt..s—June-December

128	Autos over embankments	175	persons with broken bones
250	Autos over embankments	436	persons cut and bruised
107	Autos turned turtle	270	persons with broken bones
478	Autos turned turtle	466	persons cut and bruised
165	Auto collisions	162	persons with broken bones
308	Auto collisions	344	persons cut and bruised
204	Autos collide with buggies	244	persons injured
71	Autos collide with street cars	28	persons injured
105	Autos collide with bicycles	42	persons injured
176	Autos into obstructions in road	288	persons injured
286	People struck by autos	282	persons injured
90	Autos struck by trains	97	persons injured
202	Auto accidents where auto was wrecked and no one hurt		
4	Engines through bridge		
	Total accidents	2574	
	Total number of people hurt	2834	

(Source ISHC 1917a:3–10)

State Highway Conditions. There were startling contrasts in Iowa's highway conditions. In some instances dirt roads were so impassible that county engineers had to lay planks over mud holes. Just when Iowa had begun to feel proud of her excellently graded earth roads as a near foundation for paving, it was rather humiliating to have to return to pioneer days of plank roads to keep them passable (Figure 2).

The driver on a gravel road was not consoled when the road did not drain properly. However, concrete surfacing was progressing slowly. Many roads had passed through every stage of highway improvement, having been scraped, dragged, wheel-scrapped, blade-graded, and steam-rollered. It had been a prairie trail, earth road, and oiled dirt and graveled road. Finally, it was to be built into an 18 ft to 20 ft concrete highway with hopes that it would last for at least one generation (Thompson 1989:142, 143).

A large part of this statewide advance was the arrival of new equipment. Under federal law, the Secretary of War was authorized to distribute excess war materials to various state highway departments. On January 11, 1919, the Fairfield Ledger notes that “Jefferson County has been issued two more army trucks which will arrive in a few days. They will be used in road and bridge work” (Baird 1989:15). In March, 1920, Iowa received 578 motor vehicles consisting of 512 trucks, 37 cars, and 29 ambulances. Also included for the state were 16 tractors, two concrete mixers, and other miscellaneous equipment. Of the total, 288 trucks were distributed to counties and to seven state institutions which had control over their roads. Title and possession of the equipment remained with the ISHC, but could be assigned to the counties for highway work with the understanding that counties would maintain the equipment in good conditions and pay all costs (Thompson 1989:143). These surplus vehicles played an enormous role in modernizing and mechanizing Iowa’s road construction well into the 1930s.

Figure 2. A Road Scene Near Ottumwa (Road-Maker 1912i:5).

The year 1921 was the first since the Primary Roads law was enacted that it was possible to carry on road construction without delays for reasons beyond state control. That year there was three and one-half times as much graveling and paving and two and one-half times as much grading as had been accomplished in 1920. The construction also played an important part in relieving unemployment in communities where the work was in progress.

Congress, in the Federal Act of 1921, authorized the Secretary of Agriculture to select and establish with cooperation of State Highway Departments, a system of national roads comprising over 7 percent of the total mileage of the nation. The Iowa Primary Roads system included approximately 6.5 percent (6,422 mi) of total mileage and was laid out on a state rather than a county system. The network met all of the requirements of the federal program. The interstate system would consist of important through east–west transcontinental as well as Gulf-to-Canada routes. The balance of Iowa’s Primary Roads system would comprise the federal inter-country system (Thompson 1989:144).

The year 1921 can be seen as the watershed year for the start of the state’s second road construction boom with increased focus on concrete highways. Its first boom was the ongoing “brought-to-grade” period running from around 1913 to 1920. The Primary Roads Law and the Federal Act of 1921 were the starting points for Iowa’s road construction and concrete paving boom between the great wars. At this critical point for the first time state and federal funding, laws, engineering, materials technology, construction machinery, labor, and across the state set the path for the next two decades of paved road construction and the large scale general improvement of all state roads.

Numbering and Marking Highways. As part of this expansion the signing and marking of state roads became prevalent on principal highways and in and around cities. Naming, numbering, and marking roads began with motorist associations or clubs (Figure 3), Chambers of Commerce, and in some instances, the states. Numbering county roads in Iowa was proposed as early as 1915, and in 1916 under a system whereby the state capitol would be the central location, roads would bear designations such as North 1, 2, etc., South 1, 2, etc. The idea was that tourists who found themselves at a corner marked North 67 and West 32 could locate themselves instantly. Another approach was a system of numbering township roads for the purpose of designating road-dragging districts (Baird 1989:14; Thompson 1989:145).

Marking Iowa's Primary Roads began in 1920 under the federal system, but Iowa began numbering its own primary routes in 1926 when Iowa Primary Roads were to be renumbered and remarked to conform to the U.S. system of interstate highways (ISHC 1920b:3–4, 1921f:9–10,15, 1925f:3–12). Registered highway or "tourist routes" were marked in the early 1910s but these were inconsistent. While routes may be designated Primary Roads they were not always marked. On October 14, 1919, the Fairfield Ledger noted "that all main automobile trails through the county will be marked so that they may be easily followed" (Baird 1989:15). Standard symbols were adopted with each main traveled road given a specific number, painted on telegraph or specially built poles at every intersection, turn or crossroad between transportation centers. For example, the Jefferson Highway became No. 1; the River to River Road, No. 7; the Red Ball Highway, No. 40; The Lincoln Highway, No. 6; and the Blue Grass Trail, No. 8. All numbers corresponded to those used on connecting interstate routes in adjoining states. Marking was important to provide directions for the rising tide of motorists who had previously depended upon local trail associations and automobile clubs for route guidance (Iowa DOT 2000:26; Thompson 1989:145).

In 1920 from the total of 1,068 cities, towns and villages in the state, 556 were on the Primary Roads system. Iowa had met a large part of its overall goal started in 1904. Eighty-five percent of the population either lived on the system or in towns nearby. Every county seat was linked by the most direct route to every other county seat and with the state capitol and other important centers. With such coverage, it was necessary that a uniform numbering system be developed. There was to be no interference with the special signs to indicate association trails (Thompson 1989:145–146). However, this was not always the case and disagreements arose between the heads of the Registered Roads association and the ISHC (Carson N.D., 1913–1925; ISHC 1914a, 1913–1925) (see also Appendix C). The documentation of these disputes provides a valuable insight into the meshing of the two systems and shows one the reasons for the eventual discontinuation of the Registered Highway routes in the state after 1927.

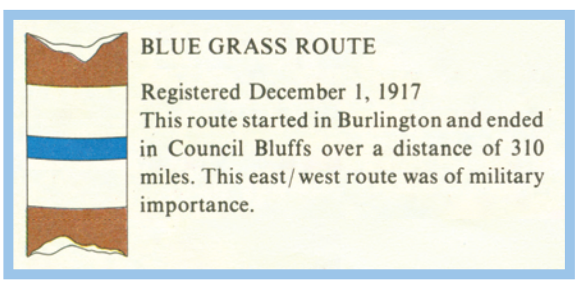


Figure 3. Blue Grass and Red Ball symbols (Thompson 1989; Iowa DOT Library–Red Ball folder).

Road associations painted various colors on telephone poles as high as painters could reach and when the colors gave out, the roads were marked with association names. The rivalry was intense between main road associations and private automobile owners to show off their roads and attract people to the communities served (Thompson 1989:146). During this time conflict arose between the road associations, ISHC, civic groups, and local businessmen. Robert Carson, president of both the Red Ball Road and the River to River road through Iowa City, was an important roads booster, especially during the Registered Highway Era. His correspondence (see Appendix C), along with others, to the ISHC paints a telling portrayal of the state agencies as they take over power with the close of the Registered Highway Era in Iowa (Blue Grass Association 1913; Brown and Mossman 1913; Carson 1913a–c, 1914, 1916a–d, 1917a–

c, 1918, 1919a–c, 1920a–g, 1922a–d, 1922–1925, 1923a–g, 1925a–d; ISHC 1914a–d, ISHC–Letters 1913a–i, 1914a–g, 1916a–j, 1917a–c, 1919a–h, 1920a–l, 1921a–c, 1922, 1923a–d, 1925a–b; Bellemy 1916; Loper 1916; Ford 1919a–b; Riggs Brothers 1919; White 1919a–b, 1922; Gearheart 1920; Rawn 1920; Jones 1923a–c, 1925a–b; Harrison 1925).

By 1924 there were at least 250 marked trails nationwide and in Iowa about 64 major trails and 30 minor or local trails, for a total of 99 (Rand McNally 1923; Iowa DOT 1986). It is possible that up to 103 registered and unregistered trails existed in Iowa at the time of their expiration in 1927. Each was sponsored by its own organization with its own headquarters, which issued maps and other materials and collected support funds. The confusion between these registered routes, state Primary Roads, and federal interstate routes led to their having a distinct system of numbering and marking designed for interstate highways to distinguish them from the others. This did not include the registered route system although early route names persisted for many years afterwards.

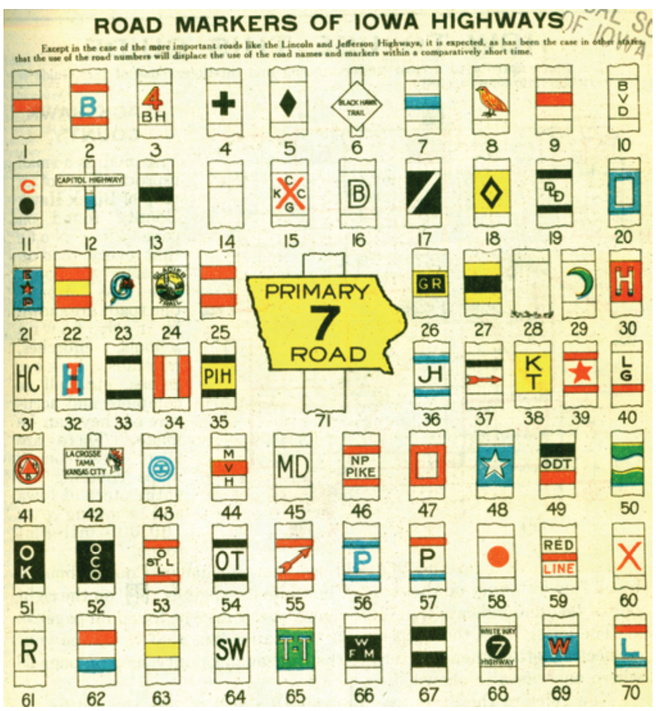


Figure 4. Trail Map Key (Huebinger 1924).

KEY TO ROAD MARKERS

1 Ayr Line.
2 Bee Line
3 Ben Hur Highway
4 Black Cross Road
5 Black Diamond Trail
6 Black Hawk Trail
7 Blue Grass Road
8 Bob White Trail
9 Burlington Way
10 B. V. D. Trail
11 Cannon Ball Trail
12 Capitol Highway
13 Cedar Rapids, Urbana and Independence Short Line
14 Chariton and Leon Short Line
15 C., K. C. & G. Highway
16 Daniel Boone Trail
17 Diagonal Trail
18 Diamond Trail
19 Detroit-Lincoln-Denver Highway.
20 East Iowa Scenic Trail
21 Everett Powers Highway
22 Farmers Highway.
23 Geranium Trail
24 Glazier Trail
25 Glidden Route
26 Golden Rod Hi-way.
27 Grant Highway.
28 Great White Way.
29 Green Crescent Route.
30 Hamlin Short Line.
31 Hawkeye Cut-Off.
32 Hawkeye Highway (now Grant H'wy)
33 Imperial Highway.
34 I. O. A. Short Line.
35 Itaska Park Highway.
36 Jefferson Highway.
37 John D. Parmelee Trail.
38 King of Trails.
39 King's Highway.
40 Lakes and Gulf Highway.
41 Lincoln Hawkeye Pike
42 L. T. K. Trail.
43 Mississippi River Scenic Highway.
44 Mississippi Valley Highway.
45 Muscatine-Des Moines Route.
46 National Parks Highway.
47 North Iowa Pike (now National Parks Highway).
48 North Star Route.
49 Oakdale Trail.
50 Ocean Wave Trail.
51 O. K. Short Line.
52 Omaha Cut-Off.
53 Omaha-St. Louis Short Line.
54 Omaha Trail.
55 Okoboji Trail.
56 Perry Highway.
57 Pershing Way.
58 Red Ball Route.
59 Red Line.
60 Red X Route.
61 River to River Road.
62 Russell Boulevard.
63 Saint's Highway.
64 Southwest Trail.
65 Tourists' Trail.
66 Waterloo-Ft. Madison Short Line.
67 Waubonsie Trail.
68 Whiteway-7-Highway.
69 Woodrow Wilson Way.
70 Lincoln Highway.
71 Iowa Primary Roads.

Thomas MacDonald and Fred White of the Iowa State Highway Commission played prominent roles designing the interstate system. Initially, an interstate system of 75,884 miles was established, of which Iowa supplied approximately 3,000 miles. Within Iowa, five routes crossed from east to west and five north and south and were renumbered to conform to the federal plan. New black and white shield shaped markers were placed on the roads in 1926. Private trails were replaced by one or more of the U.S. numbered routes, and one by one the trail associations disappeared, their purposes accomplished in promoting road identification. For many years afterward and even to the present, sections of highways in Iowa continue to be referred to by their old association names.

A number of counties are rediscovering their old routeways and are renaming sections of road to their old designations. In Bremer County the rural, winding, and graveled path of the Red Ball is marked as are portions between Ainsworth and Riverside, which were done by a private individual. Section of old Iowa 6, old U.S. 218, the Red Ball, The White Way, and others are being marked and segments revived through county pride and education. Communities and their planners are increasingly aware of the potential of such extant highway relics.

The Impact of Motor Vehicles on Iowa Road Design and Construction. Between 1910 and 1920 the ever increasing number of motor vehicles in Iowa was the primary causal factor in the state's push for constructing better roads. In 1899 the first automobiles seen in Iowa were displayed at a fair in Linn County. By 1905 there were less than 1,000 vehicles in the state. A decade later the number had reached 147,078. In Fairfield, Iowa, on May 3, 1914, it was noted that "sales of cars have reached surprising figures. The Ford agency 22, Studebaker 11, Whites 2, Buicks 3, Overlands 17, Chalmers 2" (Baird 1989:11). By 1920 there were 437,378 autos in Iowa. In 1925 there were 659,202. In 1926, 718,013 and in 1927, 782,634 (Thompson 1989:141). By August 14, 1939, it was big news that on old U.S. 34 "Keith and Floyd Shafer counted 5,243 automobiles in twenty-five minutes passed their home east of Fairfield, adding to an acute traffic problem" (Baird 1989:70).

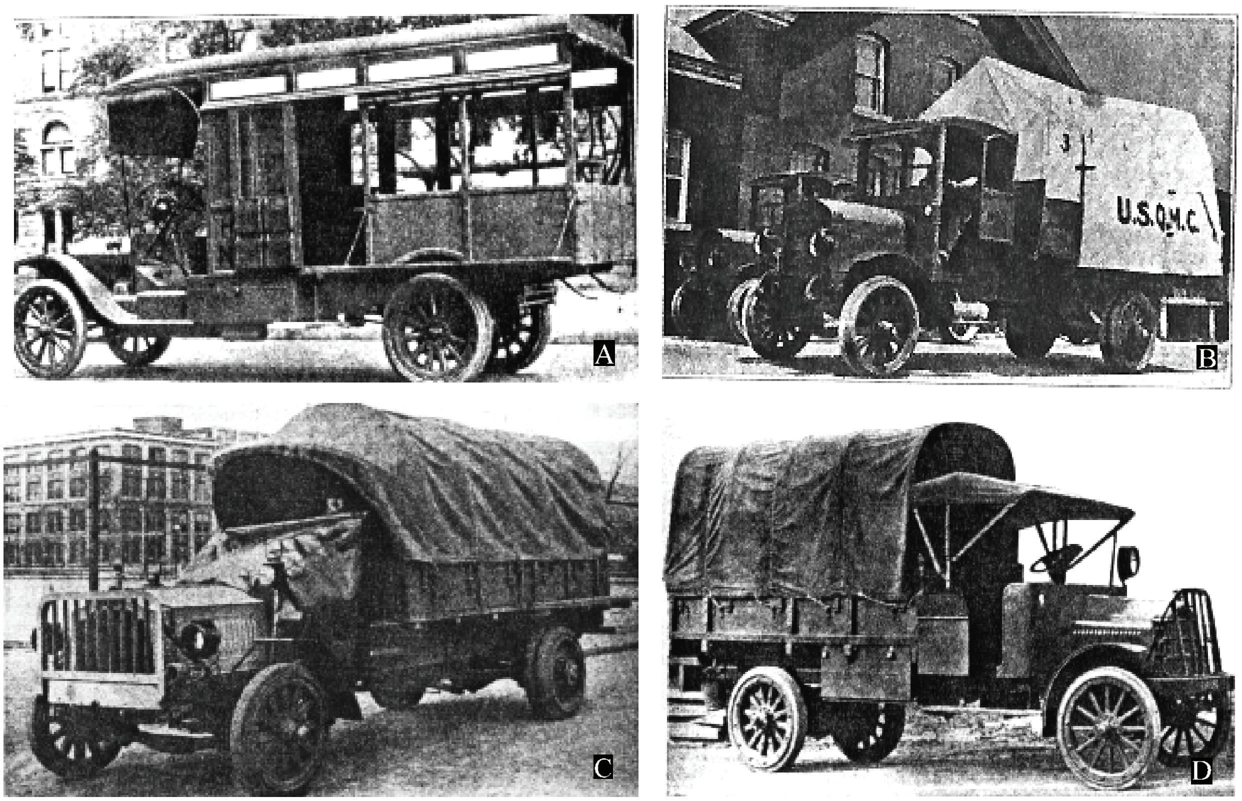


Figure 5. Trucks approved in Iowa. A. White. B. GMC, C. Packard, and D. Garford (Road-Maker 1917c:34–41).

Trucks in the years prior to World War I were basically modified car chassis. Large commercial trucks had been undergoing their own design evolution. As a result by 1917 a number of truck manufacturers were in business and some of the best new trucks for highway travel and construction, along with their critical data, was printed in Road-Maker magazine (Figure 5) (Road-Maker 1917:34–71).

Trucks were the motor vehicles that caused the greatest change in highway design and technologies. To this day they are the major factor in the wear of road surfaces and especially on bridges. Essentially, the roads and bridges barely even register automobiles but trucks cause almost all of the wear upon pavement, structures, and bridges. This was first recognized in Iowa during World War I when trucks were first in large-scale service and especially in World War II when truck traffic took to the highways in record numbers to facilitate moving goods and men that the overburdened railroads couldn't handle. The resulting wear caused the ISHC to design Primary Roads so to handle the increased weight and traffic volume. This resulting wear from increased weight and volume caused the ISHC to design Primary Roads with trucks in mind. This led to a statewide increase in the size of highways (Kelley 1915:3–5).

In 1914, a small notice in Road-Maker relates:

> Special attention is called to the double page advertisement in the center of this issue of Road-Maker showing some excellent views of the work accomplished in Mahaska county, Iowa, where the White Good Roads Truck, manufactured by The White Company, Cleveland, O., is being used to good advantage. The White Good Roads Trucks are proving to be a big saving in the cost of road making and also a big reduction in the time of every road making operation. They're used in grading, leveling, dragging, surfacing and rolling roads as well as in hauling, dumping and spreading road material…This truck has hauled gravel for as low as 7½¢ per yard-mile. It has hauled shell at 12½¢ a yard and has been found superior to traction engines in many cases [Road-Maker 1914a:12].

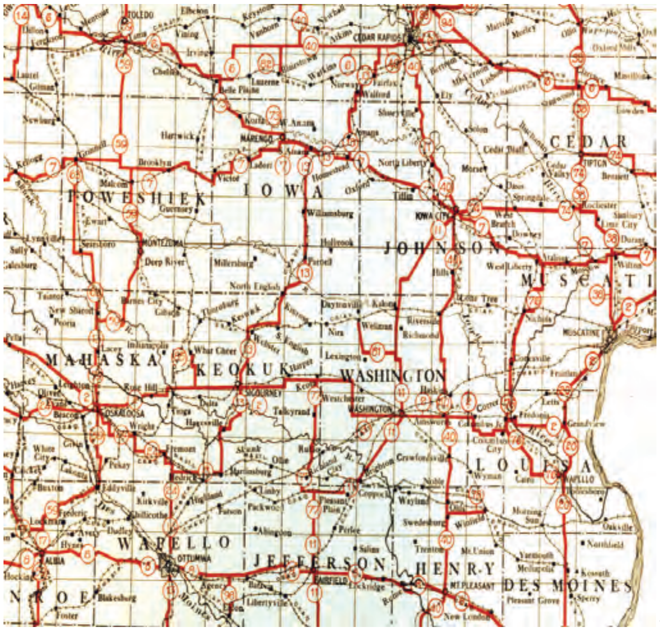
These trucks were general purpose vehicles and were replacing the old traction engines at that time. Truck technology was advancing rapidly in the 1910s and the traction engine would soon be completely superseded. Additionally, trucks were no longer converted model A's but purpose designed vehicles. Those trucks available in 1917 approved by the ISHC for Iowa road construction were those by the United Motor Company, Garford Truck (Army), GMC (Army), White 1½ ton, Packard 3 ton, Indiana Truck Corporation, U.S. Motor Truck, Sterling Motor Truck, New Nash Quad Standard Chassis, and the International (Road-Maker 1917c: 34). Trucks designated "army" were especially popular.

Primary Roads in the 1920s. Most of the improvements in the state's Primary Roads, starting in the 1910s before Primary Roads designation in 1918, were mainly in the form of grading and graveling (Figure 6). When dry and well-maintained, Iowa's earth roads were considered excellent highways. However, no mater how well they handled traffic in dry weather, in rainy seasons they became quagmires (Thompson 1989:147). Iowa's economic advantages were hampered by poor roads. Progressives felt that as long as Iowa's roads remained in a generally deplorable condition, economic and social progress was in jeopardy. The Iowa farmers were considered the heaviest losers since they used the roads most often. Mail delivery was slowed and rural churches closed during the winter and spring. Everyone could relate to these problems.

License fees provided funds for roads and Iowa's fees were lower than the national average. Research showed that when traffic reached 320 tons per day on an earth road or 470 tons per day on a graveled road, it became economical to pave. Paving could be financed through bonding with the savings paying off the bonds in fifteen years (Thompson 1989:153, 155). Gaps in road networks could not be filled if a county did not participate. Although bonds were not supported by all, five major east–west highways were hard-surfaced entirely across the state using this method (Lincoln Highway, River to River, Blue Grass, Hawkeye, and Waubonsie Trail). Two had been completed north and south (Jefferson and Red Ball highways). Unlike the early railroads their was no financial speculation that would bankrupt a county.

On the Blue Grass Road in 1927 Des Moines, Henry, Jefferson, Wapello, Monroe, Lucas, Clark, Montgomery, and Mills counties all supported the bond issues. In the western part of its route two counties, Adams and Union, either defeated the issue (Union) or didn't vote (Adams). These two counties kept the route from completion from river to river. All of the counties along the Red Ball's route voted for the bond issues. South to north these were Lee, Henry, Washington, Johnson, Linn, Benton, Black Hawk, Bremer, Chickasaw, Floyd, and Mitchell.

The alternative was to not fund road improvement and this led to other issues. The Fairfield Ledger relates on March 25, 1923, that "The county roads are in a bad condition. Four horse teams are in evidence." In the same month a year later it was noted that "Bad roads, which have put the auto out of business in Jefferson County, have led to a revival of the obsolete crime of horse stealing here" (Baird 1989:22). Five days after the above newspaper article it was related that "Roads are terrible…the school wagons require four horses and have been getting stuck in the mud" (Baird 1989:25). Bad weather and bad roads could quickly return Iowans to 19th century transportation methods. The horse and wagon were the fall back vehicles during such weather conditions through the 1940s in rural sections of the state.



A

IOWA'S PRIMARY ROAD SYSTEM, 1919-1948

	Total Miles	Road Conditions: Paved	Bituminous	Gravel	Dirt Graded	Dirt Ungrad
1919*	6,432	25	—	624	836	4,947
1920	6,619	67	—	792	1,021	4,739
1921	6,616	236	—	1,157	1,448	3,776
1922	6,615	334	—	1,558	1,761	2,962
1923	6,647	419	—	1,889	2,001	2,338
1924	6,660	502	—	2,164	1,934	2,059
1925	6,674	569	—	2,461	1,796	1,849
1926	6,654	650	—	2,819	1,732	1,452
1927	6,665	940	—	3,226	1,417	1,083
1928	6,761	1,625	—	3,221	1,114	801
1929	6,770	2,317	—	3,137	715	602
1930	7,242	3,272	—	2,863	513	594
1931	7,789	3,804	—	3,070	281	635
1932	7,845	4,085	137	3,067	127	438
1933	7,834	4,202	139	3,083	52	358
1934	7,909	4,313	324	2,933	175	165
1935	8,278	4,374	323	3,297	92	192
1936	8,318	4,546	469	3,130	63	109
1937	8,433	4,818	569	2,890	50	106
1938	8,498	5,090	587	2,690	52	78
1939*	8,541	5,135	614	2,661	51	80
1940	8,559	5,208	671	2,592	22	62
1941	8,567	5,364	681	2,458	14	50
1942	8,558	5,459	727	2,335	19	18
1943	8,601	5,459	762	2,330	2	18
1944	8,641	5,497	752	2,359	14	19
1945	8,644	5,499	753	2,357	14	21
1946	8,651	5,495	742	2,381	15	18
1947	8,662	5,558	776	2,291	22	16
1948	8,654	5,615	788	2,222	16	13

B

Figure 6. A. Iowa's Eastern Section of Primary Roads System map for 1919. B. Primary Road System 1919–1948 (Iowa DOT Library).

One of the more amusing and well known anecdotes on such conditions was related about the newly poured 16 ft wide concrete "Seeding Mile" on the Lincoln Highway between Mount Vernon and Cedar Rapids in Linn County. The Iowan's story goes that:

> In December of 1918 the editor of the Iowa Highway Commission's Service Bulletin called Linn County Engineer Ralph W. Gearhart, saying he would like too tell the nation that Iowa was at last trying to get out of the mud. He related that "I would like to have a look at your new Lincoln highway stretch of pavement, he said in a long distance call from Ames, and take some pictures. Will you have some time if I come over in the morning?" "Sure," responded Engineer Gearheart, "but don't bring to much heavy camera equipment. We can take an interurban to a point 2½ miles from the pavement and walk over." "Walk! What do you mean 'walk'? Can't we drive?' "Drive! Man! We'd have a time getting through the mud to that paving with a team of horses and a buggy. We couldn't possibly make it with a car. How are you at riding horseback?" [Clements 1969:22–23].

Figure 7 shows a traveler's dilemma in Washington County as the beautiful concrete pavement just ahead is nearly unreachable due to the quagmire of mud that needed to still be crossed to reach it.

These conditions were recognized in 1922 when Fred White, Chief Engineer, challenged state officials to decide a future policy relative to highway surfacing. Traffic had outgrown the unsurfaced roads, and the rapid increase in vehicle numbers, size and weight was causing problems. The question White raised was whether Primary Roads improvements should end with graded earth roads or with hard surfaces (Thompson 1989:152). Not only were Primary Roads in most counties both ungraded and unsurfaced, they were also often unidentified. The Fairfield Ledger on January 7th of that same year related that "Many roads in Jefferson County are "lost" as far as accurate records in the engineer's office are concerned. The landmarks used to identify them are gone" (Baird 1989:19).

Other elements of road improvement were also being addressed in the early 1920s. From 1916 to 1923, railroad crossing elimination or reduction progressed faster in Iowa than in any other state. In 1924 billboards and advertising signs were banned where they interfered with safe views of highways. The maximum speed limits were set in 1925 at 35 mph. In 1926, a black line was painted on every mile of Primary Roads pavement. Although the present study's survey crews and researchers were asked to report any road section or segment retaining its black centerline painting, none were identified during either the statewide reconnaissance survey or intensive level survey and recordation of the study routes.

Figure 7. Caption reads "Sermon Without Words. A Farmer Living One Mile From the End Of The Paved Road Finds It More Expensive To Reach The Pavement Than To Travel The Remaining 8 Miles To Town" (Road-Maker 1916f:5, Photo dated Sept. 13, 1915). Note pavement in background.

Primary Roads in the 1930s. During the 1920s the state had relied heavily on county bond issues to finance road work. Increased funds from county bond sales accelerated Primary Roads paving in the late 1920s. This slow but steady increase in road funds stands in some contrast to the onset of the real "money years" of the 1930s. The decade that started with the biggest road building year yet ended with nearly no work at all.

During 1930, the peak year of construction, 1,029 miles were paved. This brought the total paved in Iowa to 3,272 miles, with 2,863 graveled, and 513 built to grade. Added to the primary system were 429 miles of stub roads in towns with populations of 400 or more. Stub roads were not through roads and ran only a short distance from a Primary Road to a town's center and stopped. In three years the number of completely surfaced roads spanning the state had increased to nine; seven east–west and two on north–south routes. By the close of 1931 four more north–south roads were added. After 1931 the exhaustion of county bond funds and the effects of the Depression sharply reduced Primary Roads building, but by 1934, the state was within 600 miles of the goal set in 1931. An additional 324 miles had been blacktopped, a method of surfacing introduced in 1932 that was inexpensive to put in place but expensive to maintain. Although construction costs dropped 26 percent, highway revenues fell twice as fast in 1932 compared to 1931. A highway patrol was formed in 1934. In 1938 the Federal Aid Act granted aid to secondary roads; amounting to not more than 10 percent. To take advantage of this in 1939 the farm-to-market road law was passed by the state in order to receive federal funds (Thompson 1989:179–180).

There were about 400,000 motor vehicles in Iowa when Primary Roads improvements began about 1920. The legal speed limit was 30 mph and comparatively few buses or freight-hauling trucks were on the roads. By 1930 the number of vehicles and average mileages had doubled, speeds had increased, and bus and truck traffic made up a considerable portion of highway usage. The improvement of Primary Roads started far behind vehicle needs and never really caught up with the demand. The abandonment trends on railroad branch lines had rendered small towns dependent upon highway transportation.

Primary Roads in the 1940s. The 1940s were a decade of the continuation of general trends that had been initiated in the previous two decades. In 1940, it was recommended that *every town* should be provided with a dependable year-round road and every primary highway with a dustless surface. Also, as a major statewide improvement narrow bridges were to be widened to not less than 24 ft, a process that is still ongoing. Another focus of the 1940s was that continued attention was to be given to the elimination or protection of highway/railroad crossings (Thompson 1989:183).

From 1942 to 1945 highway construction was curtailed. Most of Iowa's highway engineers were involved in war service and a number of Iowa contractors went to build the Al-Can Highway connecting the U.S. with Alaska for the first time. Gas and rubber rationing added to the curtailment of automobile production and cut America's driving habits to a minimum. The decrease in driving in Iowa cut severely into the state's road funds. At the end of the war an insatiable demand for consumer and industrial products including automobiles and trucks was felt. In Iowa auto registration grew 36 percent and trucks 55 percent. Highway travel began an increase that would last for decades. However, the highways were in poor condition. Maintenance had been postponed and structurally the roads were in worse shape after than before the war.

The Federal Aid Act of 1944 authorized aid to Primary Roads systems (A system), principal secondary and feeder roads (B system), and even for urban extensions into and through cities with populations of 5,000 or more (C system) (Thompson 1989:211). In the same act, Congress established a National System of Interstate Highways, requiring the states to select roads located so as to connect by direct routes the principal metropolitan areas. The total system was not to exceed 40,000 miles. By this legislation the state highway department was brought actively into city and regional planning (Thompson 1989:211).

From 1913 through 1949 research by the highway commission was conducted on an informal basis, specifically geared to individual projects with few publications formally summarizing the results. Much of the testing was conducted at the engineering school at Iowa State University in Ames. Material testing became increasingly important (Goldbeck 1912, ISHC 1905b, 1913b:2–12, 1915d:134–135, 1925b–c). In 1950, a highway research board was created (Thompson 1989:213). Iowa's research was a critical part of its advancement and continued to earn it national recognition. The investigation of the history of Iowa's road network in the second half of the 20th century is beyond the scope of this study.

CUT-OFF ROADS AND HIGHWAY SEGMENTS

Introduction. The processes that determine an early route's path at a given time, along with both the natural landscape and seasonality all produced over time what for the sake of this study is termed "a braided route." Not unlike the geologic process of stream evolution, progressive incidents cause the roadway to bend and curve upon itself. Newer roads overlap older routes with each successive route taking a slightly different path. Often these paths closely follow the older route and obliterate it. They also may follow a slightly different path so that it may parallel an older route for a distance or time. As a result cut-off highway segments or road remnants are left in place. Each resultant cut-off segment retains evidence of its period(s) of construction.

This successive road evolution results in improving the speed and directness of route. The progress of road design towards the "Bee-Line" route continues to the present day (Figure 8) (Gubbels 1938:14). This trend towards the directness of route is a primary cause of the cut-off segments of old roadways. Cut-off segments are the natural result of progressive straightening or improvements of roads. With successively engineered roads almost always amounting to an increase in size the result is that the smaller, more crooked, and hillier sections of an earlier road designed as a lesser scale roadway are abandoned, reworked, or obliterated. As a result when antiquated routes through hamlets and villages are bypassed these places are perceived to "dry up." Even with larger communities, as the fluidity of commerce goes somewhere else changes can occur. However, cut-off segments of the old roadway are often left through parts of town. This was common with the bypassed small towns within the study routes and is applicable for Iowa in general.

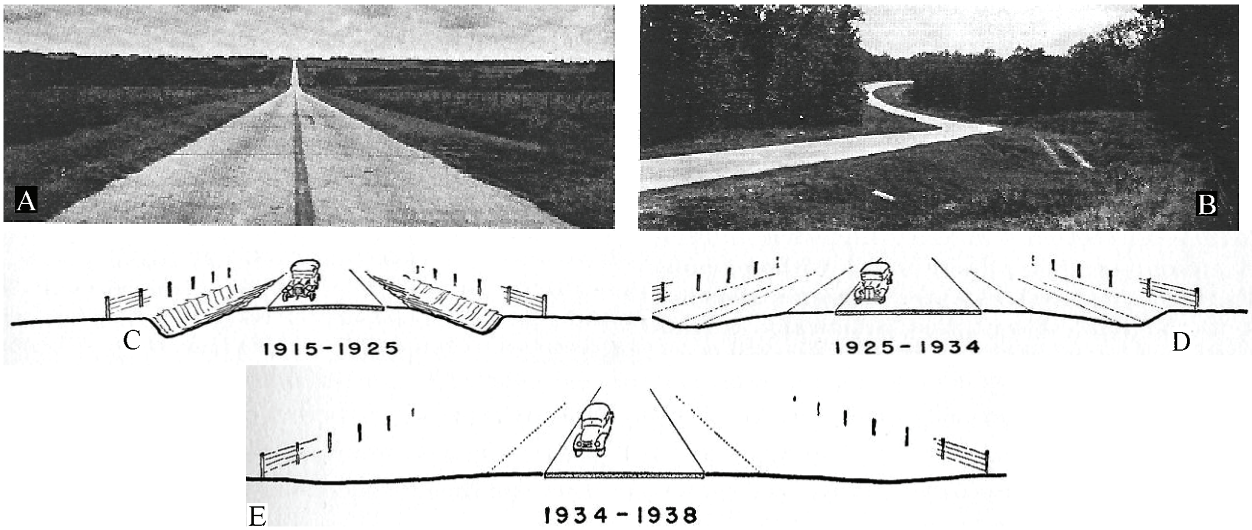


Figure 8. A. "Bee-line roads, Man's Arrogance Toward Nature." B. "Sharp-turned curves on an Old-Type Highway." C–E. "The Right-of-Way" (Gubbels 1938:14, 21).

Numerous sources relate that routeways and the roads on them evolve over time. Roads change the landscape. A road's route, even until the 1930s, often moved across the landscape in an organic fashion as areas became impassable or new routes opened up. Early roads were also topographic in nature in that they followed natural landscape features and would travel around low areas, concentrate at good river fords, and often take several routes up steep grades. Another early characteristic was that roads went to specific landscape features. They may consist of camping sites, springs and other water sources, natural landmarks, resource areas with forage or timber, and also to avoid wet or sandy areas. They did not necessarily go directly from town to town. The state's old military roads often went from fort to fort with little regard for what was in between, which was often just open country. Early roads often led directly to a private house, farm, mill, or inn, and that family's name would often be associated with a particular place or road long after they were gone. Until the 1930s even Primary Roads in Iowa frequently went through farmyards and cut between houses and barns (see Through-Farm Segments).

Construction vs. Deconstruction. For the purpose of this discussion all of the activities, knowledge, and materials that come together for road building purposes that result in the finished road itself may be termed *construction*. Antithetical to this is the process of a road's eventual dissolution and replacement. This replacement process leads to the *deconstruction* of the old road and cut-off highway segments are a product of this on-going process. Fred White's 1920 statement about roads never being finished is just as applicable today (Institute of Transportation Studies 2001).

In a chapter called Transportation and the Iowa Landscape in *Take This Exit: Rediscovering the Iowa Landscape,* transportation historian Drake Hokanson relates:

> Because the highway routes are often related in the process of improving them, we can often find several parallel and older routes of the same highway. The evolution of Iowa's highways parallels that of most of the rest of the country, and to a surprising degree, much of that process is still observable on the landscape. The braided paths of old major highway like U.S. 30 or U.S. 20 can be read as a chronology of highway development in the United States [Hokanson 1989:285].

The road itself is often disassembled, reused, replaced, abandoned, rebuilt, improved and may have any number of such actions committed upon it. Most arterial roads from the study period exhibit either a few of such elements or a large number but all have clues to their periods of construction, period when cut-off, and an applicable historic context if one can discern them. While the road's original construction can be seen as a historic "set piece," the moment or brief period of highest construction integrity progressively deteriorates and falls apart. As a result road beds or routes see a great many types of alterations and reconstructions. Some segments are left with high integrity, some with none, and many fall in between with sections exhibiting high integrity and sections exhibiting a complex of interacting elements whose integrity, as a whole or individually, are not easily evaluated without a thorough understanding of the processes involved both with putting roads on a landscape, and evolution over time.

When an evaluation of cut-off arterial highway segments is approached at the largest scale it can be noted that such segments come in a few basic types. These types relate both to the period of construction and in what ways and for what reasons a highway segment was cut-off. Cut-off highway segments are indicative of three things. These are: 1) the period(s) when built, 2) the materials sources and equipment available, 3) and the engineering and design elements available at the time of construction. In pursuing the investigation of such large engineered features or segments of such large features it was clear that an understanding could not be reached by studying only those segments that were abandoned. Cut-off arterial highway segments are part of a larger whole, the result of on-going processes. Many have been decommissioned at some time as state highways and are in the process of abandonment, and in some instances obliteration from the landscape. These processes, and their results, received a lot of consideration. The section below is concerned with determining what forms cut-off segments.

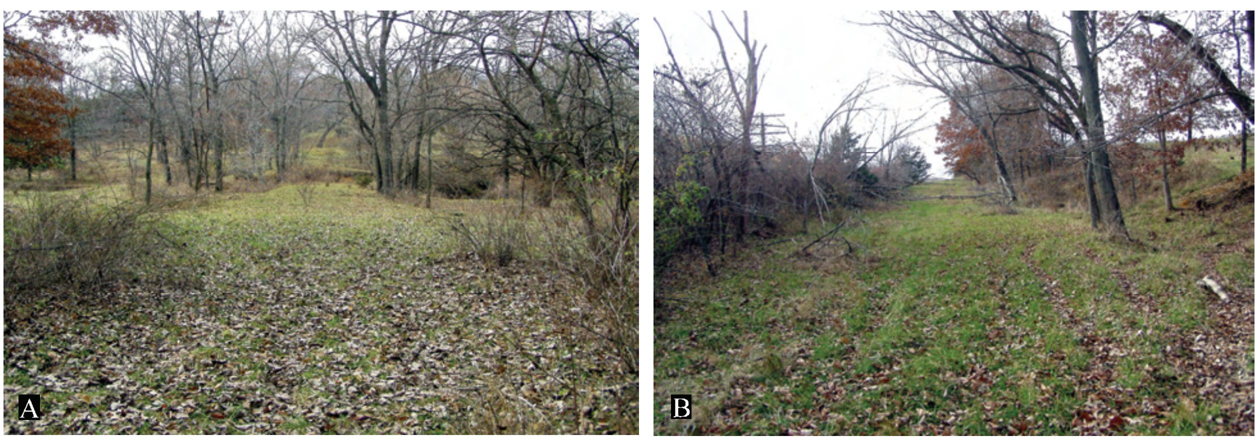


Figure 9. A. Jockey Hollow's abandoned pioneer era and early Blue Grass Road's 1910s–1920s "built to grade" road bed, Lockridge vicinity, Jefferson County. B. View to west of same route in field. 2003 survey photos.

CUT-OFF SEGMENT TYPES

Introduction. In the course of the study many cut-off segments were encountered. Through evaluation and analysis, five basic cut-off highway segment types were identified. These are: 1) Abandoned Cut-Off Segments, 2) Decommissioned Cut-Off Segments, 3) In-Place Cut-Off Segments, 4) Through-Farm Road Cut-Off Segments, and 5) Ruinous Cut-Off Segments. These types appear to be applicable on a statewide basis. A cut-off segment may exhibit more than one of these types along its length.

Abandoned Cut-Off Segments. A highway segment abandoned by the Iowa DOT may remain in service in some other capacity, but this segment type primarily refers to cut-off segments in poor or unmaintained condition (Figures 9–11). These are one of the more common and obvious types of cut-off segments.

They are especially visible if they're constructed of concrete. Earlier dirt or gravel cut-off segments often disappear back into the landscape. It was just such a dirt segment that Artz archaeologically investigated in 1995 (Artz 1995a, 1995b).

Even with significant grading and drainage elements it was becoming nearly invisible on the surface due to vegetative growth. His work showed that a progression of such features may exist side by side and represent different time periods. As an early road is upgraded and a new alignment chosen the old curves, steep grades, river crossings, bridges, and other elements are frequently cut-off and abandoned and often eventually fall into total disuse. This cut-off segment type can vary greatly in length and integrity. Cut-off segments that are unused or abandoned at the primary, secondary, county, or even township level may be turned to alternate service (Figure 10). Abandoned cut-off segments may see occasional reuse as a farm or river access road but are generally no longer maintained. Often such cut-off segments, especially if built of concrete are used on farmsteads for equipment and/or hay storage or feed lots (Figure 11). Nationally, others have been resurrected as walking, biking, sporting, or even occasionally for vintage car rallies. The best become heritage corridors (Figure 9).

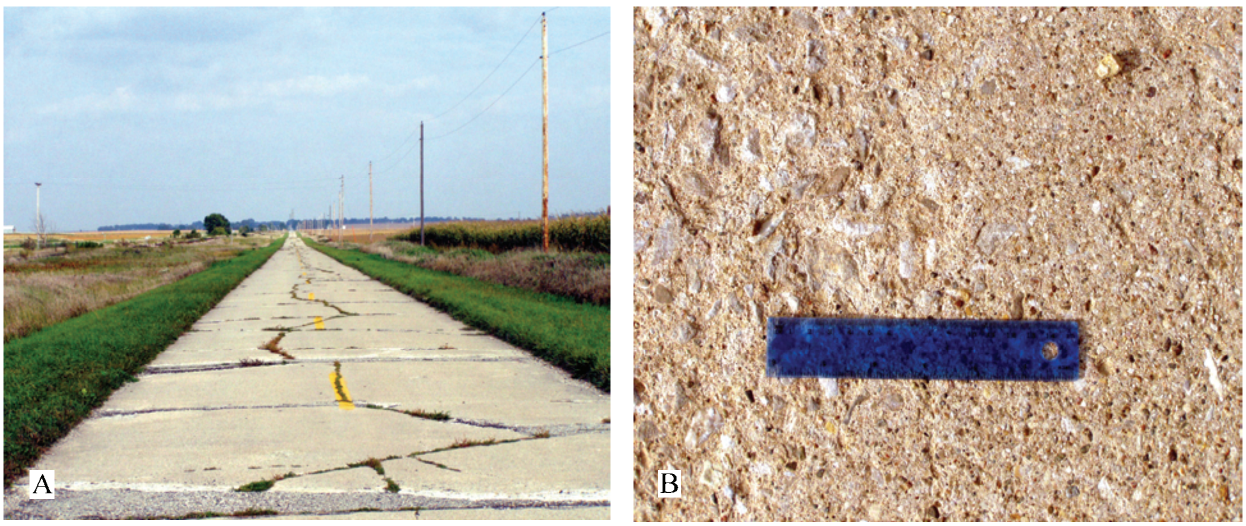


Figure 10. A. Abandoned cut-off segment of U.S. 18 in Kossuth County, Algona vicinity, returned to county or township maintenance. B. Detail of concrete pavement. 2003 survey photo with 6" ruler.

The time at which a segment is cut-off and abandoned is considered its end or terminus date. The cut-off segment will display no improvements, changes, or alterations (other than destructive) after that point. It may display high integrity of construction or design elements from previous periods. Abandoned cut-off segments always progressively deteriorate. They first lose their signage and guardrails. Road segments with earth or gravel surfaces quickly have plants and trees begin to grow in their courses. This natural reclamation process can be used to track an old road way through heavily overgrown areas, pastures, or up slopes as the consistent size and type of trees or bushes that have sprung up in the road bed can be excellent indicators of a road's path and can be used to generally determine when the roadway was abandoned. Some of these roads may have deeply incised tracks, be graded, or paved having old surfaces.

On both of the study routes long section of roads have been decommissioned. Some were decommissioned in the 1920s, many in the 1930s to 1950s, and some only very recently. While dirt roads are seldom integrated into the main county system once cut-off, gravel and concrete surfaced roads frequently are integrated. Both study routes have numerous examples of lengthy cut-off segments that have been integrated into the county road systems (Figure 10). Many such segments show either little alteration or a great deal of ongoing alteration and upgrades depending on their surface, traffic loads, the viability of the county's road funds, and the county engineer's views toward economic development.

While the Red Ball Route from Ainsworth to Riverside has remained gravel surfaced it has seen alteration in some segments, and little or no change in other segments along its remaining length. In general, it has retained its original cross-section, culverts, and bridges. The route of old U.S. 218 (Iowa 923) from near Ainsworth to Iowa City has seen a higher degree of alteration due to its having been decommissioned much more recently and its concrete pavement replaced or resurfaced due to higher traffic density.

Decommissioned Cut-off Segments. When long sections of old roadway are paralleled by new construction, rather than having the old routeway obliterated, cut-off segments of considerable length, often several miles in length and retaining their original structures, may be left (Figures 10, 12, see also 61D, 61E, 65D, 94–96, 100C, 104A, 112B, 113). This is most frequently visible on concrete paved road sections dating after 1920. However, such segments can be cut off prior to 1920 and yet retain a high degree of integrity. Cut-off segments such as these are often decommissioned by the state or federal highway commission and returned to local, county, or retain state designation depending on their length and location. Long decommissioned stretches such as old U.S. 218 retain a state highway designation number (Iowa 923). These segments are sometimes still in daily use and are maintained by state or county highway departments. Due to their narrow width and the limited load bearing capacity of bridges and culverts they often have a weight embargo applied. Cut-off segments such as these that are still in use frequently have had or will have their major bridges replaced, many have large sections of repaving or over-paving, replaced or removed culverts and drainage structures, and generally have their overall historic integrity ever progressively reduced for the needs of safety. The older the roadway and the longer it has been in use, the more its original integrity can be affected. Unchanged highway segments of any length or those showing only minimal change have much higher integrity than those whose elements have been greatly altered. This type of cut-off segment is becoming ever rarer across the state. Highways built or rebuilt in the 1950s or later, which have been cut-off or decommissioned, are at present in much less peril from post-decommissioning upgrades than they had been from obliteration during reconstruction.

Figure 11. A. Abandoned segment of old U.S. 52 used for ensilage storage, Decorah, Clayton County. B. Abandoned segment of old Iowa 2 in Taylor County used for equipment storage. 2003 survey photos.

Additionally, due to their being both feeder roads into cities and their 1910s to 1930s bridges and culverts being unable to handle large trucks and farm equipment, both old U.S. 218 (Iowa 923) and old U.S. 34 are being upgraded at present with the resultant loss of the original pavement, steel and concrete bridges, and major culverts. With the construction of large bypasses for current U.S. 218 around the towns of Crawfordsville, Olds, Swedesburg, and Ainsworth several miles of cut-off road segments of U.S. 218, whose cross-section and some structures date from the 1930s but whose pavement dates from the 1950s, have been left as access roads to and through these towns as main streets. The cut-off segment through Crawfordsville follows the exact path of the 1839 Military Road through that community. The process is the same for U.S. 34 as the smaller towns are bypassed by current construction. Some towns that were bypassed in the 1930s to 1950s are now being passed again even farther out due to the large scale of current design and construction. This progression in cut-off segment size relates to an important ongoing trend, which suggests that cut-off road segments can get progressively longer, larger, and later as the 1950s and 1960s roads are in their turn cut off.

Figure 12. A. Decommissioned in-use 1910s–1920s segment of Blue Grass brought to grade and graveled, Lockridge vicinity, Jefferson County. B. Cut-off and in use 1920s–1930s era concrete surfaced segment of U.S. 34, Lockridge vicinity, Jefferson County. 2003 survey photos.

Through-Farm Road Cut-Off Segments. Through-farm roads are one of the most common but unrecognized road segment types (Figure 13, see also 112). These roads often existed until the 1950s when nearly all Iowa roads whose right-of-way requirements did not meet the new specifications were cut-off or eliminated. In many cases these segments were turned into farm lanes, driveways, field access roads, or abandoned.

These roads often traveled through farms which straddled a major route, county line, or township road on the grid. Prior to 1940 many of Iowa's Primary Roads still ran right through a farmstead. While the time from 1900 to 1925 was the greatest period of through-farm roads, such routes lasted well into the mid-20th century. Plus the early road designs were a direct reflection of the policies put I place at the time. Engineering roads to carry motorized vehicle traffic was in its infancy. In the 1910s and 1920s, roads leading directly from or through the farm to town was appreciated. By the 1930s, having an arterial cutting so close to your livestock and home, did not less positive. As vehicles became larger, faster and more numerous, complaints to the ISHC increased. After the 1930s such road were progressively eliminated. This process is ongoing.

With Iowa receiving funding from the various national transportation acts (1913, 1916, 1921, 1937, 1945) roadways were increasingly engineered around farms, avoided specific bridges or culverts with narrow widths or low weight load limits, and had sharp curves and steep grades reduced. All of these activities cut off sections or left remnants on the landscape of degraded, abandoned, or lost road segments. Interstate construction has bisected and cut-off large numbers of rural roads in Iowa. Roads from the 1920s until the late 1940s often more closely resemble each other than earlier or later roadways. The 1920s roads remain topographic in following the ridgetops and divides. Progressively, the size of construction elements, such as road widths, and bridges and culverts, along with the increased size and number of construction machines, has cut and shaped the landscape to a higher degree than ever before.

*In-place Cut-Off Segment*s. Cut-off segments can occur within active road beds or within the current route itself. This can happen when a segment of original concrete roadway (or other paving or surface type) is preserved intact between two replaced sections. In this instance the cut-off segment is bounded on either end, and sometimes along its sides, by altered, added, or replaced roadway (Figures 13, 14). This type of cut-off segment can be characterized as an original road segment or section that lies between two altered or replaced segments on a highway that is currently being used.

In order to exhibit a high degree of integrity an in–place cut-off segment should exhibit all or most of the following features. These are: 1) exposed original pavement. 2) original cross-section. 3) intact original structures. 4) sufficient length to retain the association of time and place. For evaluation, attention should also be given for surviving segments that contain enough original period structures such as curbs, drains, culverts, and bridges (or lack of such) to retain its integrity and interpretive value.

Some degree of alteration may be present. Altered conditions could be acceptable for National Register eligibility in certain instances (see Evaluation Criteria for Cut-Off Highway Segments). Changes that occurred within the period of significance, are 50 years old or more, and do not significantly affect the integrity of the pavement or cross-section may be acceptable. Lastly, when the in-place cut-off segment contributes to the physical linkage of other significant segments the corridor, does not greatly affect or even improves the overall eligibility, and has interpretive value, it should be considered an eligible segment or section.

Throughout the state and within the study route areas some of the above noted features are common for in-place cut-off segments. Alterations for safety issues such as the attachment of later metal or wooden siderails on older rural culverts or bridges are relatively common in some counties and townships. This was usually detrimental to the structure's integrity when a more sensitive approach is possible. For preserving integrity such upgrades are better than the damage they may suffer from impacts or the total replacement of the structure. The introduction, use, condition, and integrity of guardrails and like structures within the right-of-way are discussed below (see the discussion on Culverts and Bridges, Handrails and Fences, and Evaluation of Cut-Off Highway Segments below).

Figure 13. A. In-place cut-off segment on old Iowa 2, Corydon/Promise City vicinity, Wayne County. B. In-place and over-paved, cut-off through farm segment of old U.S. 6 running through a farm near Oxford, Johnson County. 2003 survey photos.

A common subtype or form of in-place cut-off segments are the "overlain" or "over-paved" segments and sections (Figure 14). This condition occurs most frequently when asphalt is used as a surface finish for old concrete highways but can occur when concrete has been added to increase the width. When the asphalt has been laid between the curbs but the curb tops are still visible then the highway segment may be viewed as being either an original, or as a contributing element to the overall highway or highway segment, if also meeting the other integrity or significance criteria especially if the original cross-section has been retained. When both the entire surface of the original roadway has been covered to the point where the curbs are no longer visible and the cross-section altered it may significantly affect its integrity.

Many Iowa Primary Roads with narrow widths, usually 18 ft or under, have been altered by the addition of concrete strips along either side. This was a common practice beginning in the late 1940s and widely applied in the 1950s. This was especially common on concrete roads, built primarily from the

1920–1930s, whose old curbs had been removed. Occasionally the original pavement is clearly visible in the middle. Often, such roadways will have an asphalt surface laid over the top, but due to the differences in weights and stresses on the pavement over time, cracks develop through the surface coating and along the edges allowing the old road bed to be discerned. In such cases the old pavement can be preserved but is not visible. Widened roads with original cross-sections such as this are fairly common in Iowa but the underlying road or pavement may not be clearly discernable. Examples such as the removal of the significant "Seedling Mile" on the Lincoln Highway in Linn County show that very significant "in-place cut-off segments" are often removed no matter how high their integrity or historical significance.

The alterations noted below affecting integrity should be considered in an assessment of integrity. These are:

1. Deep road cuts that has required additional shaping or construction for safety's sake.
2. Asphalt resurfacing on small sections of degraded surface when kept below the curb line.
3. Replacement or alteration of original engineering elements.
4. No other viable option was available.
4. It appears consistent in materials and styling to the element it replaced.
5. An over-surfaced original pavement with original cross-section of high significance in relation to overall route.
6. Last surviving example.

Figure 14. A. View of in-place cut-off segment on old U.S. 34, Lockridge vicinity, Jefferson County. B. View of integral lip-curbed segment on old U.S. 34, Rome, Henry County. 2003 survey photos.

Ruinous Cut-Off Segments. The previous cut-off segment types all imply some means of limited use. Some are simply too short to be useful. However, there are stretches of cut-off highway segments that are completely abandoned and are returning to a natural state (Figure 15, see also Figure 16). In general a ruinous segment cannot be driven upon and some are hardly recognizable. For surfaced roadways, especially concrete, some segments conditions are so bad or dangerous that they are unusable. For Iowa's and the study route's earliest dirt roads, even on the arterial routes and trails, many sections have all but disappeared with only the occasional bridge, culvert, or other element left in a field or over a drainage to show where a once important or "arterial" road once ran. Additionally, these roads no longer go anywhere. While many abandoned and other cut-off segment types still have purpose very few ruinous ones do. Even cattle frequently avoid these road beds or structures in their pastures. If only a tractor can get down the old roadway it is a field access, but still a viable transportation route. It may be the point that it is no longer clearly visually apparent and is lost, having returned to the landscape. This is the type of cut-off highway segment encountered by Artz (1992), who recorded it as an archaeological site.

It would be possible to rehabilitate some ruinous dirt or gravel roads to usable condition but generally not ruinous concrete highways. Under some conditions they might contribute to interpretive issues and be used to rejoin other segments into a route with larger interpretive values or be considered as contributing elements (see Evaluation Criteria for Cut-Off Highway Segments). The resultant evaluation of such ruinous elements or roads may be more difficult than intact sections and may have only archaeological considerations (Artz 1992, 1995a, 1995b). It may be considered that if it is ruinous it is no longer a road. If it is indistinguishable from the general landscape or topography, if it can only be discerned by experienced surveyors or route knowledgeable individuals, from aerial photography, or if it cannot be associated with a significant context through visual means; it is in all transportation sense nonextant and no longer a road, but has devolved into the trace of a road on the landscape and is an archaeological site.

Figure 15. A. Cut-off segment of old U.S. 92, Mapleton, Monona County. B View of old U.S. 218 (ca. 1930) broken-up for reuse as bridge rip-rap, Mount Pleasant vicinity, Henry County. 2003 survey photos.

In some instances ruinous segments may have high interpretive value or be important contributing elements. Ruinous segments dating to the early part of the study period were encountered, recorded, and evaluated along the intensively surveyed study routes. Relic roads and trails in ruinous condition that precede the study period have a different context and period of significance. The evaluation criteria differ between pre-1900 and post-1900 roads. Pre-1900 roads were from a time when almost all rural roads where dirt and were often ephemeral during their own time. A route is not the road itself and routes change.

Figure 16. A. Segment of the Airline Highway (1900s–1920s) now a field access (later Iowa 8) east of Albia cut off in the 1930s. B. Contributing cut-off segment of a pre-Civil War road used as part of the Airline Highway (ca. 1916–1925) with early parapet culvert visible from old U.S. 34. 2003 survey photos.

A pre-1900 road and its precursor routes need to be assessed and their historical significance and contexts evaluated differently than a modern graded or paved highway whose route is more firmly fixed upon the landscape. In such an evaluation length, visibility, as well as early surviving sections or structures are important considerations. This is especially evident if early cut-off segments can be seen from the roads that replaced them. Most of Iowa's earliest roads were dirt and 100 to 150 years of weathering and cultivation have resulted in reduced visibility. They often appear as only faint traces across pastures or hillsides. These traces, when within the context of a larger heritage corridor, may be evaluated as contributing elements, especially when visible from the current route. Eligibility criteria for evaluating cut-off contributing and/or interpretive segments is discussed below.

Conclusions and Recommendations. Remnant road segments as archaeological sites have been recognized for years. One such site encountered as part of the old Lincoln Highway was previously evaluated (Rogers 1997:4–5). It showed that remnants of significant roads and highways, segments from which the pavement has been removed but the berm remains, and segments with an unknown amount of other modifications may be evaluated at the Phase I level as potentially eligible even though questions remain concerning site integrity. It was recommended that development avoid impacting these features and make note of their presence. Such cut-off segments can be important for the interpretation of the resource. If needed, further investigation can make a final determination of eligibility and what procedures would best be applied.

ROAD CROSS-SECTIONS AND BEDS

Introduction. In Iowa the military roads were often the first in an area to show any degree of design and maintenance. It is not known at this time what the building specs were for the Agency Road or the Old Military Road, government surveyed and built precursors to U.S. 34 and U.S. 218 respectively, other than that they were to be cleared and bridged. It was understood prior to 1900 that graded, dragged, and ditched roads served best. For the purpose of this report it should be understood that the vast majority of Iowa's rural roads prior to 1905 were essentially unplanned, other than preferably being on section lines, and except for rare cases, had no distinctive cross-section. The first widely disseminated engineered road cross-section was published by the ISHC in 1905 (ISHC 1905c:74). This was Iowa's first official road cross-section and all roads in the state were expected to be built and designed to this basic standard and the application of road cross-sections in Iowa formally began at this date. It was also one of the first such published road cross-sections in the nation and was nationally known as "The Iowa Section" (Figure 17) (Harger and Bonney 1919:60). This work and nine others (Appendix G) were noted in 1984 as necessary to the understanding of historic highway construction in the state by Iowa DOT engineers.

A road cross-section can be defined as the profile of a roadway's right-of-way generally from fence line to fence line. All roads have a cross-section. A road cross-section can be planned or unplanned. Unplanned cross-sections are those that evolve over time with use. These usually relate to the early settlement period and were common in Iowa until the formation of the ISHC in 1905. Planned cross-sections are those that have been developed, planned, or engineered on some level.

The cross-section is a critical piece of information in determining when a road was constructed. Road cross-section widths in Iowa have varied over time. For Primary Roads the 66 ft (Gunter Chain) road width for the cross-section within the right-of-way has been in use in Iowa since the mid 19th century. However, the type or shape of the roadway cross-section within those boundaries has not remained the same and discernable periods of construction, design, and alteration can be determined from the cross-section.

Evaluation. A road's cross-section is made up of several key elements. When property was allotted for a road a right-of way width was established. This was usually the land owned or controlled by easement dedicated by the state, county, township, or community for roadways. The cross-section is the shape of the road's path and bed between within legal ownership or control markers for the right-of-way.

In 1905 the newly formed ISHC published the seminal *Manual for Iowa Highway Officers*. This was the first official document issued by them containing an overview of road construction. It gives a lengthy discussion of the construction and maintenance of properly engineered road beds, and typical cross-sections are included. These simple cross-section designs were to be used as general guides across the state. Within the manual the chapter on cross-sections is longer and more involved than that on concrete construction that occurs towards the end of the bulletin. As dirt and gravel/macadam roads were infinitely more common than concrete paved roads at that time it is logical that the discussion of proper road construction should have cross-sections for dirt roads illustrated. The use and scale of the machinery available at the time such as the road drag, small scoops, graders, and ditchers, and teams of horses mostly run by farmers was taken into account. These were cross-sections nearly anyone could make and maintain and that was the purpose of the manual.

With the establishment of statewide standards in 1913 and the first federal standards in 1916 the cross-sections become increasingly standardized across the state and nation. By the 1920s the use of the 18 ft to 20 ft gravel and concrete pavement widths gave roads from these periods strongly identifiable characteristics. After 1940, the introduction of 22 ft and 24 ft width road beds on state Primary Roads was mandatory.

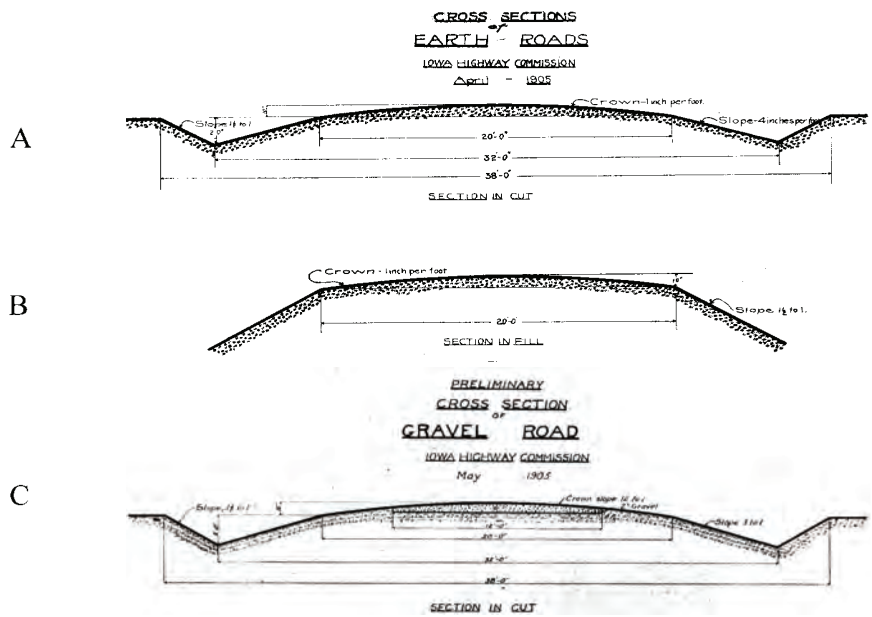


Figure 17. A and B. Cross-sections of Earth Roads (ISHC 1905a:59). C. Preliminary Cross-Section of Gravel Road (ISHC 1905a:74; Harger and Bonney 1919:60).

Identification. The 1905 ISHC's manual contains two figures of the optimal cross-sections (ISHC 1905a:74). While these cross-sections in some ways were generalized for their use as examples they were probably the most copied and followed examples of "official" road cross-section construction in the state (Figure 17). Except for the road bed or pavement width, which was progressively widened over time, throughout Iowa dirt and gravel road cross-sections built today appear much the same today as they did in the 1905 illustration as the basic road cross-sections have remained the same. While the basic cross-section has remained the same changes in construction methods and machinery have changed leaving discernable patterns or marks, materials, and structures that can date the road and its changes.

The basic techniques or methods for building a road and the cross-sections of gravel for dirt roads in the state, having been so well documented, can help to interpret when a particular road bed was built. When evaluated along with period maps, the construction elements, and especially the pavement widths they can be used to place the construction date(s) and changes within a few years. Compared to the early twentieth century, few new rural gravel or dirt surface roads are constructed today for permanent use by the state or counties and none are arterials.

For the purpose of this study the cross-section usually contains two basic elements for evaluation. These are both contained within the width of the right-of-way. The first and largest element is the entire roadway within the right-of-way. This includes all the various sub-elements such as fencing, signage, grade, the fore-slopes and back-slopes of cut banks, and bridge and culvert approaches, and especially drainages including ditches, tiling, and stream channeling. Even prior to 1900 it was clear that ditching along side roads promoted better drainage.

The second element is the road bed itself. The road bed has it own divisions: base, sub-grades (from coarse to fine materials), crowning, and paving. Crowning of the road’s bed by dragging, layering, grading or paving all promoted drainage. This was especially critical in the early days when the compaction of the road’s surface promoted drainage on both dirt and gravel roads. For concrete road paving the crown was designed in and formed with a template during the pours. The road bed always has additional structures within and along its right-of-way cross-section. The roadway and road bed are best visualized in both their horizontal and vertical perspectives as a road travels in three dimensions. Additional elements can be any additional construction features within the boundaries and the varied elevations of the right-of-way.

It should be kept in mind that the surface paving is not the road bed. Road surfaces paved with gravel or concrete often started out as dirt road beds. Subsequently, for gravel roads the bed was put down in layers with fine gravel as the pavement surface. As concrete replaced gravel as a surfacing material (or pavement) a road’s bed may have been rebuilt. The procedure between 1913 and 1940 was to first bring a dirt road to grade. Second, the road bed was established and surfaced with gravel. The bed was put down only after the construction of the culverts, bridges, and drains. Concrete culverts and bridges were introduced very early and were frequently used under gravel roads. For many years the culvert’s construction was far more important than the road’s surface. Lastly, after the gravel road bed and surface had been compacted further by a few years (or decades) of use, the concrete surface was laid over the gravel after it had been scarified. Sometime the gravel bed was reworked in other ways.

These two primary elements, the roadway and the road bed itself, can have many levels of design and construction complexity that relate directly to their period(s) of construction. Like the cross-section they can place the route and roadway within a general context and help further both an evaluation of integrity and in determining the period of significance. In general, the earlier the roadway the more simple its design elements, the more locally-derived the materials, and the narrower and less developed its cross-section. As a general rule, roads in Iowa develop from smaller to larger, from simple to complex, and from dirt to gravel, to concrete over time. Straightening results in the most cut-off segments over time.

MATERIALS ACQUISITION

Introduction. Highways are a combination of engineering, materials, and construction. During the project’s study period (1900–1948) both the research and investigation into which materials were suitable for road construction went hand-in-hand with the acquisition of suitable materials and their use within the construction projects. This was especially relative to the formative or experimental period dating from the early ISHC days (1904–1913) when the testing of road construction materials was beginning. The suitability of various materials for road construction was very new and nearly unknown in Iowa between 1900 and 1910 and standards were being set by extensive experimentation at the engineering school at Iowa State University in Ames as early as 1895 and the University of Iowa in Iowa City starting in 1890. Iowa’s Portland cement plants did not begin operation until 1906–1910 (Transit 1910). It is important to be able to recognize the resulting structures from the period and tie the materials to their construction period and place of origin. For analysis, the use of local materials, small project size, and the marks of small concrete batches indicative of hand labor are hallmarks of constructions from early in the study period. For evaluation of significance the types of materials used are crucial to dating and context.

Materials needed for road construction had to be gathered and brought to the construction site. They needed to be graded for suitability primarily in their size, hardness, and sorted for undesirable components such as raw hematite, soft limestone, shales, and ironstone concretions. This selection and acquisition could occur locally if usable materials could be found or quarried nearby. Natural materials needed included sand, gravel, rock, and soil (mostly clay) in large amounts. Water availability was also a consideration. Areas with few or poor raw materials had to bring them in from elsewhere and this raised the cost of projects. While eastern Iowa has good road building materials (including rock, gravel, and soil) other counties, mostly in southwest Iowa, had very poor local resources for road building. Concrete requires the costly additional ingredient of Portland cement and this had to be imported in the early days.

The ISHC's standards published in their seminal *1905 Manual for Iowa Highway Officers*, and later the numerous ISHC's *Service Bulletins*, leads one to understand that the actual and practical application of these standards were most often followed, to a greater or lesser degree, only on the Primary Roads system of state and federal arterials. These roads were to be supervised by competent people and predictably they most closely followed the standards. However, with local officials, county engineers, and township road crews compliance with the standards was often poorly understood and executed. This was especially true from 1913, when the ISHC began mandatory plan review, until the late 1920s. Even when the plans had been approved and the standards had been met for the right-of-way width, cross-section, grading, road bed, and shoulders, the consistent use of basic materials such as the concrete aggregate, or simple construction processes such as soil compaction, or for road bed materials to be applied in horizontal layers with each compacted before the next was applied, were often incorrectly executed. While the ISHC had set up basic formulas for proportions of materials that were combined to make the aggregate, serious mistakes were frequently made. Frozen, dirty, or ill-mixed concrete was a major problem in Iowa for decades.

Books and Sources on Road Materials. With the first geological publications of Iowa's mineral resources in the 1850s the state's mineral resources began to be outlined. In 1896 the potential use of dolomite exposed near Mason City for concrete had been elucidated (Schultz 1896:41). By the early 20th century a number of books discussed where such materials were located. Several of these were dedicated to either commercial or highway materials(Moore 1917:26–27). One of the most important for the purposes of this report was *The Road and Concrete Materials of Iowa* written ca. 1930 by Samuel Walker Beyer and H. F. Wright. Around that same time Beyer and Ira A. Williams published *The Geology of Iowa Quarry Products* (Beyer and William ca. 1930; Beyer and Wright ca. 1930).

In the 1930s the Iowa Geological Survey published Volume 36 containing their annual reports from 1930 to 1933 with accompanying papers. The ISHC is noted in the acknowledgements as having furnished the funds by which the material resource survey was carried out. Special mention is made of Iowan R. W. Crum, then Director of the Highway Research Board, Washington, D.C., who organized the Materials Department of the ISHC, and who inaugurated and encouraged the survey. Advice from the ISHC also went to Bert Myers, Engineer of Materials and Tests for his contribution to the chapter on Road and Concrete Materials, with those chapters having to do with the development of materials deposits (Iowa Geological Survey 1930–1933; Beyer and William ca. 1930; Beyer and Wright ca. 1930).

With the increasing use over time of crushed dolomite and quartzite as preferred materials for aggregates and surfacing the great variation shown in early aggregates diminishes. As a result, the survivability of very early roads that were handmade from local material sources is low due to the low total mileage built, age, and subsequent replacement. Highway segments less than 18 ft wide and hand built of local materials are very important survivors of early road building technologies and may have high historical significance. In general, 18 ft wide highways have become increasingly rare and potentially more significant.

MATERIALS TESTING AND EXPERIMENTATION

Materials Testing. The engineering school in Ames, later linked to the ISHC, had begun material and concrete testing as early as the mid-1890s. The University of Iowa's engineering school was also deeply involved in concrete testing at this time although much of their early work was dedicated to the testing for railroads (Transit 1895:121–142). Testing was going on at many universities across the nation. The University of Iowa focused on testing types of concrete from different early manufacturers. Two types commonly used in Iowa were from Utica, Illinois, and Milwaukee, Wisconsin (Transit 1893:16). These were somewhat favored over other brands. An article on Mason City Dolomite and Iowa Building Stone appeared in the Transit in the 1896–1897 issue (Schultz 1897:160). Another article in the Transit that measured the effects of freezing on concrete showing that Portland cement lost 50 percent of its strength when poured in freezing weather. They found that the addition of salt could partly help the problem. In an 1899 University of Iowa experiment where concrete was laid under a brick surface it was found that the concrete was still soft after a year and that weak cement would be damaged by vehicles (Bowman 1899:41–60). By the 1910s the University of Iowa was apparently gradually leaving the field of concrete testing although general road experimentation articles appear in the Transit, an engineering publication, until around 1930. Concrete manufacturers often did their own research and testing (Concrete Highway 1924a–c; Transit 1926c:171, 1927:41–43; Portland Cement Association 1949).

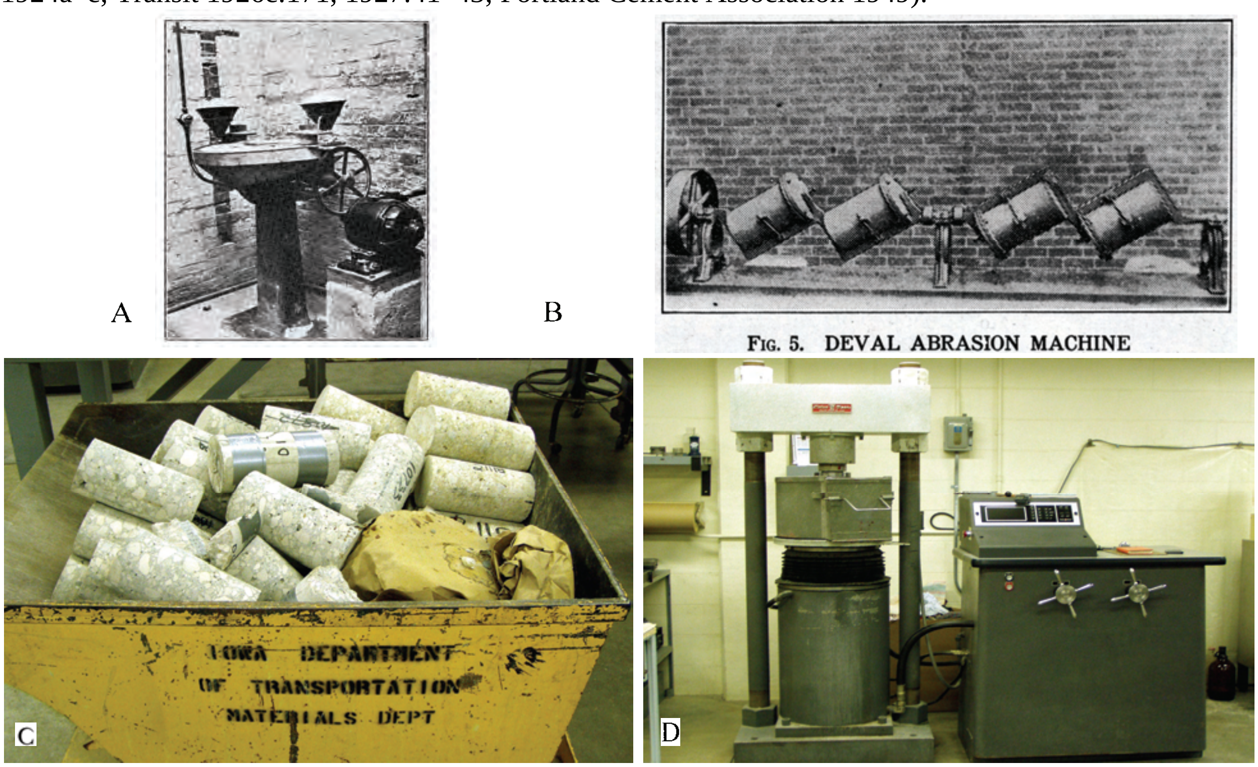


Figure 18. A. Dory Hardness Machine (Road–Maker 1913b:4). B. Deval Abrasion Machine (Road-Maker 1913b:5). C. Cores at Iowa DOT testing laboratory. D. Iowa DOT testing lab equipment (2003 photos).

By the time of the formation of the ISHC in 1904, the testing of all road materials was well underway. By 1907 a dedicated highway materials testing station had been set up in Ames and its first test results were reported in the ISHC's Second Annual Report (ISHC 1915a:130–135). It tested materials, structures, vehicles, tools, and safety. Concrete cores were taken and tested for their hardness by tumbling (Figure 18). Compression, weathering, stress, hardness, slump, and other tests were also made using these cores. Sections of both the Blue Grass and Red Ball route's old concrete paving and structures have had cores taken from them. Core holes are still visible on these road's pavements in sections that display unusual wear or cracking or that have been in use for a number of years. Additionally, cores are also taken from good sections for comparison and a number of cores may be taken over time in or near the same location. Bridge decks, culvert beds and tops, and concrete highway pavement sections may all exhibit these core holes. Some similar holes can be found in pavement that relates to other activities, especially temporary signage and/or barriers and possibly mud-jacking. Mud-jacking involved pouring slurry through pre-drilled holes to raise a pavement. It was first developed at the ISHC by John Poulter in the late 1920s (Iowa DOT 1999:28).

Testing on metal, tile, and concrete pipe culverts was also conducted at Ames. In 1915, when testing small concrete pipe-lined culverts around the state it was found that 84 percent of one type of pipe, 46 percent of another, and 35 percent of a third type was defective (ISHC 1915a:135). The U.S. government was also in the materials testing business and often relied on Iowa's testing data (Road-Maker 1912:1–5; Crum 1915, 1930, 1931, 1934, 1936). Evidently the testing of road construction methods and materials was primary to the vision, mission, and improvement in Iowa's roads of all types from its earliest days until the present.

By 1926, the nearly 30 years of testing had quantifiable results that were starting to be disseminated nationally. Basic ideas, such as the economic value of reinforcement in concrete roads, had not been fully comprehended by the road construction industry as a whole. The Proceeding of the Fifth Annual Meeting of the Highway Research Board in Washington, D. C., headed by Iowan Roy Crum, took up these issues and used a great deal of Iowa data. This included discussions of the overview and analysis of the undesirable characteristics of non-reinforced concrete roads and streets (Stewart 1936:369–379).

Previously Tested Pavements and Structures. Many historic or early road segments as well as bridges exhibit a couple to numerous 3" diameter bored holes through their concrete surfaces. These holes remain after the ISHC, or later Iowa DOT, removed a core sample for testing. This sampling may occur during construction, during the life of the road or structure, in areas exhibiting poor construction methods or materials subject to heavy wear, failed areas, and for general testing for stability and longevity. While core samples were also taken from dirt and gravel roads for testing at Ames no such sample sites were encountered or are expected to survive. Experimental, test roads, or frequently tested roads are important.

Road Cross-Sections and Beds: Evaluation of Integrity. Road improvement increased exponentially across Iowa from 1900 to 1948, and Iowa still has a high number of dirt and gravel roads. While many have seen changes in cross-section and paving type or width others have been less modified. They still may exhibit their original cross-sections and construction features such as ditching, bridges, culverts and bridges, surface, and other features despite paving changes. When encountered in sufficient lengths, with original features, a known context, and high integrity these road segments may be evaluated as potentially significant and as having achieved the first step towards potential eligibility to the National Register. Age and survival alone are not sufficient evaluation criteria for cut-off road segments, they must also have been important.

Most of Iowa's roads exhibit some degree of modification or improvement over the years if still in use. This is especially true of arterial roads, which often saw upgrades to sections or elements both before and after they were cut-off. Pristine historic road sections are difficult to identify so it is necessary to be able to evaluate the cross-sections, structures, paving, and other elements for each time period and to demonstrate what changes may have occurred and to what degree during a particular period of significance or context (Figure 19, see also Figures 8, 17, 58E).

The sequence of a road bed's evolution, from dirt pathway to arterial, can sometimes only be discerned with certainty by exposing the cross-section of the road bed under investigation. While this is understandably difficult on roads in use it is easier on abandoned road segments or those under construction. With caution, an old road cross-section may have been exposed and an examination made.

Artz's archaeological excavation of the cut-off road segment, related to the route of The Great White Way (predecessor to current U.S. 61), shows the basic sequence of construction events and the cross-sectioning of a non-concrete surfaced road and that it relates to the statewide period of bringing Iowa's Primary Roads "to grade." This period can generally be identified as occurring from 1913 to 1930, but peaking in the 1920s as a statewide movement. The cross-section, construction methods, materials, and drainage design and materials he uncovered all point to that cut-off segment's date relating to brought-to-grade era of the 1910s to 1920s. Archaeological testing methods may be a definitive means by which determining the period of construction can be achieved.

The archaeological cross-sectioning of a road bed segment can be an accurate way of determining its periods of construction. Such information can help to determine that the road's path was the same as that depicted on historic plats or maps. It can establish that a specific construction sequence is missing or how an unidentified cut-off segment may lie in relationship to the current route. Cross-sectioning and survey combined can establish the locations of previous routes, route changes, and the sequences of construction.

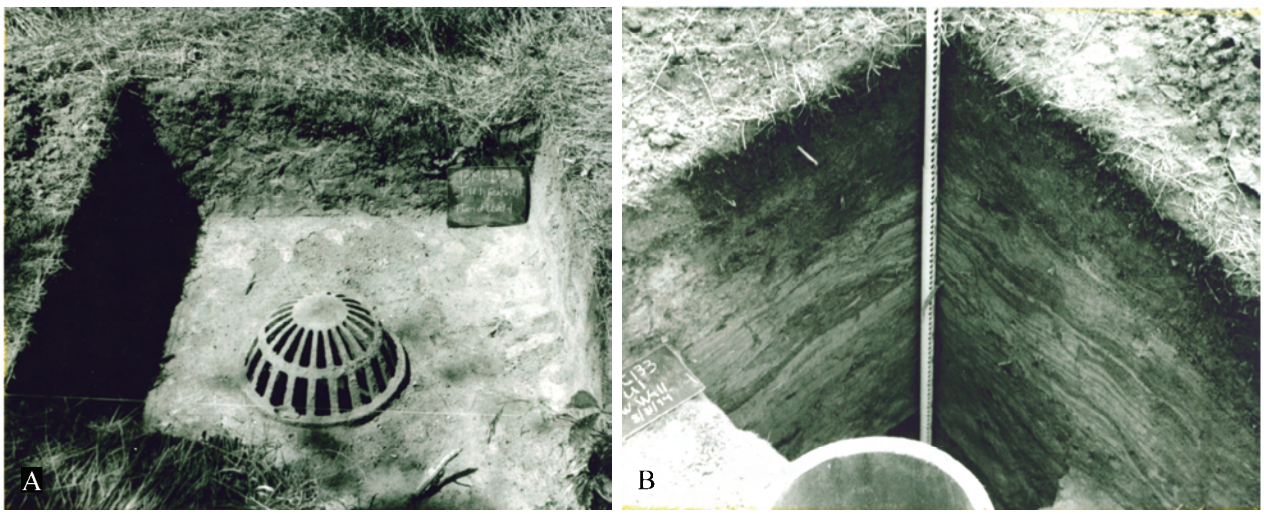


Figure 19. A. Archaeological excavation around dome top drain inlet in Muscatine County similar to example on U.S. 34 (see Figure 58E). B. Profile of road showing ruts and depositional sequence around drain inlet (Artz 1994).

IOWA HIGHWAY CONSTRUCTION: LEARNING HOW (1900–1918)

Introduction. Concurrent with the design of roadway structures and materials testing in the engineering departments at Iowa State and the University of Iowa was the process of teaching people how to build good roads. One of the first items with the formation of the ISHC was the vision to conduct road schools. These road schools were taught by both Anton Marston and Thomas MacDonald in the beginning, but MacDonald, as field engineer became the principal educator.

The first road schools were conducted at Ames. The road between the campus and town was an especially apt project due to its location along a creek through a low and frequently muddy area. Some of Iowa's best "stuck in the mud pictures" were taken in this local quagmire (Hank Zaletel, personal communication 2003,). Quickly the road schools were conducted at project sites such as on the Mason City to Clear Lake Road, or in Jefferson County on the Lincoln Highway. The road schools provided a core of trained individuals who could start Iowa on the path to good roads. Also, many of the experimental test sections of roads, and not a few culverts and bridges, were built around the campus and perhaps into Ames. If discovered, lost segments of these roads using early experimental methods used on local routeways may be extant away from the heavily rebuilt main roads. These early experimental roads around the state may have great historical significance.

Between 1900, when no standards or even examples were available, until 1920, when general standardization was adopted statewide, one of the principal means by which construction data was disseminated was through the ISHC's road schools. Beginning in 1905 and continuing for the next decade the road school provided hands-on practical experience for county engineers, township supervisors, and local contractors. The road schools were held in central locations throughout the state. The earliest schools were usually held in cities and towns, whose roads had yet to be paved, and where a maximum number of participants could be drawn. Some schools were conducted in counties with especially troublesome sections of highway so that builders and designers could learn to handle complex situations.

Road Schools. As early as 1905 the ISHC was involved in holding "Road Schools" in order to illustrate how good roads should be built. The early schools were held both in communities heavily involved in road construction and at the headquarters in Ames. Iowa held the first road schools in the nation and they were an integral part of the state's education program for improving roads. Road school trains traveled the state educating local officials and citizens and teaching the use of the King Drag (ISHC 1905b:72; Brindley 1912:218). These schools allowed those involved in road construction to all "get on the same page," so to speak (Brindley 1912:218). They taught basic surveying, grading, planning, and construction. Only earth and stone roads were considered at first because most of Iowa's roads at the time were of dirt and ungraded. Introductory lessons in construction of concrete structures, especially culverts, were also taught. These schools provided certification for road builders having taken and passed the schools.

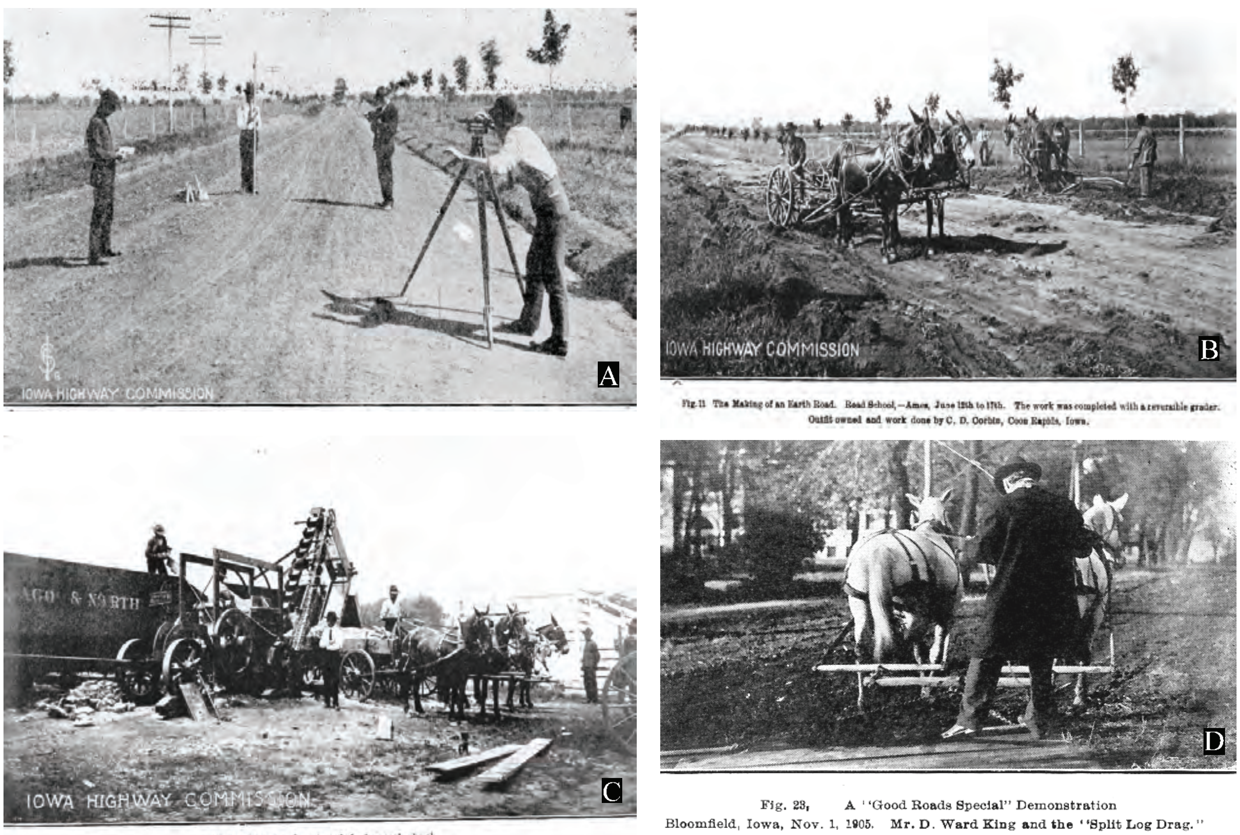


Figure 20. A. Road School surveying party at work in 1905 (ISHC 1906:37). B. The Making of an Earth Road (ISHC 1905b:36). C. Stone crusher at work (ISHC 1906:43). D. A Good Roads Special Demonstration of the split log drag by D. Ward King, Bloomfield, November 1, 1905 (ISHC 1905b:72).

The earliest road schools (Figures 20, 21) were mostly for professionals and both Thomas MacDonald and Anson Marston participated directly. MacDonald and Anton Marston, the early heads of the ISHC, frequently traveled around the state to conduct these schools personally. Later, such schools were less formal events and were held not in Ames but in counties where road construction was considered a priority. Many participants were county engineers and county or township supervisors whose county lay along a cross country route (ISHC 1921c:36, 1927b:12).

It appears that the basic fundamentals of road construction, which followed the doctrine outlined in the Manual for Iowa Highway Officers, were to be a hands-on demonstration that usually lasted for three days. Proper road dragging and grading, basic surveying, materials acquisition and selection, road construction, and the manufacture of concrete culverts were the primary subjects. These events were designed to be fun for the participants and many spectators turned out to watch and learn.

Road Days and Road Contests. Eventually most counties which had participated in road schools adopted the practice of holding “Road Days.” Road days varied between highly organized public events and more casual affairs. The purpose was for the county, townships, and communities to all drag and repair roads on the same day. These were held in the spring after the first rains when the roads were most workable. Gangs of men, sometimes in the hundreds, would bring their wagons and teams, road drags, farm equipment such as ploughs and harrows, and just hand tools and go out and fix local roads. Counties and townships would furnish scrapers and graders, rock and soils, and basic supervision. Often roads that were the most heavily traveled or in the worst condition were chosen. Road Days often became Road Contests in which a spirit of friendly competition was engendered. In some communities these were referred to as “road bees” and held the same kind of local cooperative community efforts as barn raisings, or husking and quilting bees. The early days of Iowa’s road progress and road support were very local. People would band together to fix “their” roads or “the” road and cared little for the conditions or problems of other areas. It was up to the county to organize large events for its main or through roads.

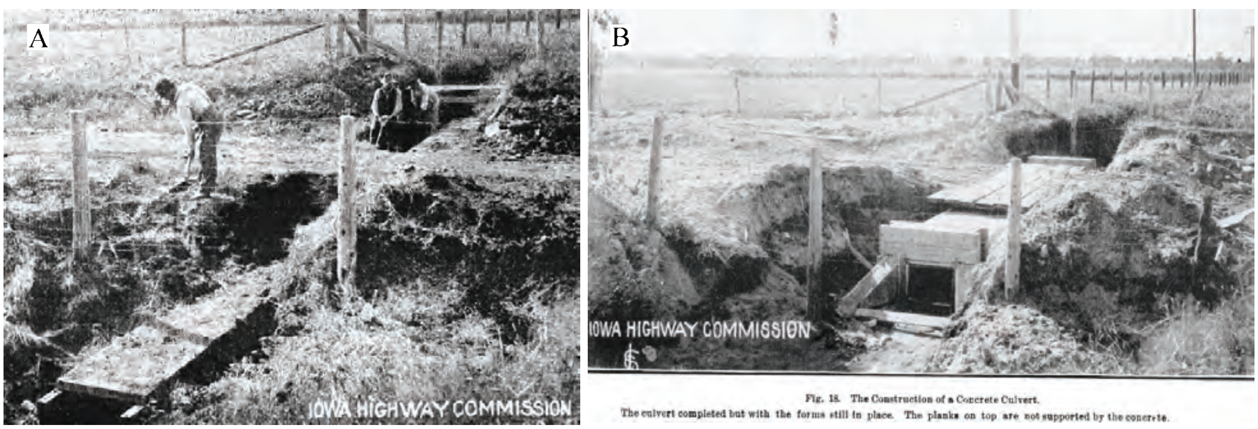


Figure 21. A. Road School Demonstration Culvert under construction (ISHC 1905a:44). B. Finished structure (ISHC 1905a:46).

The road improvements were seen for the betterment of all and until fully mechanized road construction began to take over in the late 1920s most Iowa counties held such events. They were especially popular in the spring time, before and after the planting season, when the rainy spring weather was most conducive to road work and farmers had some free time. As an example, in Page County such a contest was oriented to young boys who could both prove their worth and make some money by participating in such a contest. About such an event in 1912 it is related that:

> …Iowa, has a most interesting road contest now in progress in which the participants are boys. Any boy under twenty-one is privileged to enter the contest and is assigned half a mile of road to be worked with a king drag and ordinary farm tools. Each township puts up a prize of $5.00 for the best half mile, $3.00 for the second-best, and $2.00 for the third. Other prizes are furnished by the county organizations and all the boys will receive pay under the drag law up to a certain limit. Special prizes from $10 to $100 are offered

> for team work done by a group of boys to keep up from two to five miles of road and the leaders of the five winning teams will each receive medals. It is a valuable idea to instruct the rising generation in road making because it is one of the problems that will attract public attention most during the coming generation [Road-Maker 1912g:11].

Another short notice in the Road News section of Road-Maker magazine in that same year was that "Road dragging day at Owasa, June 20th, was a great success" (Road-Maker 1912h:6). This sounds like the true community event where many hands pitched in for the public good. This was a change from the approach where generally only professionally trained individuals supervised special crews to build roads.

HIGHWAY RESEARCH, ENGINEERING, AND TESTING

In the 19th century principally individuals with academic or military backgrounds built new roads and these were mostly urban. The National Road from Washington, D.C., to Vandalia, Illinois had been built and operating for over 100 years but had little affect on Iowa. The techniques of bridge building had advanced greatly and the bridges were often far superior in design than the roads they serviced. The bridge in a box system had been developed and numerous bridge manufacturers, with several in Iowa, would erect bridges. One told them how long it should be and they quoted a price. In the same regard roads were far behind as at the time no road could be made to order.

In Iowa, the 1905 *Manual for Iowa Highway Officers* by Marston, Curtis, and MacDonald can be recognized for it seminal importance and as a huge leap forward in taking the basics to Iowa's road builders. It was the first such publication of its kind in the nation. The road school, to which it was essentially a companion text, was also a critical step but road schools were also new and generally literature was lacking even at the professional level.

While the ISHC's *Service Bulletins* provided some construction and design information in the first few years they were basically involved more with promoting good roads and specific local projects within Iowa. By 1915, Roy Crum's Iowa Service Bulletin article on *Grading and Testing of Concrete Aggregate* showed great expansion of the state testing laboratories and their statewide dissemination and concurrent application to Iowa road building technology (Crum 1915:8–9). The boosterish contemporary *Road-Maker* magazine, also initially published in Iowa (1912–1916), gave a wider national and even international view but was also short on real engineering information. In Iowa, Wilson Harger and Edmund Bonney published the significant *Handbook for Highway Engineers* (Harger and Bonney 1919). Their illustrations and discussion of grades, and especially their discussion of "Typical Sections" were instrumental to the understanding of road cross-sections. This was followed by their *Location, Grading and Drainage of Highways* in 1921, and in 1927 an updated 4th edition of *Handbook for Highway Engineers*. In 1925 the ISHC published their *Standard Specifications for Road Construction*. In 1930, the commission published both its *Standard Specifications for Construction Work and the Secondary Road System* and its *Standard Specifications for Materials for Construction Work on the Primary and Secondary Road Systems*. Lastly, Arthur Bruce in 1934 published his important work *Highway Design and Construction* (Bruce 1934, revised 1937). These are seminal works for researching Iowa's roads.

Established in 1920, the national *Highway Research Board's* 1920s and 1930s publications were fundamental in professional materials testing, construction, and problem identification (Crum 1928, 1930, 1931, 1934, 1936). Their 1926 publications entitled "Presentation of Data: Undesirable Characteristics of Plain Concrete Roads and Streets," taken from Part II of the *Report of Investigations of the Economic Value of Reinforcement in Concrete Roads*, was an invaluable source in its time and was one of the primary means for identifying and analyzing concrete and its problems for this study. It combines photos and text for a diagnostic approach to concrete road failure (Highway Research Board 1926). Iowan Roy Crum, formerly of the ISHC in Ames, had become editor of this national publication by 1928.

In 1938, Jac L. Gubbels published his interesting work on *American Highways and Roadsides*, where he outlined roadside landscaping. This also appeared in both the national Highway Research Board's publication that same year and in the ISHC's Service Bulletin shortly after. By 1940, Thomas Agg's *The Construction of Roads and Pavements* was in its fifth addition. His volumes and work with the Highway Research Board foreshadowed the great boom in professional publications in the 1940s prompted by AASHO in Washington, D.C. In 1940 AASHO published *A Policy on Sight Distance for Highways* and *A Policy on Intersections at Grade*. Laurence Ilsley Hewes published his two volumes, *American Highway Practice* in 1942, and in 1941 a *Policy on Design Standards–Interstate, Primary and Secondary*. Clearly this last work takes highway construction to the next level–the Interstate system–and Iowa was certainly a big part of this evolution. These works led the field and soon saw practical applications.

While the above list is not meant to be comprehensive it does show the advancement of literature for the professional community. These works and others were vital to the present understanding and evaluation of roadways and road structures. They also provided the temporal links for the documentation of engineering advancements in Iowa and concurrently for the state of such knowledge and advancements across the nation over time. Publications seen to be critical by the Iowa DOT to the understanding of Iowa roads are listed in Appendix G.

LABOR

Introduction. Early road construction in Iowa was an extremely labor intensive operation. It necessitated large gangs of well organized men, teams of trained horses or mules, and lots of wagons, some specialized. Like the agricultural machinery of the period the implements available during the early period (1900–1915) were small, hand operated, low maintenance, and ridden upon and controlled by the operator while being pulled by horses. Powered equipment for road construction, which generally consisted of a traction engine, was only available on the largest projects, or was to be found only in the quarries using rock crushers and steam shovels.

Unlike the technological evolution of road building machinery, road labor in 1900 remained much the same as it had since colonial times. During the early years of the study period an Iowa man could still work off his road tax. Not until the introduction of hard surface paving in either brick or concrete did the age-old process change and specialists evolve. It was still very hard labor and one marvels today at the laborious construction of urban brick streets and roads (see Figure 22). It's clear from a labor point of view alone why long stretches of rural road in Iowa were never paved with brick. Permanent paving for Iowa's rural roads was dependent on the adoption of concrete as a surfacing material. It was the era of construction mechanization with the use of steam driven traction engines, cement mixers, elevating graders and scrapers. It should be noted that even an implement with no moving parts was regarded as a "machine." With army surplus trucks arriving by 1919 things changed even on the local level. In the 1920s the caterpillar tractor became available and was in heavy use across the state by the 1930s.

Eras and Ages. For the purpose of this report an understanding of terminology is needed. Time periods in history, often overlapping, are called eras and ages. While the two words are synonymous "age" is defined as a period characterized by some person or by some outstanding feature or influence (Webster's 1968:25). An "era" is a period of time considered in terms of noteworthy and characteristic events, developments, or people (Webster's 1968:474). The use of terms such as the Golden Age of Agriculture and Mechanized Transportation Era are related to both their historical and vernacular usages but they are also specific historic contexts listed within the State Historical Society of Iowa's (SHSI) Rural Property Guidelines (SHSI 1993a), the National Park Service's National Register's publications, and other state, federal, and preservation publications. The Golden Age of Agriculture is the period from 1885 to 1929 when rising agricultural land prices and technological innovations lead to a period of national prosperity for the farmer. The Mechanized Transportation Era began in the 1850s with the railroad. It is the time from the introduction of machines to move goods and people. Autos made significant impact after 1900.

Road Related Labor and Community. Prior to 1945 most counties and townships maintained only small crews of men to work on the roads. This was often seasonal employment that employed young unskilled laborers. A core of permanent road workers who could operate drags, graders, ditchers, and elevators were also kept. Larger scale road constructions employed the young men from entire towns and villages along its route and provided a substantial financial boon to the local economy. The later part of the state's Golden Age of Agriculture coincided with the early automobile era in the 1910s. Both of these were national movements whose elements overlapped during the early 20th century in Iowa. Much of the local worker's pay from highway construction went directly into the local economy. Often locally made earnings were spent locally as there was no easy way to spend it some place else. The commercial districts of much of small town Iowa still reflect this automobile related economic boom that lasted well into the 1960s.

Aided by the local road related cash flow most Iowa downtowns built or enlarged during the early automobile era. A few rural hamlets faded. Communities expanded down the main newly graded or paved highways and new construction mixed in with the architectural styles of earlier eras. In between antebellum and Victorian-styled buildings more modern, and often auto-related, buildings arose using new materials such as reinforced concrete, steel frames, pressed or enameled steel siding, and cheap plate glass. These new technologies, styles, and materials functionally and visually expressed the dynamic future, and that future was connected to the road and mobility. The new upstart and distinctively designed catalog houses in the economical "Foursquare" shape with Prairie School, Art Deco, and Art Moderne styled houses and businesses were intermixing with the older buildings. They were progressive, modernistic, and innovative all at the same time. Some were even prefabricated such as the cleanly efficient and newly purpose-built gasoline filling stations and diners. The era of the novelty buildings was just beginning along with that of the various roadside attractions mixing motoring with entertainment.

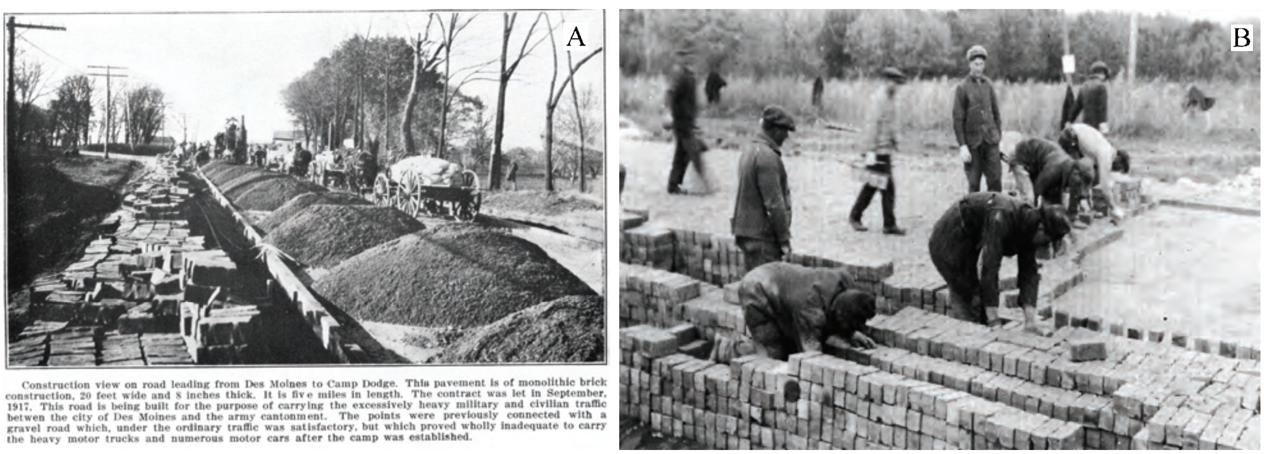


Figure 22. A. Material set up on the Des Moines to Camp Dodge Road in 1917 (ISHC 1917d:inside front cover). B. Workers laying the Des Moines to Camp Dodge Road (1917–1918) (Thompson 1989:146).

Convict Labor. The use of convict labor for road work and maintenance was a longstanding practice in America. The use of convict work gangs in general has a long, varied, and often sordid history. During the 1910s a number of states, including Iowa, promoted or adopted the use of convict labor for road construction. This turned out to be a rather short lived but significant period in Iowa's road building history (Figure 23, see also Figures 25A, 27B, 29, 48, 53, 71C, 75). The use in 1914 of a prison work force on the Fredonia to Columbus Junction concrete road was truly an important experiment in road construction and for Iowa prisons (Figure 23). In 1992, Joyce McKay related in her multiple property National Register nomination of Municipal, County, and State Corrections Properties in Iowa that:

> The Iowa state legislature sanctioned the use of honor prisoners in state road construction and in public works projects in 1913. It prohibited the leasing of prison labor to contractors and specified payment of

> wages and their proper supervision under the authority of the warden. Concerned about the reaction of the local community, it also warned against the use of conspicuous clothing. In 1914, an ordinance passed by the City of Fort Madison prohibited their use along its streets. In 1913, the State Highway Commission began to use a limited number of prisoners on state highways. Prisoners from the penitentiaries also worked on building and landscaping projects and on agricultural lands at state institutions including the Institution for the Feeble Minded Children at Glenwood, the State Hospital and Colony for Epileptics at Woodward, and the State School for the Blind at Vinton. The state accommodated the inmates in tents without guards [McKay 1992:60].

Later, in 1938, honor prisoners assisted Works Progress Administration workers with the levee at Fort Madison. An amendment to the 1927 bill regulating piece-price labor in the Fort Madison Penitentiary and Anamosa Reformatory also permitted the use of prison labor to build and maintain roads in state parks. As early as 1915, the Board lauded the successful operation of these projects and their benefit to the prisoners (McKay 1992:60). No doubt some of these men went on to instruct others about road construction in the following years, and in essence learned a trade once released.

In Iowa, the Board of Control for state institutions was placed in charge of approximately 50 miles of roads through and adjacent to state lands at all of the state institutions. Labor was to be provided by convicts; twenty of whom were used to build two miles at the Iowa State College in 1914, and in 1915, about one hundred were engaged in building roads and culverts at other state institutions. They were housed in tent camps, wore any type of clothing and were paid 20 cents per hour, of which they could keep five cents. As McKay notes above there were no visible restraints on the men. Although they built public roads much of their labor was used to build or improve the institutions in which they were kept. Also, tent camps were the common housing for most highway construction crews. Being temporary and portable they moved along as the road did.

Figure 23. A. Fredonia to Columbus Junction road convicts camp (ISHC 1914c:94, 1914d:3). B. Cherokee convict camp photograph (ISHC 1915q:3)

In 1915, the Iowa Service Bulletin relates that “fifty-two men from Fort Madison worked at Cherokee, twenty-five from Anamosa were in Ames, and about twenty Fort Madison men (out of sixty) were at Woodward” (ISHC 1915g:2–5). In the previous year there had been two road building camps. One camp was at Ames and the other at Columbus Junction with both totaling about fifty men. The men lived in tents, camp houses (large boxes on wheels), or relocated farm houses and were engaged in cut-and-fill, culvert gangs, and road grading. An Ames convict crew was building a concrete girder bridge and operating a small-gauge industrial railroad for the cut-and-fill operation (ISHC 1914d:3–5, 1915e:3–5).

A number of states were using prison labor at that time and prison labor for road building was included. Oregon had used convict labor on the construction of the Columbia River Gorge Highway. In the *Road-Maker* magazine a 1915 article about Wilmington, Delaware, relates some of Iowa's convict road crew's history in relationship to other states. In comparison, a suit had been filed to test the constitutionality of prison labor in Rhode Island. The Iowa crew was given as the best example with pay, clothing, and some relative outdoor freedoms. In contrast the Rhode Island prisoners were contracted to shirt manufacturers and were forced to labor in sweatshops and received no wages. That was considered by the suit to be slave labor (ISHC 1915a:17).

While the ISHC considered that convict labor had made a good showing in these isolated instances they did not feel that the experience warranted its use in general road work, as contrasted to contracting the projects to those with the necessary experience and equipment (ISHC 1914c, 1914d; 1915g, 1915h, 1915l; Road-Maker 1914c, 1915b; Lockridge Times 1917a; Thompson 1989:105–106). Much convict labor was behind the scenes such as the convict work gangs in the state quarry in Anamosa (McKay 1992). Breaking big rocks into little rocks had been an important function of road building and materials acquisition for the state as early as the 1880s.

Local Labor. Two types of local labor were utilized. In the first instance, counties and townships maintained a small permanent road gang or a larger seasonal crew to maintain roads and build or rebuild bridges and culverts. These were local men who operated much like a railroad gang with each operating on his section of county road, building bridges and culverts, and keeping the Primary Roads' surface in working order. The second local labor force was the "road draggers." These were usually local farmers and they did not work for the county or township road gangs but were paid by the county for dragging the roads near their property (Lockridge Times 1916l–m, 1917g). In some instances local farmers would team up for large scale personal projects.

It is noted in the Lockridge Times newspaper, along the Blue Grass Road and later when it became Iowa Primary Road 8, that county and township gangs maintained the roadway until around 1916. It notes in the minutes of the County Board of Supervisors that "a crew of four was kept busy along with a team of horses, a wagon, and a grader" (Lockridge Times 1916b). After federal highway funds had paid for the roadway to be brought to grade and partly graveled the county and township crews would return to working mostly only on local roads (Lockridge Times 1916o; 1917l). These county crews were often seasonally employed with only the foreman possibly retaining a permanent position. Large scale main route or bridge work was usually bid to a contractor who supplied their own trained personnel (see Coleman Road below). Local auto shops flourished in small towns along main roads (Jackson 1916:1).

Other Labor. While road and bridge contractors could be either from the vicinity or from a considerable distance most would be from a nearby medium to large city. This held true for most small and medium sized bridge projects in Iowa. Des Moines, with its large size and bridge manufacturing companies, was a common central provider for such contractors. From the late 19th century until the 1920s in-state companies did most of Iowa's road construction. Many projects were managed by the counties and labor was brought in from whatever source was available. This was the era of convict labor and as road construction was a relatively new thing few experienced laborers were available. This was especially true in the time prior to concrete construction in an area. Concrete construction required a trained crew and an experienced foreman. In 1909 the ISHC related in its Third Annual Report that "township funds are not sufficient to do much road grading as the handling of road machinery implies not only trained men but trained horses and adequate tools and machinery" (ISHC 1909:22). Many examples of poor construction occurred from 1900 to the 1920s due to inexperienced construction crews and supervisors. Sometimes even trained crews would produce inferior products.

During the 1920s and 1930s many Iowa contractors were working on highway projects. State and local politics could play a part in the letting of lucrative construction contracts. In 1927 the 11 mile section of U.S. 34 east of Ottumwa in Wapello County was being constructed by the Harrison Construction Company, from Ottumwa. A similar 11 mile section west of Fairfield on U.S. 34 in Jefferson County was being built by the Des Moines Asphalt Company (ISHC 1927c:3–5, 9). In 1927 the construction of the

Coleman Road was let to "Doc" Rombeeler from Keokuk. On that road Cameron Joyce of Keokuk constructed four bridges while the Harrison Construction Company of New Jersey did the actual concrete paving (ISHC 1927c:3–5, 9; IDOT 1927a). This arrangement suggests that local politics played a role in providing labor and jobs in an area while national companies were involved in specific aspects such as concrete paving. The problems with dealing with the township system and trustees, state and county engineers, and bridge contractors are outlined in an interesting article in the Transit (v.18) (Morrison 1913:5–12).

After the 1920s it was increasingly common for out of state contractors to construct Iowa roads, although many Iowa companies still accounted for a large portion of the work. For large or special projects such as the Keokuk lock and dam project, bridge erectors and road contractors who were used to working on large state or federally funded and managed projects would often be brought from out of state These companies provided their own heavy excavating and construction equipment and provided the crews to operate them. Often the company that had the specific road construction contract or supplied the bridge would bring a crew of experienced builders from whatever state their company was operating out of. In general, on many projects while the road crew was from the county or nearby large city the bridge erectors and pavers were often from out of state. This held especially if the company supplying the bridge was also from out of state. In many instances plain laborers were hired locally just for the duration of the contract while very skilled laborers were often on permanent crews that traveled from project to project.

EXCAVATION AND CONSTRUCTION EQUIPMENT

Introduction. Between 1900 and 1948 the scale of road construction, excavation, and the materials needed changed dramatically. Where early (pre-1900) roads followed the topography and made little or no attempt to change or modify the route, post-1900 roadways were the opposite. With the formation of the ISHC in 1904 information on correct road building methods and materials was disseminated to a much wider group. It was between 1905 and 1910 that serious changes to the landscape became involved in the approach to road building. The cut-and-fill method of construction became a very important and innovative practice. It didn't matter how good the roadway was if one couldn't get a load up the hill, across the river, or through a low or wet spot. However, this early change in engineering and design was still being accomplished with largely 19th century equipment until the 1930s. Automobile technology had a direct effect on road design. On early autos the gravity-fed gas tank would stall on a steep grade so many early road sections wound up hills on a mild grade for that reason. Later innovations such as improved tires, brakes, lights, and increased speed also affected highway design.

During the later part of the Good Roads Movement the introduction of the King Drag helped keep rural roads packed and graded. These were small horse-drawn devices originally made of split logs that were used to add or keep a crown on the road and help pack it (Figure 24A). The crown is essential for good drainage of the road bed for without proper drainage from the road's surface maintenance was often in vain. Roadways need to have the bed crowned but it was imperative that good drainage be installed at the same time and this was a struggle. In especially low or marshy areas elevated roadways needed to be built. These road beds were laid atop a berm made from imported and/or excavated materials. These are often very substantial structures and their construction for roads was not initially well understood. Much was borrowed or adapted from railroad technology.

Besides the extremely simple King Drag early road machinery or implements were very similar and were often derived from agricultural implements of the same period. Plows, harrows, disks, spreaders, wagons and other implements were commonly used. In 1916, the Lockridge Times reports, "Farmer Gravels the Streets: one day…100 loads…using gravel…to pave the streets…" (Lockridge Times 1916m:5). The farm wagon continued to be a major road construction implement through the 1930s.

Highway construction involves the movement of materials. The earliest Iowa arterial highways were in a sense handmade. Early photographs show the common use of mules, teamsters, and wagons for hauling.

Shovels, rakes, and buckets moved and mixed materials. Mechanization was not a large part of the "making" of concrete except for the mixer, and the variation in the product—concrete—was both noticeable and a sometimes a drawback. The earliest Iowa concrete was made by hand in small batches from local materials. The 1904 LeMars downtown road surface was of large concrete squares with incised lines so that the horses wouldn't slip. By 1905 the use of the steam traction engine for grading and rolling or packing was beginning. Steam shovels moved quarried materials from the quarry face or pit to the carts. Some innovative systems were used. By 1907, small traveling concrete mixers were being used on the Eddyville road. Another innovation was the use of a small railroad tram to move materials from the quarry or storage area to the work crews, or to move materials along the road way. The relatively small machinery used along with the continued need for horse-drawn wagons, limited the size of the projects.

Early Machinery (1900–1918). As noted above, during the early period of Iowa road design and construction little or no mechanization as yet had filtrated down to the majority of road construction at the county or township level. The early basic equipment such as scoops, scrapers, drags, and graders and been in existence for a while and were nearly all horse-drawn. It required large numbers of well-trained horse teams and drivers and the ISHC made special mention of the importance of the well trained horse team (ISHC 1905b:78). As a cost saving feature for county and township road work it was noted that the minimal equipment necessary should be kept and it should be left to the contractor to provide the expensive elevating graders, steam tractors, and shovels.

On occasion a large contractor would use a "traction engine," one of the huge steam powered engines used to pull agricultural equipment (Figure 24B). The traction engine was the one piece of equipment that early county and township road builders did not have yet as a common and vitally necessary item. Equipment tied up money each year and needed competent crews to operate them. While many county road crews could operate horse-drawn equipment few could operate such a machine for road work.

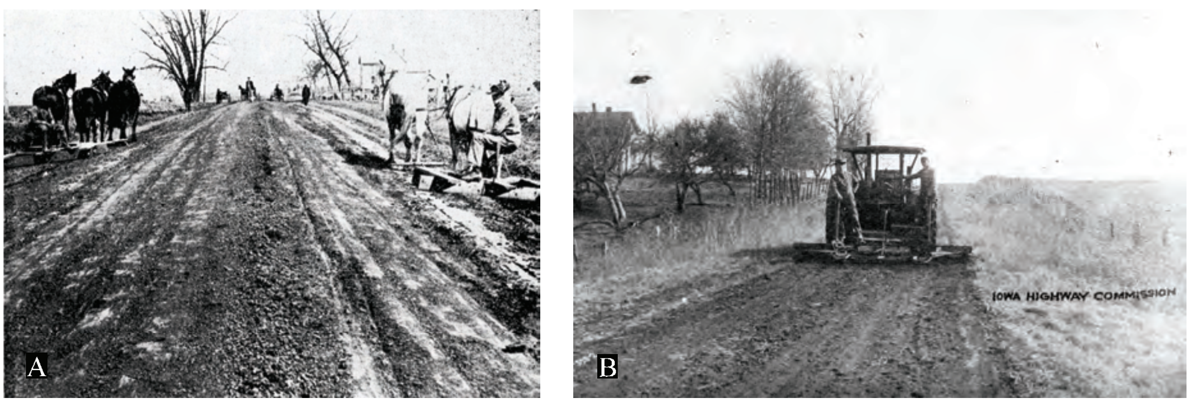


Figure 24. A. After Dragging in Jackson Township, Hardin County (Road-Maker 1916c:27) Note use of four drags. B. Iowa road crew dragging road with a traction engine in 1915 (Road-Maker 1915b:6).

The type of machinery used determined several aspects of the road construction. When looking at the small horse power of the equipment and large gangs of workers it becomes apparent that the roadway's scale is related to the size of the team employed in its construction (Figure 25). As noted above, early highway cross-sections and beds, pavements, and associated structures exhibit a very large amount of handwork. The materials were quarried and sorted primarily by hand, power was mostly provided by horses, concrete was mixed and moved in small batches, and the resulting concrete structures may exhibit marks related to the use of hand tools on their surfaces. Even steel bridges were hand riveted.

Scrapers. In 1905 the Manual for Iowa Highway Officers noted the type of equipment required for road building (Figure 26) (ISHC 1905a:63). The first are the "Drag or Scoop Scrapers." They were often called "slips" or "slushers" during the time. The early models were pulled by two horses and held either five or seven cubic feet of earth. The manual is specific when it stated that “proper use of this scraper was entirely for side work and it was not to be used to haul earth even short distances” (ISHC 1905a:64).

Wheel Scrapers. The “Wheel Scrapers” came in three sizes (Nos. 1 through 3) and held 9, 12, and 17 cubic yards, respectively (Figure 26). While the nine cubic yard sized No. 1 scraper (the cheapest) was the most commonly used in Iowa it was strongly noted in the manual that this was precisely the size that townships should not buy. It was recommended that they should buy the 12 cubic yard No. 2 wheel scraper. The ISHC related that “the number one waste of road money was from hauling long distances with small scrapers” (ISHC 1905a:64).

Figure 25. A. Henry County road gang working on the Blue Grass Road near New London ca. 1914 (Road-Maker 1914e:6). B. Fredonia to Columbus Junction Road convict paving gangs in 1914 (Iowa DOT Library–Paving Folder, Photo #2254).

Reversible Grader. The “reversible grader” was used for every day jobs of cutting, cleaning, and grading roadways and ditches (Figure 26). The slightly later “elevating grader” could be used for general grading and scraping but it came into its own in low areas where elevated road beds were necessary. It was noted that “care should be taken to construct the side ditches to a continuous grade, and not to deepen them below an outlet” (ISHC 1905a:6–66).

Traction Engines. Large steam-powered agricultural machines called traction engines had been around since the 1890s. These machines were widely used in agriculture for plowing, threshing, and heavy transport. They were huge and heavy requiring tons of water and coal for operation and were prone to explosions and accidents. Before the introduction of the Caterpillar tractor to Iowa in the 1920s they were the primary implement for heavy tasks and were used into the 1930s. They were widely used in road construction although many counties had to contract for them due to their cost. After World War I they were slowly replaced by heavy trucks and gasoline tractors. They were the principal cause of bridge collapses in Iowa and in 1905 the design standards of concrete and wooden culverts and bridges were specifically set to hold the weight of these ungainly behemoths. These machines also functioned well as the first steam rollers, as their great weight and wide wheels were ideal for compacting materials.

Steam powered traction engines and cranes were most commonly used from 1900 to 1918. They were used to power or pull other quarrying, road construction, and maintenance machinery that had previously been powered by horses. The basic equipment that nearly all township and county road builders had on hand is depicted in Figures 25–29. These remained nearly unchanged until after World War I. They left a relatively small imprint on the landscape and the sizes of the quarries need to supply raw materials were also proportionately small. The roads built between 1900 and 1918 are all products of the small scale tools and machinery used to build them. Their cost and use in road construction was a major consideration for engineers. With the great boom in gasoline powered construction equipment and in motorized vehicles after the war the change in scale of the equipment prompted the resulting increase in the size and complexity of the roads being built during the next period.

LATER ROAD BUILDING MACHINERY

Introduction. The change in road construction machinery was due both to technological feedback and an expanding road system's need for larger, more efficient, and cost effective construction equipment. Larger projects needed larger equipment (Figure 26:top row). The simple graders and plows from the earlier era (bottom row) were not sufficient. Horses could not pull the three-gang road plow. The steam traction engine was used into the early 1930s for Iowa's road construction but was seeing quick replacement by gasoline tractors and eventually caterpillar tractors. After World War II no steam traction engines were used in Iowa Primary Roads construction. For several decades the use of horse-drawn equipment and "modern" power equipment overlapped combining old and new technologies. Concrete mixers were one of the first new technologies.

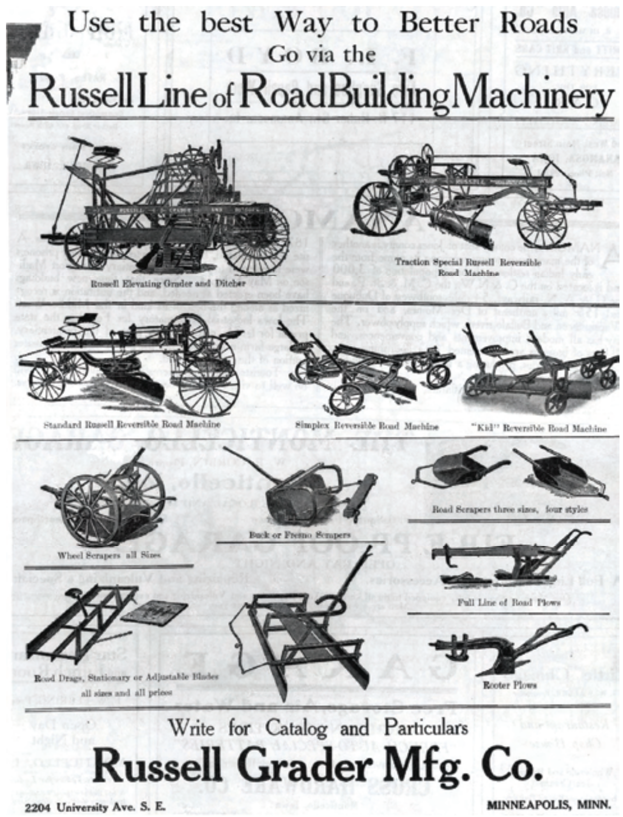


Figure 26. Russell Equipment advertisement for 1912 (Huebinger 1912a:70).

Concrete Mixers. The scale of the concrete aggregate mixer used on the 1908 Eddyville road project appears small when compared to the same machine use in constructing the 1914 Fredonia to Columbus Junction Road built by convict labor (Figure 27). The 1912 advertisement for the contractor who built the 1908 Eddyville concrete roadway relates in the ad's sidebar about his machine:

> That's the Coltrin at Eddyville, Iowa. The Pioneer Mixer in Making Concrete Roads. The only Continuous mixer with the batch feature mixing action consists of the same cutting through at the bottom, lifting and pouring from the sides that prevails in the latest and best developed batch mixers, and the machine combines with this the accuracy of automatic proportioning feed and uniformity in mixing due

to mechanical discharge. E. L. Martin, factory Sales Agent, Woodburn, Iowa. The Knickerbocker Co. Jackson, Michigan [Road-Maker 1912g:12].

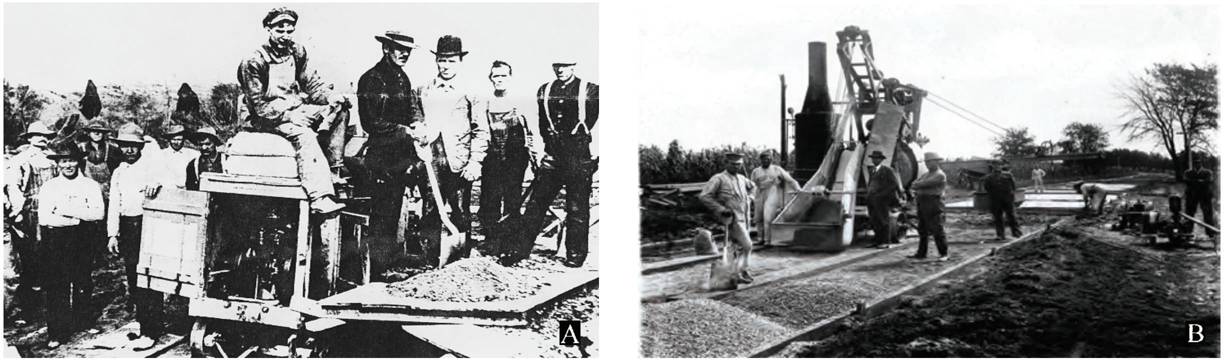


Figure 27. A. The Eddyville mixer on the job in 1908 (SHSI files). B. Mixer with lift bucket on Fredonia to Columbus Junction Road ca. 1914 (ISHC 1916a). Note mixer's sizes and use of water pump in B.

As concrete road construction moved from one mile lengths of localized concrete paving to multi-county lengths federally-funded arterial roads the scale of the machinery increased. This occurred also in the width of pavement poured as the 12 ft wide early pavement was enlarged to 16 ft. The width was standardized by the ISHC to 18 ft by 1916 and was federally mandated by 1922. It was expanded to 22 ft during the late 1940s and 24 ft during the 1950s. Many 18 ft pavements were widened at this time to 22 ft or more if possible. This evolution in scale forced changes in the size of the excavation machinery in the quarries and on the road site. Rather than the agricultural type road working implements of the early 1900s, by 1915 elaborate mechanical devices such as the "giant" elevating grader had come into use. Early concrete roads were built by the batch method prior to the introduction of the slip-form paver in 1940 (Highway Transportation Research 1999:30–31). The Fredonia to Columbus Junction road's concrete mixer (Figure 27B) gives a good idea of the process at that time. This steam powered machine mixed the aggregate with the cement and dropped that mix into a hopper. The hopper ran out a rail extending 20 ft to 30 ft from the end of the machine to the pour area were it was dumped. The operator and crew would watch the load being batch mixed and when it was full and ready dump it all out and load a new batch. It was an art to keep a continuous flow going.

During the 1910s gasoline engines ran specialized equipment such as a vibrating shaker box designed to force air bubbles out of the concrete and to compact it by vibration. Additionally, some paving machines had top levelers and floaters that would almost completely finish the surface. Hand tooling for final finish was generally still required until the late 1930s.

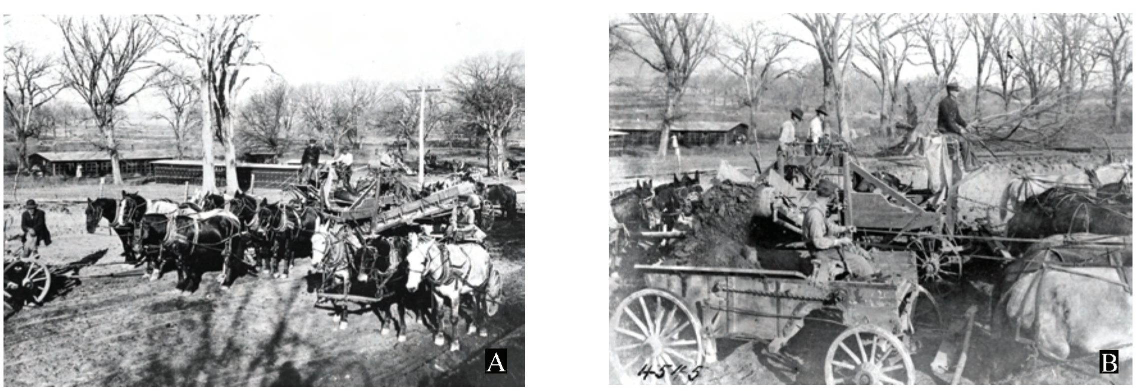


Figure 28. A and B. Washington County elevating grader and ditcher crews working on the Red Ball Route ca. 1916 to 1920 (Photo #4545, Iowa DOT Library–Paving Folder).

Elevating Grader and Ditcher. By the 1910s America's mechanical ingenuity was put to work designing new road machinery. The elevating grader and ditcher combined two previous tools into a machine that cut the ditch, graded the road, and filled wagons with the excess all in one continuous operation (Figure 28). It took a lot of horses, a traction engine (which did not work well when not level), or a gasoline tractor to make it operate. This was not a simple machine and its numerous parts required a skilled operator and significant maintenance. In Figure 28 this machine is shown ca. 1916 to 1920 in operation on a Washington County road being pulled by eight horses.

Pumps and Water Wagons. Road construction required water (Figure 29: see also Figure 27B, far right). For dirt roads the draggers had to wait for rains to soak the roads so it could be worked, packed, and allowed to dry to set up. For gravel roads water was needed to help compact each successive layer and for setting the final coat of chips or dust. For concrete construction water was used to wash the materials, to slake the concrete cement, and to dampen the surface of the freshly poured road. Water often was used simply to settle dusty roads and slake workmen's thirst. Gasoline pumps were the solution.

Water wagons were commonly used to bring quantities of water to the construction site. They obviously had to be constantly refilled, were a specialized type of vehicle, and needed a team and driver to operate them. By the 1910s gasoline powered pumps were beginning to be used. Concrete paving needed large quantities of water and the gasoline pump was the answer. During the construction of the Fredonia to Columbus Junction road in 1914 small gasoline engines powered water pumps that were connected to sand-point wells, which worked well in the shallow aquifer surrounding the construction site. By the 1920s large trucks with pumps and tanks mounted on them were becoming available.

Figure 29. Convicts and water pump on the Fredonia to Columbus Junction section of the Blue Grass Road ca. 1914 (ISHC 1914c).

Stone Crushers. From 1900 until 1906 only a very few rock crushers were in operation in the state. Early roads did not use crushed rock. Most were operated by the companies noted below and produced railroad ballast—thus their strong connection with railroad lines both for use and for distribution. Crushers were generally found in quarries in or near the larger urban areas and were run by private operators. In 1906 there were a very limited number of stone crushers owned by counties. In the 1910s and 1920s numerous articles lamented the lack of affordability of such machines by the counties. Most crushed stone had to be ordered from one of the listed companies and transported to the work site. Although most supplied materials in a relatively small region, some shipped very far. The 1905 Manual for Iowa Highway Officers relates that while counties should be able to operate their own crushers they had previously been too costly (ISHC 1905a:63–66). The 1905 crusher used in the road school appears tiny and primitive (ISHC 1905b:43). As crusher size grew so did the size of rocks crushed and the rate of production. A complete portable crushing plant consisted of a stone crusher, engine boiler, portable bins, revolving screen and elevator to lift the stone, after it has been through the screen to be separated. Such an outfit would turn out from 80 to 100 tons (60 to 80 cubic yards) of broken stone daily (Figure 30).

A list of companies operating stone crushers is noted in 1905 (ISHC 1905a:86–87). All are on or associated with rail lines for shipping purposes. They included:

Arquitt, N. N. & Sons, Farley, Iowa, Chicago and Great Western Railway
Bealer, E. J. C., Cedar Valley, Iowa, Chicago and Rock Island & Pacific Railway
Cedar River Stone Co., Waverly, Iowa, Illinois Central, Great Western Railway
Chilton, Chas., Ottumwa, Iowa, Chicago, Rock Island & Pacific Railway
Dearborn, H. Bros., Stone City, Iowa, Chicago, Minneapolis & St. Paul Railway
Des Moines Building & Stone Co., Peru, Iowa, Chicago, Great Western Railway
Erickson, F. Co, Stone City, Iowa, Chicago, Minneapolis & St. Paul Railway
Ellsworth Stone Co., Iowa Falls, Iowa, Des Moines, Iowa Falls & Northern Railway
Kemper, E. G. Burlington, Iowa, Burlington Route
Linswoods Quarry Co., Linwood, Iowa, Chicago, Rock Island & Pacific and Chicago, Minneapolis & St. Paul Railways
LeGrand Quarry Co., Marshalltown, Iowa, Chicago & North Western Railway
Laines, Andrew, Dudley, Iowa, Chicago, Burlington & Quincy Railway
McManus & Tucker, Keokuk, Iowa, Chicago, Burlington & Quincy, and Chicago, Rock Island & Pacific Railways
Shields, T. H. & Sons, Dudley, Iowa, Chicago, Burlington & Quincy Railway

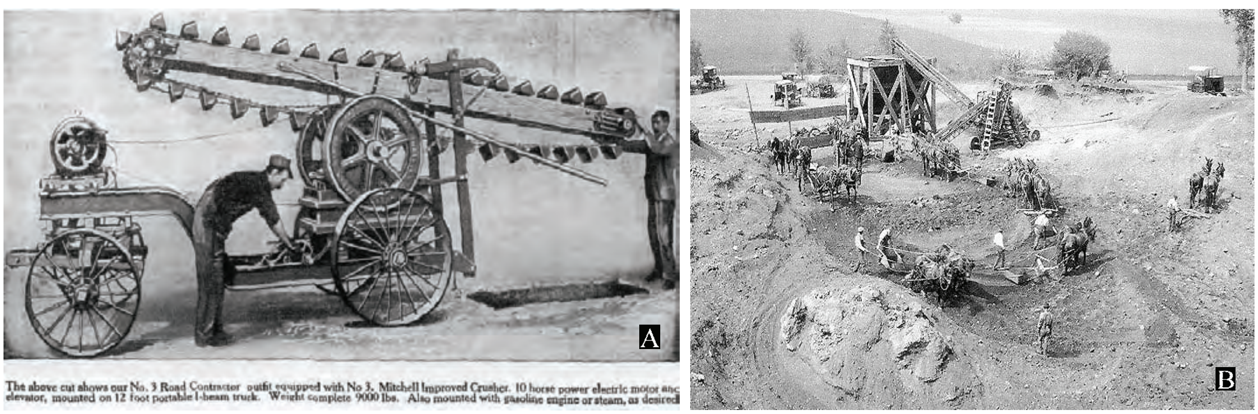


Figure 30. A. An innovative electric rock crusher (Huebinger 1912a:74). B. Henry County quarry possibly for the Great White Way and Iowa 2 ca. 1920 (Iowa DOT Library).

For early gravel and concrete surfaced roads and structures it is possible that one of these companies provided the crushed stone for the project. It is possible that some of the crushed rock for the Blue Grass Road came from the Chilton Company in Ottumwa. It is known that the gravel for the Fredonia to Columbus Junction road came from the Mississippi River valley. The section through Burlington may have used the Kemper Company in that city. The River Products quarry, on the Iowa River in Coralville, was started to provide crushed rock for the early River to River Road. It later provided quarry materials (both river gravels and dolomite) for old U.S. 6, including its concrete paving, and for Interstate 80 in the 1960s. During the earliest period all major quarries were connected to the railroad lines both because they provided ballast for the same but also as a shipping point, especially to roads located next to rail lines.

Early masonry structures used mortared limestone. The railroad had used quarried limestone exclusively for its structures. By 1905 the first concrete structures were being introduced both on roadways and in railroad construction and this required sized stone for the aggregate. Large, quarried, single blocks were replaced by poured-in-place concrete structures made of sorted or crushed stone or gravel materials generally acquired from local sources. As many of the earliest arterial roads paralleled railroad lines, materials could often be shipped to the site by rail. Some innovative contractors even built their own small-gauge rail lines to move materials. Large road beds and berms may still have these wooden trestles inside of them (see also Figure 38).

By the 1920s individual counties were buying their own crushers. Crushers were used onsite on many road projects and river rock was crushed as well as quarried dolomite (Buyer and Williams 1922). The aggregate used in the concrete is very indicative of local materials sources until the mid-1930s, when state operated quarries took over for Primary Roads projects. On December 22, 1933, the Fairfield Ledger noted "The new Jefferson County rock crusher will arrive in Fairfield on Monday, ready to be set up in whatever quarry the Board of Supervisors shall designate" (Baird 1989:50). Its arrival at that time shows the relatively late acquisition of stone crushers by some counties. This purchase was probably partly pushed along due to the 1928 completion of Iowa 8/U.S. 34, formerly the Blue Grass Road, through the county. County road builders and maintenance crews would have seen such machines in operation on that large-scale project and appreciated what such a machine could provide for them.

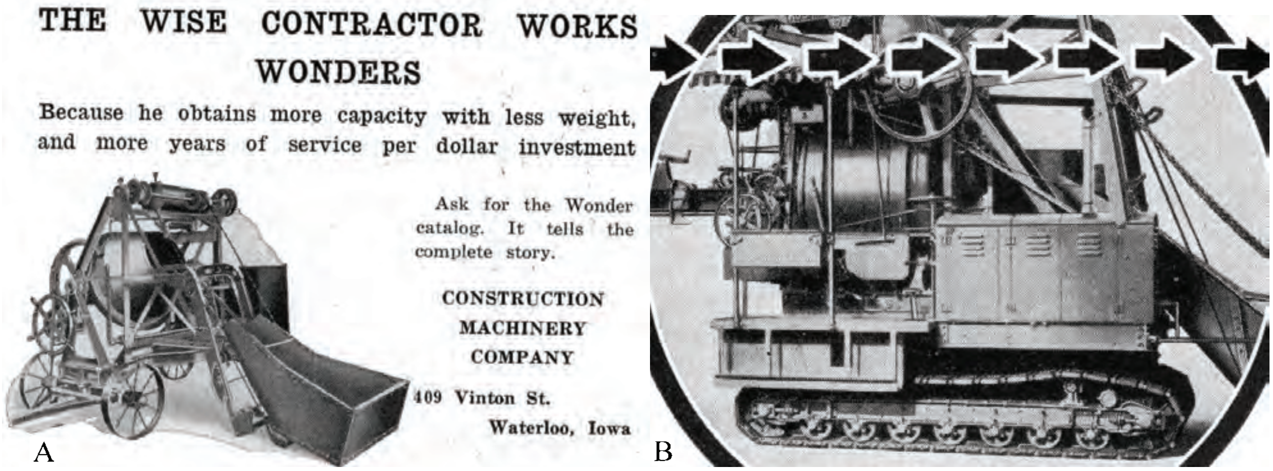


Figure 31. A. The 1922 Koehring cement mixer (Transit 1922:3). B. The 1926 Koehring 27E traveling cement mixer (Transit 1926:124). Note introduction of caterpillar track system.

HIGHWAY CONSTRUCTION MATERIALS

Introduction. The acquisition, processing, and distribution of road building materials was a crucial part of highway construction as was mixing (Figure 31). All the construction materials had to be purchased, shipped, and organized before anything was built. The principal materials used in early highway construction included dirt, clay, gravel (bank, river, or crushed), stone (crushed or rip-rap) and stone dust (crusher dust), wood and nails, water, drainage tile, and mortar. Materials need to be sorted and sized requiring sifters and screen graders. When concrete was used as a paving material all of the above materials were needed along with additional materials such as rebar, wire, expansion joints, sealants, Portland cement, aggregate, assorted hardware, and other materials and tools. Little has changed in more modern times except that crushed dolomite replaced the types of gravels so important in the early years.

Soils, Stone, and Gravels. These necessary construction materials either had to be quarried nearby or otherwise acquired. This led to some areas in Iowa lagging behind in local road construction by having to import raw materials. Until the 1920s road materials were generally quarried and acquired locally. Around 1900 the railroad's load rates were made inexpensive for crushed stone so that areas without gravel could afford to bring in crushed stone (ISHC 1905a:87). The most convenient quarries were located directly along side the construction project. From 1900 to 1920 materials for small local projects, such as concrete bridges and culverts, could be hauled only a short distance. With many highway routes paralleling railroad tracks materials could be brought in by train. The larger the roadway the more materials it required and the further from the original quarries new materials came. This led over time to a distinction between local, regional, and state quarries. Often the type of material used in the concrete aggregate can tell a great deal about quarried local materials along with distribution, acquisition, sourcing, and use over time. When the aggregate along the route changes it suggests a different quarry was used. Aggregate changes occur at county or other political boundaries and where contractors were changed.

Local and State Quarries. One of the primary differences in quarried materials was whether it was from local or state quarries. Local quarries were the earliest type. These were located either right along the highway route or within a few miles and usually operated by local landowners or small companies. State quarries were opened and operated starting in the 1920s. However, prisoners in Anamosa were making road gravel by hand as early as 1884. In that year "An Act providing for breaking and loading stone by convict labor at Anamosa penitentiary and the State quarry, to be used in improving highways and streets by macadamizing" was passed. Upon proper application "any county, township, road district or town or any city might secure a quantity of this stone not to exceed ten carloads in any one month for use on streets and highways, the only cost being the cost of transportation" (Brindley 1912:204).

Period road literature frequently bemoaned an area's lack of natural resources. Many areas of the state, especially the southwestern region, had few local construction materials resources to tap. The importation of materials could greatly increase the cost of a project. Eastern Iowa has a wealth of good local building materials and sand, gravel, and stone are in abundance. However, not all stone or gravel is suitable for road construction or aggregate ingredients. Much of Iowa's limestone is too soft. Many gravel sources have too little hard materials or too high a concentration of limonite or other iron-bearing material, which is decidedly unsuitable. As well, certain Iowa clays and soils are more suitable for road construction than others. Early technologies were not suitable for the large scale sorting of gravels, crushing of stone, or excavation of these deposits. As the technology grew, partly in the understanding of what materials were suitable, but mostly in the introduction of increasingly large excavators, graders, and trucks, so did the quality and quantity of available road materials (Figure 32) (Wood 1935). The differences in the quality, sorting, and application can sometimes be seen in a road's pavement or cross-section.

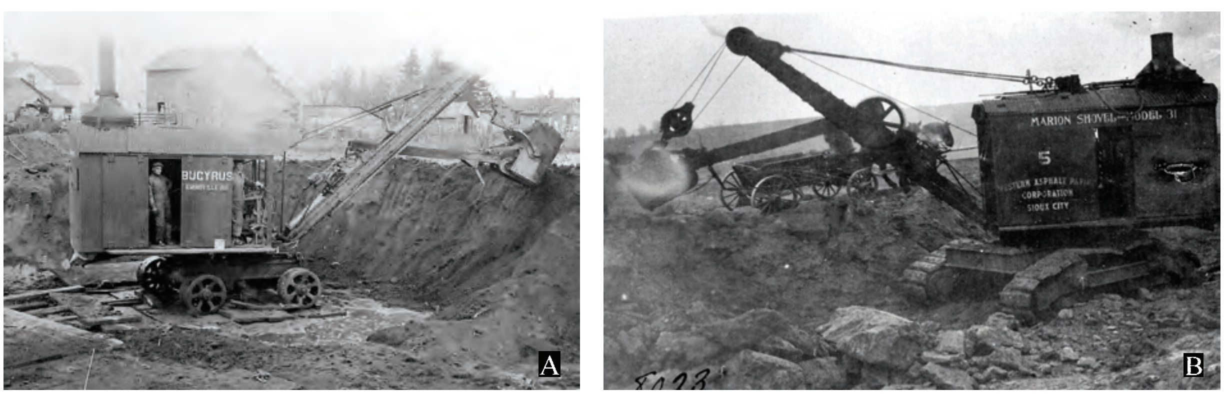


Figure 32. A. Materials acquisition operations (ca. 1915) at an unidentified Iowa quarry (Iowa DOT Library). B. Operations at a Sioux City quarry (ca. 1915) operated by the Western Asphalt Paving Corporation (Photo #8023, Iowa DOT Library–Photos).

The acquisition of road building materials was crucial to the construction from both the point of cost and from that of durability. While materials acquisition was left to the contractors during the early period (1900–1910) by the late 1910s and 1920s counties acquired their own quarries. In 1921 the purchase of land by counties for gravel pits was legally limited to five acres (ISHC 1921a:8). State owned quarries expanded, especially in the late 1920s and 1930s, after the introduction of state and then federal transportation funds. By then the size of major road building projects had forced the state to purchase land for quarries and operate the quarries themselves. The materials from the state owned and operated quarries are almost always of either crushed dolomite or quartzite. These two rock types can be easily differentiated by just their texture and color.

A 1916 article in the Lockridge Times related that the state was contemplating the opening of its own quarries and using convicts to surface roads (Lockridge Times 1917a:4). Another article in Road-Maker related that a quarry was to be worked by convicts:

> The purchase of a large quarry of Sioux Falls granite by the state marks one of the most distinct forward steps that have been taken in the Iowa good roads movement. This quarry, operated by prison labor, should afford a cheap and excellent road building materials [Road-Maker 1916a:28].

Highways that were poured with the continuous slip-form paver in the eastern part of the state primarily used crushed dolomite and date after the late 1940s. State quarry dolomite in concrete aggregates can be found statewide. Sioux City quartzite (the granite referred to above) is the material found in the western part of the state but its use has increasingly spread eastward over the years. Private companies also supplied these materials.

Wooden Planks and Pilings. Road construction required a lot of lumber. It was indispensable from the earliest times but changed in its applications as it went from a building to a forming material. Lumber's advantage was that of being light, strong, and accessible. Numerous historical images are available of planks covering deep mud holes. Through the 1910s one of the major uses of planks and pilings was for the construction of bridges. Most of Iowa's 19th century wagon bridges were of wooden construction, and unsafe (Figure 33). Most steel bridges had plank road beds. Wood piling highway bridges are still common but were not encountered along the survey routes. Wood and iron railroad bridges are still used.

Figure 33. Woodward plank and pole bridge declared "Death Trap" (Road-Maker 1916m:7).

However, by the early 20th century good cheap lumber was no longer as accessible. This helped lead to the innovation of concrete construction where the lumber used in the forms could be reused over and over. All of the simple early concrete structures built on Iowa's roads exhibit the imprints of the planks used in the forms. Builders such as Marsh and Stark often covered these marks on the upper parts of their bridges and culverts by surface coating the concrete. This is a finishing method where a top layer of marble dust, fine sand, or finely sorted gravel sometimes called "sugaring," was applied. This kept the forms from sticking. Often the white or tan color and fine surface texture of early concrete structures was due to the marble dust, or colored and size sorted sand or gravel particles, used to cover them. Other colored concrete surfaces resulted from "floating" the surface and coating it with crusher dust. Such finishes are usually seen only on the more finely crafted structures and were generally beyond the experience or pocket books of most local contractors or county crews, although some survive.

Expansion Joints. Early poured concrete roads in Iowa do not have expansion joints. The ISHC's 1905 *First Annual Report* and *Manual for Highway Officers*, has no reference to expansion joints (ISHC 1905a, 1905c). The first apparent mention of them in ISHC literature found during research was in 1925, although they were definitely used prior to 1916 (Figure 34) (ISHC 1925b:38–39). In 1925 the ISHC had reprinted its *Standard Specifications for Bridge and Culvert Materials* and it noted “filled joints, open joints, sliding or friction joints, and water tight joints” (ISHC 1925b:38–39). At first the expansion and contraction of concrete was not well understood and little compensation made for the effect. Pavements such as the 1905 Eddyville Cemetery Road were poured in long lengths with no or minimal expansion joints. Like sidewalks, a deep line was scored into the surface to control cracking. Section lengths were determined by a day’s pour and were not always of a standard length. Variable section lengths may be an identifying characteristic of early, local, private, or idiosyncratic highway pavement construction. The following day’s pour was abutted to the previous day’s pour with no expansion joint. It was not deemed necessary to use expansion joints except in specific circumstances. They were costly, often unavailable, and needing individual fitting. By the 1910s, due to both state plan review and federal-aid project requirements, expansion joints were being used. While other types were developed, the iron Baker-type joint was used until the 1930s. The U-shaped iron with tabs held the bitumen-based material in its groove.

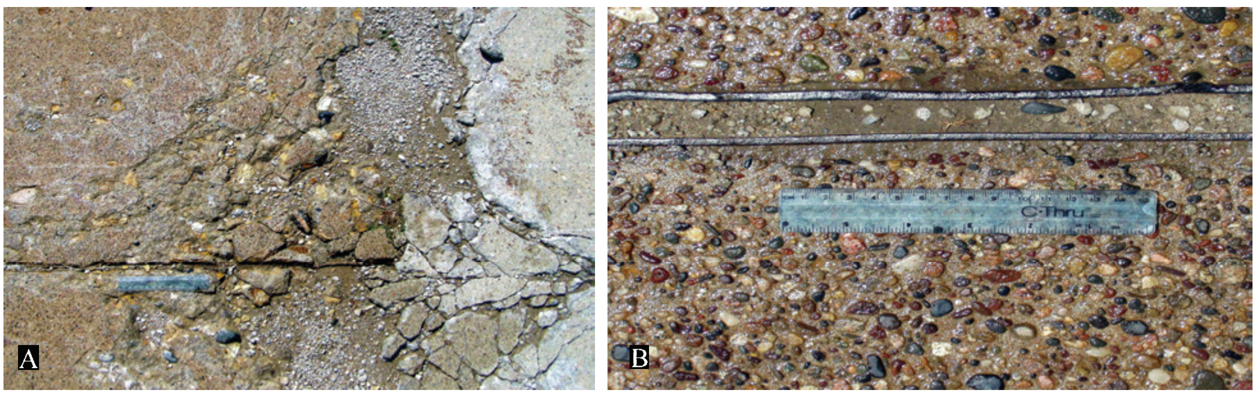


Figure 34. A. Hand cut, 1914, Baker-type steel expansion joint on Fredonia to Columbus Junction Road segment of the North Diagonal section of the Blue Grass Road. B. Detail of same. Note absence of tar paper filler in channel. 2003 survey photos with 6" ruler.

The Fredonia to Columbus Junction road exhibits one of the first applications in the introduction of iron expansion joints known to the author. Begun in 1914, it used lengths of U-shaped iron or steel with bendable tabs sticking out of it horizontally. It was used between both the lanes and the section ends. These metal joints were innovative at the time and are still in place today, but had drawbacks. One was that as iron units they had to be individually cut and installed by hand and this was no easy task. Another problem was that work was often delayed because the expansion joints were not available. Several joints on the Fredonia to Columbus Junction convict-built road exhibit hand cutting, fitting, and the absence of pieces in some sections. A third disadvantage was that their U-shape allowed them to quickly fill with wet dirt and detritus limiting their effectiveness and life span. Iron or steel expansion joints came in several variations, and a cut-off segment of Iowa 2 through Cantril also displays iron expansion joints placed ca. 1927 when the road was poured (Thompson 1989:155). A final problem was the use of relatively poor quality iron, which rusted and allowed water to get between and under the pavement. Often the iron expanded as it oxidized further spreading the joints and splitting the concrete. Apparently no sealant was used with the iron to waterproof the pavement gaps or to prevent seepage. Projecting pieces of poorly set, displaced, or broken iron expansion joints could puncture tires and be a potential hazard.

It may be assumed that the use of expansion joints did not occur widely until long sections of concrete roadway were being constructed. From 1900 to around 1910 the miles of concrete road construction were so few that expansion joints were not considered important or even necessary. Highway paving at this early time with lengths of half a mile were very rare. Like sidewalks some early road sections were deeply scored at a given length. These older pavements may have their whole surfaces scored to keep horses from slipping and should not be confused with the deeper anti-cracking grooves.

In the 1920s when federal gasoline tax dollars were pouring into Iowa's road coffers and being distributed to various counties concrete roadways became more economical and thus of greater and greater length. When the federal and state agencies began planning the construction of the state's arterial highways, based on the earlier post-road system, plans for long stretches of poured concrete highway show the common use of expansion joints. By the early 1930s expansion joints were being filled with a simple strip of a tarry or bitumen substance which provided elasticity, was waterproof, and allowed for ease of replacement. Ads for such materials are numerous in publications during that time. Rubber was also tried in expansion joints but was not practical in Iowa on a large scale until after the study period.

Rebar. The use of iron reinforcing bars, or rebar, in concrete was an early innovation. Testing had shown that inserting rebar into the concrete greatly increased the strength and flexibility of the concrete, and basic strength standards were set. The 1905 Manual for Iowa Highway Officers suggests several types of rebar, and lists three products specifically. These are the "Ransome," which is a "square twisted steel bar with a high elastic limit" along with sizes from ½" to 1½", and the "Johnson" and "Thatcher," which were both corrugated bars. The Johnson is noted as having "a high elastic limit" and came in sizes from ¼" to 1¼". The Thatcher had a "low elastic limit" and ranged from ¼" to 2" (ISHC 1905a:88). The large twisted steel bars seen in many pre-1920 structures are known as twisted squares (Figure 35).

There were many patented forms of steel used in this kind of construction. The ISHC's service manuals and bulletins, along with ads in Road-Maker and other national magazines, show both the variations in types available regionally and the opening of a national market for such materials. A number of very common kinds of commercial steel which made good reinforcing material, such as barb wire, plain wire, and plain bars or rods were discussed. The manual related that this material could be purchased at almost any hardware store. Most of the wire was shown by tests to have a high elastic limit. Single wire, such as was used in making barb wire, had a small cross-section and had to be twisted into cables with a number of strands. Fence wire was often used in early highway concrete, especially culverts, with varying success. Several types of rebar and wire could be placed in the same structure.

Figure 35. A. Fort Dodge Culvert Company advertisement showing twisted rebar (Road-Maker 1912: back cover). B. Woodward County, ca. 1913 culvert with fence wire and early, square, corrugated rebar (6" ruler). C. Square and round rebar in Cherokee County ISHC plan culvert (2003 survey photos).

One ISHC report on Bridge and Culvert Work in Greene County for 1906 relates that they had built twenty bridges in the county that year and that:

> …In each and every one of these bridges were used junk rods, bars and buggy axles for the walls, and 60 lb railroad rails on the longer bridges, 20 such pieces of steel in each job. On the smaller bridges we used 30 lb. rails and in the 4-foot waterway culverts we used buggy axles [ISHC 1906:32].

Of these same structures 11 used bank gravel, seven used river gravel, one used fine gravel and broken or crushed stone, and one used river gravel and crushed stone (ISHC 1906:31–32).

Clearly, if the use of buggy axels as rebar occurred it marked the end of the horse-and-buggy era. With the drop in buggy sales and many axels in storage across the county, the advent of early automobile transportation allied with concrete construction reused the now undervalued axels for a totally new purpose as rebar. Other articles related that iron bed frames also made good "rebar" and were commonly used in some areas prior to 1913 and are generally associated with county or township crew constructions.

Early bridges and culverts can be distinguished by their rebar when it is exposed (Figure 35). During the 1910s and 1920s time period most rebar was supplied locally. Iowa cities with steel production capabilities such as Des Moines, Ottumwa, Mason City, Sioux City, Clinton, Dubuque, Burlington, and others produced rebar for local needs. These materials can often be ascribed to a local plant or contractor until the early 1920s. After that time the increasing standardization of materials and rail transport made rebar appear increasingly similar, although few specific types can still be discerned.

In the construction of early concrete road pavements and structures the type of rebar used may change from bridge to bridge, culvert to culvert, or from one road pavement segment to another. Rebar types often changed at county boundaries as different contractors were used and projects often stopped at county lines. There was variation even within county boundaries until the mid-1920s as different rebar types and various small distributors were used. The extensive paving of large arterial highway projects in the late 1920s and 1930s precluded the use of smaller rebar suppliers and more stringent state and federal requirements often prompted the use of large manufacturers to supply the rebar for a whole project.

Asphalt. As asphalt was not an original paving surface on any of the study routes it was not researched in depth. However, some basic history of its use is important. During research it was found that the first documented asphalt surfaced roadway in Iowa dated to the summer of 1910 (Transit 1911:22–25). This was contrary to the 1928 date stated by the Iowa DOT (Thompson 1989:94), when an experimental asphalt-type road was built in Des Moines, Polk County (Lockridge Times 1929x). Patent claims had curtailed its use by the ISHC until 1957 (Thompson 1989:94, Iowa DOT 2004:2). The 1928 date apparently relates solely to the ISHC's use of asphalt and not to its use by private companies within cities. An article in the Transit related that in 1910 a combination of asphalt surface and concrete base was laid over five miles of Iowa City streets, which included downtown and four main streets. In 1911, W. F. Beard, the city engineer of Grinnell along with other city delegates, traveled to Iowa City to observe the pavement. They found it very satisfactory and determined to pave downtown Grinnell similarly. It was to be "Bithulithic Paving" composed of a 5" concrete base, Portland curb and gutter, with a 2" wearing surface of crushed granite cemented with bituminous cement, under "the Warren Brothers Patent" (Transit 1911:22–25, May). This paving was partly over the route of the Red Ball Route. Today the very early use of asphalt over a concrete base could be easily mistaken for later paving activities and misdated, thus underestimating its significance as an early and important experiment in independent urban paving.

At present it is not known where or if any examples of this very early, innovative, and possibly experimental combination asphalt and concrete paving method survives. It may possibly be distinguished by the granite aggregate. The Grinnell section is especially interesting due to its relationship to W. F. Beard. Beard was a civil engineer and master builder who graduated from the University of Iowa in 1900. He worked on several projects between 1913 and 1920 for the ISHC (see Signature Culverts and Bridges, and Recommendations and Conclusions). He was one of several previously unrecognized men important to Iowa's highway construction.

Beginning in 1923 *The Asphalt Reference for Highway Engineers* remained essentially the same until 1937, when innovations initiated a new volume (Asphalt Institute 1965:foreward). The use of asphalt required a markedly different set of construction machines and testing equipment (Asphalt Institute 1965:110–114) that slowed its adoption and it was not a factor during the study period on the study routes. Subsequent asphalt surfacing after 1957 has had a profound effect on the integrity of Iowa highways as the original pavements are covered by asphalt.

Concrete. Concrete aggregate is composed of stone, water, and a cementatious material, almost always Portland cement. Chemical reactions between cement components and water cause the mixture to harden as it dries, a process known as setting or curing. Well-cured concrete possesses great compressive strength but relatively little tensile strength. Reinforced concrete is concrete strengthened by the addition of other materials, usually metal bars embedded in the concrete before it sets. The combination of concrete and metal allowed the construction of sturdy slabs, beams, columns, and pavements in the early twentieth century. Much earlier experimentation, some with success, and the introduction of reinforced concrete in 1875 (Bowman 1899; Transit 1895:17) led to the expansion of early 20th century construction. Once begun the expansion of concrete paved roads increased almost exponentially across Iowa and the country. Some of the formative advances needed both technology and the lower costs provided by mass production to eventually be effective and accepted.

One early application of concrete helped begin the race towards paving America's roads. Orson S. Fowler's book of 1848, and revised in 1853 to be *The Octagon House: Home For All*, set forward the idea of an early method of concrete construction (Fowler 1964:16–19). His son, S. T. Fowler patented a reinforced concrete wall in 1860, but widespread acceptance of the material took some time. In 1877, Thaddeus Hyatt, an American engineer, published his ground-breaking book setting forth the principle that iron reinforcement would act in conjunction with concrete. By the 1900s competing techniques had emerged but by 1910 the term reinforced concrete was generally accepted (Jester 1995:96).

Reinforced concrete gained popularity as a material for buildings as well as other structures and was adapted for the construction of arch bridges, allowing for structures of much less mass than was traditionally employed. The system was patented by Joseph Melan in America in 1894. His system reduced the amount of steel needed in concrete bridges, and by 1897 the precursor of the concrete deck girder bridge had been achieved. Such bridges were more economical to construct than those involving elaborate arches. Elegant reinforced concrete bridges of the 1920s and 1930s were the culmination of these early design developments (Huebinger 1912a). Discussions of aggregates and reinforced concrete for beam bridges, culverts and conduits, and foundations were widely discussed (Spalding 1921:114–115, 153–158, 271–275, 321). Prestressed concrete was developed in the 1920s but didn't gain wide acceptance in the U.S. until the late 1940s and expanded rapidly in the 1950s (Spaulding 1921:116).

The aggregate contains high percentages of sand and gravel while the binder is the cement used. Modern concrete suitable for road construction is a relatively recent development. Portland cement was redeveloped in the construction field in the 1870s, but was not applied to road surfaces or roadway structures in Iowa until 1893 on the Lyon County bridge (ISHC 1915a:75; Fraser 1994:25; Iowa DOT 2005). The cement used in the Lyon County bridge was actually imported from Germany (ISHC 1915:55). Portland cement is a mortar that is very high is silica content and is considered "hydraulic cement" in that it will set up underwater. Nationally, Portland cement manufacturers quickly emerged and they quarried stone deposits that could be easily exploited. Between 1900 and 1910 almost all Portland cement used in Iowa was shipped in by rail and much of it was in barrels. Each barrel contained 3½ cu. ft and weighed 380 lbs, but was in a waterproof container. In contrast each bag contained 7/8th cu. ft and weighed 95 lbs. and was thus easier to carry. In contrast, natural cement weighed 80 lbs. less per barrel and 20 lbs. less per bag (United States Department of Agriculture [U.S.D.A.] 1905). By the 1910s shipment in bags began taking over. Difficulties arose from its initial higher manufacturing cost to troubles resulting from having the bags or containers rained upon in the rail cars and spoiled, however it became the packaging method of choice by the 1920s (Fowell 1927:41–43).

Due to the high cost and shipping expenses regional Portland cement manufacturing plants were started in Iowa. This occurred in areas with both a need for concrete and access to high silica content rocks. Due to construction of the Mason City to Clear Lake road, Mason City had one of the state's earliest Portland cement manufacturing plants around 1910. Others opened in eastern Iowa in Dubuque, Davenport, Burlington, Ottumwa, Iowa City, Cedar Rapids, and Des Moines. In western Iowa Sioux City, Council Bluffs, and possibly other manufacturing centers opened. These plants provided the cement for the early highways. By the 1920s commercial plants were providing regional availability for cement.

The concrete manufacturers organized their own journal and publications very early in the 20th century. The Concrete Manufacturers Association was organized in Chicago around 1905 during the early development phase of the industry. They promoted all aspects of concrete construction for houses and commercial buildings (Outwater 1921), farm buildings and barns (Universal Portland Cement 1912), and everything in between from fence posts to giant silos. They did help disseminate such information in Iowa and nationally and help to get rural Iowans to understand, appreciate, and then use their products. Publications dedicated to concrete roads and bridges such as the Concrete Highway Magazine were very widely read journals in that period (Concrete Highway Magazine 1924a–c). Highway construction during the early part of the study period *did not* incorporate early concrete block technology which began around 1900 (Simpson, Hunderman, Slaton 1995:80). Blocks were regarded as too soft for road construction but were considered suitable for road related buildings.

It should be noted that the development of concrete houses and buildings, and especially their construction methods, materials, and chosen locations often coincided with the construction of a major concrete surfaced roadway in the vicinity. The U.S.D.A. promoted concrete construction (U.S.D.A. 1905) for many farm structures. When concrete roadways were being constructed in an area the influx of people needing housing (community growth), the novelty of "fireproof" and "modern" houses, the abundance and cheapness of materials, and the presence of knowledgeable builders all led to experimentation with concrete in the building industry. Practical knowledge from road construction and road crews went into farmstead improvements ranging from fencing to foundations to entire buildings and structures.

Figure 36. A. Concrete farm along Iowa 1, Linn County (Sites #57-05641–#57-05645) (Carlson 2000). B. Dated Bremer County concrete barn foundation (1914) poured at time of highway being brought to grade (Site #13-BM-56H) (Ingalls 1996:379). C. Concrete headstone dated 1906 in Pilot Mound Cemetery, Boone County, along old Iowa 169 (P70) near its intersection with county road E18 (2005 photo).

Examples of farm buildings and even farmsteads influenced by road construction are numerous (Figures 36A, 36B) (Universal Portland Cement Company 1912; Wallace's Farmer 1914). An example is the West Farm south of Mount Vernon along Iowa 1 (Sec. 20, T82N-R5W). This farm (#57-05641) was rebuilt in the 1920s and 1930s using poured concrete technology. In his 2000 corridor study of Iowa 1 the author relates:

> The most distinctive feature of the West Farm is its extensive use of concrete technology. Ely West was a strong believer in the use of concrete as a permanent building material. While concrete was used on most farms during this period, it was usually limited to building foundations, feedlots, and sidewalks, with concrete silos becoming popular by the mid-twentieth century. In the rare cases where farm buildings

> were constructed of concrete, they were usually constructed of concrete blocks rather than "monolithic" reinforced concrete. In the late 1920s, the term "monolithic concrete" referred to poured, reinforced concrete, to distinguish it from concrete blocks or concrete staves…Ely West experimented with a wide range of uses for reinforced concrete on his farm. During the first decades of the twentieth century, cement associations were promoting concrete buildings, and agricultural colleges were testing them… [Carlson 2000:4].

Roadwork and road workers built additional structures along roadsides and even into cemeteries. It has been noted that when a concrete road was first poured through an area that concrete headstones, made out of the same aggregate as the road, can be found in nearby cemeteries (Figure 36C). While this report only considered the road elements within the right-of-way, road construction through an area could result in the construction of other types of concrete structures and objects that are a direct outgrowth out of the road construction.

ROAD SURFACE MATERIALS: DIRT, GRAVEL, BRICK, WOOD, ASPHALT, CONCRETE

Iowa's road surfaces have evolved over time. The original dirt surfaced roads were later graveled, bricked, oiled, concreted, and then asphalted. While all of these surface treatments are in use now each has its period of introduction. Wood surfacing was primarily a 19th and early 20th century experiment. Except for wood all the other surfacing materials have been used, adapted over time, and are still in use today. Wood is still a special use material. Each material's periods of introduction and use are noted below. Concrete and concrete paving are discussed in their own sections and are not included here.

Dirt. Dirt was Iowa's original road surface through the early mechanized transportation era (pre 1900–1918). Different soil types in Iowa produced different problems in construction and maintenance of dirt roads. Their usefulness under certain weather conditions made them an uncertain adventure in Iowa's transportation system. The use of the King Drag and early ditching scrapers and graders greatly improved Iowa's dirt roads. Dirt roads are still present in Iowa but in most instances have been reduced to cut-off segments, farm and field accesses, and river bottom accesses, and few run for any distance. Abandoned 19th century roadways are common as Type B roads. There were more roads in Iowa in 1875 than now.

Gravel. One of the earliest and primary "paving" materials in the state is gravel. Most Iowa roads were unpaved until the statewide paving activity began under the Federal Highway Act period of the mid-1910s. Under a concerted statewide effort by the late 1930s most of Iowa's roads had been "brought to grade" and many were gravel paved. Iowa's quantity and quality of gravels varies from region to region. The south central and southwestern parts of the state encountered difficulties in early road building efforts due to their lack of quality gravel deposits. Not all gravels are suitable for road construction. For a period account of gravel road paving see Gravel Roads below.

Wood. With antecedents in Colonial times wood was a fairly common paving material in the early days, but not in the 20th century. While the mid-19th century employed corduroy and plank roads these met with little success in Iowa and were abandoned. Treated wooden blocks as an early paving material were introduced across the country from the late 19th century until the early 20th century. Although they varied somewhat by size the usual wooden pavers were 8" x 6" and usually made from treated oak or hickory. Some were probably locally made but most were made by non-local commercial enterprises and shipped in by train. They were creosote and tar impregnated for weather resistance. Advertisements for various types of wooden pavers rarely appear in the trade publications. At a time when many materials were being experimented with, wooden pavers competed with other paving materials. While relatively inexpensive to acquire and lay wooden pavers had a short life span when compared to brick, concrete, and even asphalt. The ISHC was not known to have advocated wooden pavers. They were used almost exclusively in Iowa for urban applications. A number of cities and towns in Iowa paved small areas with chemically treated wooden pavers. The city of Fairfield had the city square surfaced with wooden pavers in 1918 (Baird 1989:32). While they were experimented with in larger towns it was found that their relative cheapness was eventually outweighed by their lack of durability. Wooden pavers had a relatively short life span in Iowa, less than 10 years. Those sections that were laid had to be removed when concrete was to be poured over them. Wooden planks were used extensively for bridge floors and early culverts.

Brick. Brick was a common urban paving material in the late 19th and early 20th century. A brick paved portion of the Blue Grass Road through West Burlington in 1918 was the first paved section of that road in the state. While brick was the paving surface of choice in urban areas of Iowa from around 1890 to 1930 it was eventually completely superceded by concrete. Brick roads were laid from urban centers to suburbs in Iowa during the early 20th century. Sioux City, Des Moines, and Davenport all had long brick roads that ended beyond the urban area but subsequent development quickly left such roads within the ever-expanding corporate limits. The brick paving of the road to Camp Dodge north of Des Moines received wide attention. In Iowa City the first brick streets were designed to lead out of town on one of the registered or marked routes but did not extend beyond the city limits. Urban brick streets have largely been over-paved by asphalt since the 1950s. Brick pavers are a distinctly shaped and sized brick and are very dense and hard to withstand traffic wear. Standard bricks could not be used for paving and many field tile companies in Iowa took to making road brick. At one time each large city in the state of Iowa had its own brick manufacturing plant. By the 1920s most of these had been closed by the importation of brick on trains from regional production centers such as Chicago or Galesburg, Illinois, where Purington Pavers had been produced since 1895. Many brick streets were laid when sewers were installed beneath.

Concrete. See Concrete pp. 73–75, Concrete Culverts and Bridges pp. 84–89, Concrete Pavement 97–100, and Concrete Roads 102–109.

Asphalt. Although experimental use of this product was applied in Iowa as early as 1907 in Des Moines as “Petrolithic” and in Grinnell by W. F. Beard as “Biulithic” in 1911 (Transit 1912:22–23) it was not until 1928 that this bitumen based product was first used by the ISHC on Iowa’s roads. It was not used again until the settlement of a court case in 1957. After that time it has found increasing prominence as a cheap resurfacing material over both concrete and brick. Numerous sections of the study routes have been patched, surfaced, resurface, or replaced with asphalt. In these cases it has served both as a general surface extending for miles, and also in localized areas as a treatment for structurally poor pavement.

Black Top and Oil. The use of oil as a surfacing material on roads was widespread in Iowa in the early 20th century and is still used today. Oiled dirt roads started in Ames in 1914. Black topping is not asphalting. Black top is a combination of viscous oil applied with pea gravel or rock chips and dust on gravel based roads during the hot parts of the year. This process has produced miles of “black top” surfaced roads in Iowa, but these roads are not found on the study routes as all original oiled or black topped sections have been resurfaced on these arterials. A number of old highway routes through rural areas connecting county seats or large towns and trunk roads to villages and hamlets have received this surface treatment. Most black top roads are maintained at the county level and have problems with weight limitations and endurance requiring seasonal maintenance.

In the first decade of the study period some communities and counties oiled their roads. Oil was applied to road surfaces after they had been dragged and compacted. The oil would penetrate over an inch binding the surface into a waterproof layer. It was necessary to reapply oil nearly every year but the road surface produced was superior to dirt roads that were left untreated.

Stone. Almost all of the stone used in early Iowa road or arterial highway construction was of the river or bank gravel, or crushed rock type, creating thousands of miles of graveled roads in the state. Cut stone was used for road bridges and culverts in the 19th century. Examples such as the Three-Bridges in Monticello (NRHP) (Iowa DOT 2005) and the stone culverts and bridges, such as the Elkader Bridge, in Clayton County (NRHP) (Iowa DOT 2005) are examples of locally significant efforts by local contractors, often master craftsmen, using local materials in a traditional manner, and are still used as modern roadways. Although Iowa’s early river cities probably had stone causeways, ramps, wharfs, and other structures no extant stone block or stone paved rural road segments are known to the author at this time. While stone curbing is common enough on Iowa's urban streets, again none was observed during the statewide survey on rural pavements. In general, as a paving medium for roads, cut stone must be considered very rare while crushed stone and gravel very common. No stone paving segments survive in either of the study routes, although stone structures do. On Iowa's early arterial highways cut stone appears to have been reserved for the earliest masonry structures, and not paving.

Besides paving, curbing, or masonry bridges and culverts, stone constructions such as walls, drainage linings, and rip-rapping were constructed along Iowa's roads until the 1930s. Some of this is related to railroad construction. In Iowa's parks, state facilities, and in various other locations many WPA or CCC related structures were built along and under roadways. In Muscatine County a recent study was conducted concerning a stone retaining wall along U.S. 61 in Davenport, built from 1934–1936 in connection with the road's construction (Carlson 2005). State roads utilized limited PWA, WPA, and CCC labor and funding during the Depression.

Cinders. The burning of coal during the 19th century produced huge amounts of waste products in the form of cinders and clinkers. Cinders and clinkers have often been used as a paving material due to their abundance, drainage qualities, and relatively good durability. Cinders were applied to urban streets and especially to alleys and driveways from the mid-19th century onward in Iowa. They also were applied to farm lanes and rural roads. Because of their good drainage and packing features cinders were primarily used as a road shoulder paving material until the late 1930s in some areas. Cinders were also added to or used as a bed for or component of Iowa's gravel roads and additionally were mixed with sands and gravels to produce concrete aggregate. Cinders have also long been used on steep grades to improve traction during the winter months.

Grade and Surface. While horse and wagon teams were used in road construction until the late 1920s, by 1930 power machinery such as tractors, graders, and trucks were increasingly used to move road material from the high areas to fill the low ones. Several well known areas in Iowa had hills or valleys that often dissuaded travelers from taking that route and parts of Iowa often had severe construction issues in the early days. The early ISHC bulletins proudly show the grading of several notorious Iowa hills to an easier grade. The costs of cutting the hill and fixing a troublesome roadway was generally compared against the money and time lost by inefficient travel. That it cost twice as much in time and effort to use the old road when compared to the new helped sell the idea of road improvement on the local level (Figures 37–38).

Experiments had shown that a five percent grade on a hill was the most efficient. Interestingly, this number was reached by having a horse pull a known weight up a grade. Tests showed that a horse could pull a load up a five percent slope with little loss of motive power or speed. On a seven percent grade a great deal of motive power was lost but the load could still be moved. On a 10 percent grade the horse would often come to a stand still (ISHC 1905a:100–102). These kinds of experiments the Iowa farmer could understand and helped sell the idea.

In 19th century Iowa several spots were referred to as "Horse Kill Hill". These steep grades often proved too much for entire teams. Horses would fall dead from the exertion. Many farmers or teamsters at such localities made a living or just extra money keeping teams at the top or bottom of such a hill and for a fee would hitch together teams and help pull the load up or ease it down the hill. Certainly this practice continued on Iowa's early automobile arterials at low spots and hills where people frequently found themselves mired down and farmers made some quick extra cash.

The trouble had long been recognized that it was difficult to establish a gentle or consistent grade and that maintenance of a road's surface was a full time job. Early experiments with road surfaces coincided with those of lessening or establishing a grade. Highway Commission experiments with 1½ ft and 3 ft cart wheels showed that such a wheel traveling over a well drained and properly packed and surfaced road used less than a third the energy to traverse the same road under poor conditions. Two processes were established to be at work. The first was that when a wheel is sinking into the surface it is essentially always traveling up hill as the material compressed under the wheel makes a slope that the wheel must constantly climb. The second action was that obstructions in the road's surface "checked" the momentum of the wheel. The wheel's momentum was what kept it turning with the least effort and any counter force decreased the momentum, forcing it to be reestablished before the wheel continued. Thus it was that early experiments showed that the grade and surface were responsible for the ease and efficiency of travel.

During the early 1910s ISHC was dedicated to bringing the Primary Roads and arterials "to grade." This meant that over much of a road's route a five percent grade was established. In certain areas this grade had to be exceeded. In 1913 the Lockridge Times was joyously reporting that the state was going to bring the Blue Grass Road between Mount Pleasant and Fairfield (and Ottumwa) to grade at no local cost. This was one of the first uses of federal transportation dollars in the area and along a study route. In 1916 considerable discussion was made over Federal Road Aid and its primary use in bringing the main routes to grade and this held great interest at the local level (Lockridge Times 1916o:6). In the early 1920s bringing routes to grade was a state priority (ISHC 1921d:36).

Figure 37. A to D. Washington County road crews at work along or near the Red Ball Route using horse-drawn elevating graders and other equipment (Photos B #5075 and D #4325, Iowa DOT Library).

Dirt Roads. Prior to the start of the study period earth roads were the only rural road surfaces in Iowa. The problems were myriad and anecdotal accounts rife in the period journals and papers. Anecdotal accounts from the time are numerous and most attest to the seasonally poor conditions of Iowa's roads. It was no accident that stage fares were "twenty-five cents a mile and a fence post" (Pratt 1967:597–603; Colton 1939:3, 1940:183). Another traveler on a trip from Jo Davies County, Illinois, to Iowa in 1845 related:

> …The roads are bad. We traveled at the rate of 3½ miles an hour, often getting out to walk over bad mud holes…The roads of course are made anywhere. When one is worn out, they make a new track…[Iowa Journal of History and Politics 1920:46–48].

The number of such dirt roads in Iowa reached its peak in the late 1870s at the same time as Iowa's rural population. Generally, these roads had no surface, were not built to grade, were not well maintained, and followed the natural topography. Since that time the number of such roads has decreased until the present day. Iowa's big push in this arena began in 1915 as intense graveling began (Geyer 1915:3–4).

The archaeological investigation of the Muscatine County cut-off road segment (Artz 1995a), which formed the impetus for this investigation, was a dragged road that had been brought to grade and then abandoned. The importance of dragging on Iowa's roads is critical to the interpretation of roads prior to the 1930s. These dragged roads often had advanced grading, drainage systems, and concrete culverts along with the simple dirt or gravel surface. The survival of arterial road segments which date to this early period, retain integrity, and are of any significant length are uncommon.

Wooden trestle made of chopped timber

Figure 38. View of improvement of U.S. 62 west of Bellevue showing timbering of a small-gauge railroad viaduct for construction and later incorporation into road berm (Transit 1926:197–198).

The King Road Drag. Earth roads simply will not maintain themselves in good condition and so the split log drag was introduced and used in every Iowa county by 1906 to remedy this endemic road problem (U.S.D.A. 1908). E. Ward King of Missouri developed the King Road Drag. King's success in smoothing his road attracted the attention and interest of Iowa road officials (Figure 39). During 1905, a special Chicago and Northwestern train visited fifteen northern counties stopping at various places to demonstrate the drag, and people around the state became familiar with this method of maintenance by additional lectures at the Road School in Ames. A positive point about the drag was its very low cost to build making it affordable for even the poorest counties in the state (Thompson 1989:94–95). Road drags were often built, owned, and operated by local farmers who received a payment for dragging the roads four times a year. Information on its use specifically directed towards farmers was also produced by the USDA (1908).

The "King Road Drag," or just "the road drag" as it was often called, may be the single most important implement in Iowa's early road building history. Promoted in the late 19th century to drag roads into shape it was still being used after the 1940s. The "traditional" road drag was constructed using two logs or planks held apart by iron bars. When the ISHC initiated its "road schools" in 1906 one of the first pieces of equipment the men were trained upon was the drag. The 1905 ISHC illustration (1905a:68) suggests using old wagon tires. The operator stood upon the drag, and extra weights could be added, and with the horse team pulling would drag or level out the ruts, spread new or loose materials, compact the surface, and cut a crown into the road simply by shifting the weight of the driver from side to side. Some wooden drags had metal edges attached to the bottom. All-steel drags came on the scene pretty quickly. Steam traction engines could pull three drags at a time. They evolved until their slow replacement by modern road graders in the 1930s.

The statewide dragging of Iowa's roads was probably the single most fundamental change in Iowa's transportation history. Ascending out of the late 19th century and the beginning Good Roads Era this simple device was responsible for the improvement of more miles of Iowa's road than any other single tool. With the road drag a dirt road could be crowned to drain properly, the ruts filled, and the whole compacted. The use of the road drag was the first thing learned at the first 1905 road schools. The simple road drag played a surprising complex role in Iowa's state and local politics, road engineering, funding, planning, farming, and even served as local entertainment. Almost every Iowa dirt road has been serviced by a road drag at one time. Many of Iowa's dirt roads have a county grading schedule today.

Road dragging was considered such an important part of rural road maintenance that "road dragging days" or "road dragging contests" were frequently held in the state. It was noted in the Fairfield Ledger that the governor of Iowa in 1914 had declared June 16th as "…road drag day for Iowa, and in various places in the state, programs were given intended to encourage road dragging. It is expected that thousands of miles of roads will be dragged this week" (Baird 1989:12).

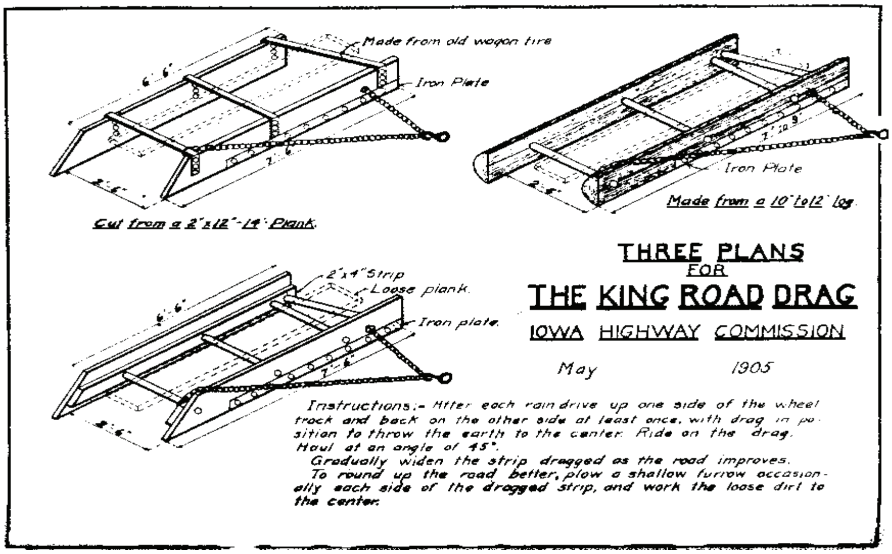


Figure 39. Three Plans for the King Road Drag (ISHC 1905a:68). "Instructions: After each rain drive up one side of the wheel track and back on the other side at least once, with drag in position to throw the earth to the center. Ride on drag. Haul at an angle of 45 degrees. Gradually widen the strip dragged."

Dragging the Road. The theory behind the drag's use was that the surface of an earth road was smoothed after each rain, ruts formed were filled and the road was in condition to shed water during the next rainy season. The drag was hauled to build up a crown by almost imperceptible degrees. If ordinary soil was subjected to continual wetting and mixing, it puddled and could be molded into shapes that would hold water. This condition was observed on main traveled county roads where water stood in ruts and hollows. After the surface softened, the wheels of wagons and hoofs of horses mixed, molded and packed the earth into a series of cups which would hold water until it evaporated. In addition to preparing the surface for the next rainfall the drag also distributed the puddle earth over the road in a thin layer which was beaten and packed into a very hard surface by heavy traffic (Thompson 1989:95). All of the roads which make up the study routes were maintained by dragging for decades.

Road dragging was so important that it became a political issue and came under legal stricture. The following is taken from an address given by Sam C. Smith of Winterset, Iowa, at the County Attorneys Association in Cedar Rapids, on June 26, 1912 (Brindley 1912; Road-Maker 1912g–h:6; Smith 1912; Burlington Hawkeye 1914). The following quote gives a sense of the period context and the importance of roads within it. This article outlines the reasons for the legislature enacting a "drag" law, its effect on local road maintenance, and its enforcement. Smith's straightforward discussion and general lack of boosterism gives the article greater credibility than most others on this subject read by this author:

> …The statute related to dragging of public highways…is one of much importance…provides for the raising and expenditure of a large amount of money…affects every community in the state. It was passed…in recognition of the fact that a given sum of money expended for dragging under proper conditions benefited the highway more than the expenditure of a like sum for any other kind of temporary

road work. Under the circumstances it is unfortunate that the new law did not receive a better reception at the hands of the people than it did [Road-Maker 1912h:6].

There has been much discussion as to what the legislature intended the maximum compensation to be. Whether it should be fifty cents for each mile traveled in dragging or only half that amount…While it was intended that the higher rate be accepted, the officers in some localities have refused to pay more than the lower rate and parties have refused to contract on the ground that the compensation was not adequate and was less than was being paid in other localities [Road-Maker 1912h:7].

A fixed rate of compensation was not to exceed the rate of 50 cents per mile for each mile traveled in dragging…The time at which dragging can be done to advantage is usually very limited…If a contactor were arrested for failure to drag when notified the question as to what notice was required would be pertinent. On account of local rains it frequently happens that roads are in condition to drag in parts of the township so remote from the residence of the superintendent that he would have no knowledge of the facts [Road-Maker 1912i:10].

Dragging is very much needed in cities and towns. On account of the heavy travel when the roads are soft it is a notorious fact that some of the worst roads are found within corporation limits. Many farmers believe that the dragging law originated in the minds of the auto owners living in the cities…It is specifically provided that the county motor vehicle road fund may be used for dragging outside the limits of cities and towns…The township road fund is limited to the repair of roads and other things [Road-Maker 1912i:11].

The penalty section of the statute is the reason many farmers would hesitate to sign a dragging contract due to the weakness in the application of where a “good faith” attempt to comply...We have assumed that the dragging in this state will be done mainly by the farmers. They have the greatest interest in good roads…are closest to the work…can generally do such work when the fields are too wet to work there. I can think of no occupation or employment to which dragging can be better connected than farming, and dragging will not give continuous employment to anyone [Road-Maker 1912j:6].

There is a penalty for neglect of duty. They [the public] do no believe perhaps or appreciate the difficulty of securing men of proper ability to accept the office. The duties are irksome. They interfere with the farm work. The salary amounts to nothing, and does not pay for them given to it. In recent years the author has expressed the idea that a strong public sentiment in favor of good roads…is a strong incentive for good work…[Road-Maker 1912h–j:6].

Not all opinion on the road drag laws and roads in general was of the positive type. The following quote gives a more local and public view than the above entry on drag laws. Some negative aspects were encountered, especially when the roads in some counties were neglected or ignored. A 1914 Road-Maker editorial relates:

There has been much favorable comment upon the road drag everywhere in the state of Iowa, and it was the general belief that an immense stride forward had been made when the law was passed, regarding the dragging of the roads. But the complaint comes from many points, that the roads are not dragged. Many grow enthusiastic over dragging of the roads…Of what possible use or benefit is the road dragging law, if the roads are not dragged. When the drag was a new thing, people got out and dragged the road upon the slightest provocation. Now, that the novelty has worn off, things are different. In the county dragging is done under contract with the supervisors…and it is done when it is needed. But in some other counties, in some other parts of the state, there are complaints that after all the drag does not seem to have solved the road problem. Neither will anything else. The so-called permanent road will require repairs now and them. But so does the best fence…so does any other improvement that has been made by human hands. But the so-called permanent road has proven its value in some parts of the work…and right here in Iowa we are going to have some of the best permanent roads in the world, in the near future [Road-Maker 1914d:18].

Some counties took the laws seriously, and neglected roads and their “drag contractors” could be held accountable. One Hancock County contractor “…who failed to drag the roads was fined $10 and costs at Britt on complaint of the rural route carrier” (Road-Maker 1915c:19). Other counties did little to punish the recalcitrant dragger. In March of 1917 the Lockridge Times put out a public notice to road draggers that “New mail routes are to be dragged…” (Lockridge Time 1917i:3). Later that same month a plea was put out for “graveling and dragging the roads” (Lockridge Time 1917l:3).

Gravel Roads. The graveling of Iowa roads progressed year by year until the 1920s. In the 1910s the amount of gravel paved roads built began reducing the amount of dirt roads. One of the key elements for the construction of gravel roads is choosing gravel with the highest “binding” or “cementing value” (Huebinger 1912a:86). Bank gravel was also touted due to its high clay content that helped binding. Round clean river gravel was considered the best in 1912 but it was suggested to use it as a bottom level then quarried gravel on top. It further relates that there were “many different methods of building a gravel road. Most of them are built without method or plan. Some fail because the material is inferior, most fail due to the material being improperly applied to the surface” (Huebinger 1912b:86). This is also applicable to the gravel surfaced study roads.

Most road failures occurred for six basic reasons (Huebinger 1912b:86). They were:

1. poor materials; round worn gravel; too little binder, or too much sand, earth, or clay.
2. lack of durable foundations; placing gravel on surfaces filled with ruts and holes, or not deep enough.
3. poor drainage; too flat, or too high in the middle, side ditches too deep so they were soon filled with silt or trash.
4. spreading gravel in dry weather, dumping it in piles and leaving it for the traffic to spread.
5. making the road too narrow to accommodate the traffic, or so narrow that wagons will track and soon cut the surface into ruts.
6. failure to keep ruts and holes filled with gravel.

With good binding or cementing gravel, satisfactory roads could be made by surfacing the prepared subgrade with one or two layers of this material. The earth foundation had to first be shaped with a road grader and, if possible, rolled with an eight or ten ton roller (or traction engine). In the construction of the earthen foundation it was suggested that it be slightly crowned. The material was to be spread in one, two, or three layers to a total depth of from 8″ to 12″ in the center and from 4″ to 6″ at the sides, then gradually diminishing in depth to a feather edge toward the side ditches. The depth of the gravel would depend upon the traffic, and, to some extent, on the material as well as the earth sub grade (Huebinger 1912b:86).

If spread in layers the coarser grade was to be placed for the foundation and the finer grade for the wearing surface. In case unscreened gravel was used, the larger sized pieces (those which will not pass a three-inch ring) should be thrown out or raked into the foundation course. Some gravels had to be sprinkled and rolled before they would consolidate, while others were found to bind well under ordinary traffic. Applying them to the road in wet weather was considered good practice. A little clay or loam was added to hasten the binding process. The work could best be done in the spring since often no roller or sprinkler was available. The road grader or split-log drag was recommended to remove ruts and fill holes while the road was still “green.” It was further recommended that if the gravel failed to bind or wear well a thin layer of good quality crushed rock screenings should be applied to the surface (Huebinger 1912b:86; Hammond 1915:1–2).

In March of 1915, during prime road working season, an article appeared in Road-Maker magazine. Published in Iowa at the time, Road-Maker had a large regional and probable national circulation. At that time it printed an important discussion on building gravel roads using the experience of Green County, Iowa, as the subject. The following excerpt outlines both the approved method for laying gravel roads for that time and the pitfalls encountered in the reality of construction. It related:

> In Greene County Iowa 300 miles of road was graveled. Greene County used her wonderful supply of gravel in pulling townships and counties out of the mud. The usual plan of work was to lay the gravel sixteen feet wide and eight inches deep, but the principal streets were traveled the full width. They were smoothed down well with a shovel and then kept smooth for the first year and in some cases were trimmed up with a grader. It was fortunate that so much gravel was available. There are large quantities of bank gravel over the county, which is now supposed to be better for roads than that obtained from the river. The state law providing for the condemnation of gravel pits by counties was inspired by the Greene county work. For the most part local gravel is well adapted for road making. The gravel roads became immensely popular. Gravel was first put on the wet spots and pieces of a bad road, and sometimes only for short distances, so that now there are at least one hundred unconnected strips of gravel road. For the most part the gravel is quite evenly distributed over the county. When work was done on a comprehensive plan the drainage was usually provided and the grade prepared. There were cases where the drainage was not provided and where the gravel was put on wet land and sank out of sight and was lost…The informal and volunteer methods of graveling are not so common now as they were a few year ago, but they still continue.
>
> The one unfortunate thing about the roads of Greene county is that the grades were not all carefully made, for some of them are not in line and some are too narrow for the conditions of the present time. It was necessary to tear up the Lincoln Highway clear across the county and destroy good graveled road to meet the demands of a new age and make in its place a modern road to be part of the greatest of all Transcontinental roads in America [Road-Maker 1915d:1–2].

Macadam Roads. Although macadam roads are made of or surfaced with stone or large gravel they differ in some respects from gravel roads. Macadam roads have been around for centuries and utilized older technologies. Without a rock crusher and size sorter some Iowa counties built macadam roads in the late 19th and early 20th century and they are discussed in the 1905 Manual for Iowa Highway Officers (ISHC 1905a:77). Macadam roads were generally not built after 1917 and were replaced by gravel roads. Although macadam roads were built in Iowa none were identified during this study. In general, macadam roads and gravel roads were considered the same thing by many, but they're not. On the study routes and across Iowa the use of large stones in the bed layer common to a macadam road was to be avoided and removal of large pieces was recommended in the ISHC publications on gravel road construction.

A "modern" (1900–1912) Iowa macadam road was described as being composed of broken stones of "small" dimensions, not exceeding 2½″ or 3″ in diameter, bonded together into a water-tight mass or crust, but with no matrix or binder except dust or screenings. It was usually from 12 ft to 16 ft wide, with earth shoulders five ft wide on each side. A width of 12 ft allowed two vehicles to pass, but not if the road was less than 12 ft as the shoulders tended to rut. The usual depth of stone was 6″ when consolidated but it could be laid with 6″ in the center grading out to the edges. With a solid ground of foundation the depth of stone could be decreased to 3″ or 4″. In a few years a 3″ stone would be thought large for a paving bed.

The road was to be crowned and on hill tops blind ditches built and filled with gravel around a 6″ tile pipe. The road, with larger stones in the first layer and smaller on top, was to be finished with screenings. Asphalt, tar, or other bituminous preparations were used with success, especially where the road was extensively used by motor vehicles. Loam was not to be used as packing or binder. While loam was generally to be avoided in Iowa road building clay was an important component.

It is possible that macadam roads that were built in parts of Iowa survive under later surfaces. In such instances only coring or excavation through the road would identify its characteristics that differentiate it from common gravel roads. Most macadam roads in Iowa have been replaced but the early roads literature cites areas in which they were constructed in the early part of the study period.

CULVERTS AND BRIDGES

Introduction. The history of Iowa road making is as much about crossing stream drainages as it is the road surface itself. One of the principal acts in improving Iowa's roads was the construction of culverts and bridges over drainages large and small. In south central Iowa, Ringgold County's road supervisor related in 1917 "that there were 8,000 hills and 8,000 drainages in the county and that bringing these features to grade would take forever" (ISHC 1917d:4–6). In general, during the study period and along the study routes permanent concrete culverts increasingly replaced the numerous and generally faulty wooden bridges. Where nearly every culvert is now, a wooden bridge or ford would have been found in the late 19th to the first quarter of the 20th century.

Box Culverts. The 1905 Manual for Iowa Highway Officers outlined for the first time the size, shape, materials, and construction of road drainage structures. The use of curbs, gutters, and drains had not been included in the manual but the construction of culverts was a major topic. Small culverts were expected to be built by local or county crews while large culverts and bridges were often contracted. Many structures were poorly made in the early years and served as examples on how *not* to build such structures.

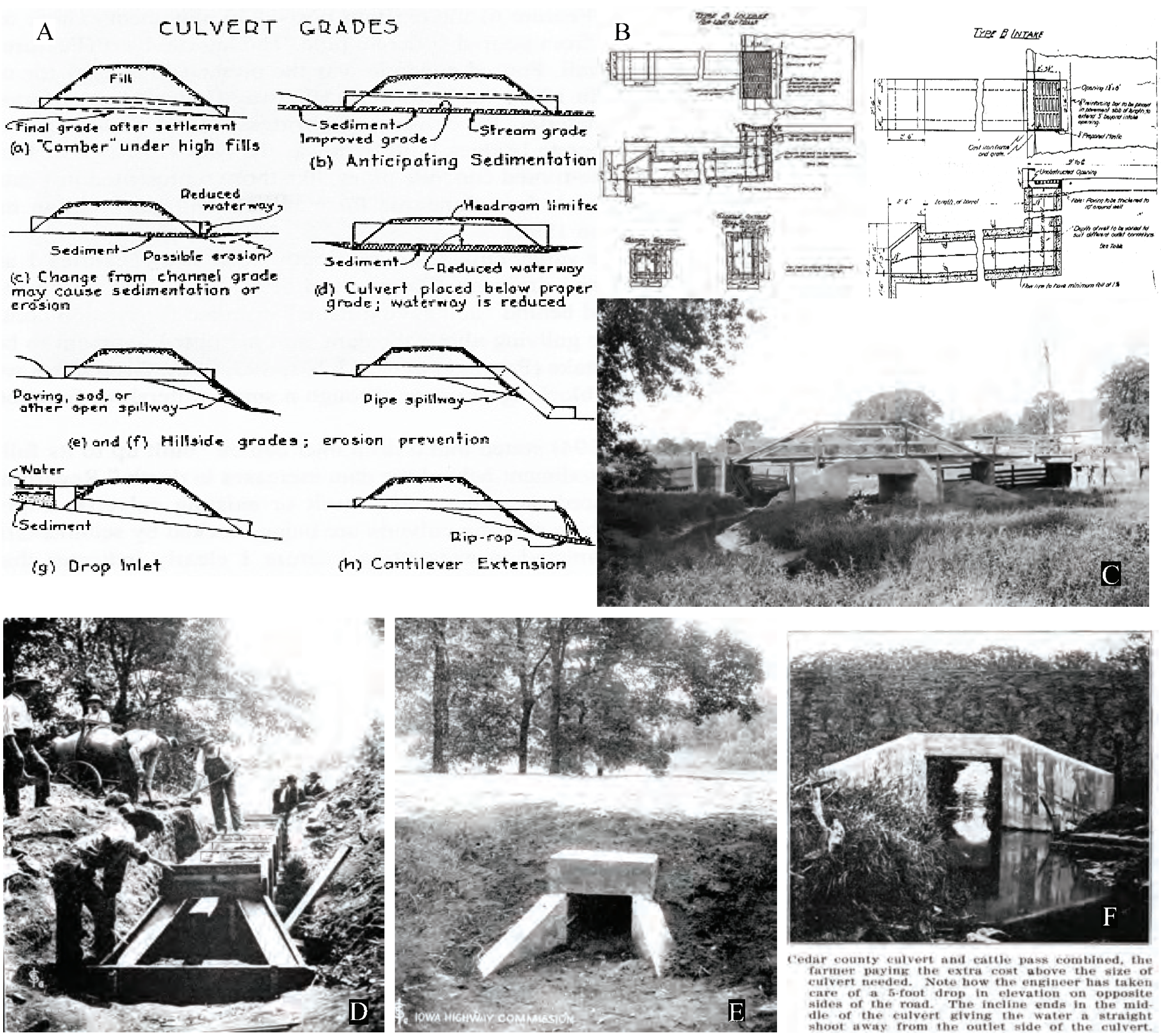


Figure 40. A. Culvert Grades (Patton 1937; Artz 1995:218). B. Type A and Type B culvert plans from 1927 U.S 34 plans (Iowa DOT–Map Division). Note rectangular grate cover. C. The ca. 1928 Carson Culvert in Washington County (IDOT Library–Culverts folder). D. Culvert under construction (ISHC 1906a:5). E. Finished culvert (ISHC 1906a:5). F. Iowa Standard Box culvert and cattle pass combined with flaring wing walls, Cedar County (ISHC 1915j:cover). Note caption.

Generally, when a road was "brought to grade" this implied that concrete, stone, or steel pipe culverts or small bridges were in place. With the concrete culverts and bridges in place the road bed and paving could be finished and good drainage was assured under normal circumstances. Long wagon bridges over major rivers or bridges that were important links were left alone. On the U.S. 34 (Iowa 8, Blue Grass Road) study route the 19th century wagon bridge over the Skunk River east of Rome was a good example of a bypassed bridge. Numerous bridge studies have been done in Iowa, from small (Nash 2000, 2003) to large (Frazier 1992).*Box Culverts*. Reinforced concrete box culverts were used on American highways in the first decade of the 20th century, and they have a history nearly identical to the development of the slab bridges. A box culvert derives its name from its similarity to a box with open ends (Figure 40). It is distinguished from a slab bridge by the slab integral with the side walls and floor. Box culverts are especially appropriate for minor or seasonal streams and locations where room is limited. They require little expensive form or foundation work, and they could be placed in trenches. The cover (top) slab can either directly support the roadway or be placed under fill. The culvert is proportioned to carry both the live load and the entire weight of the fill, if any.

Box culverts may be single or multiple cells (one or more openings) with the single-cell span length rarely exceeding twice the height. Since the 1920s, box culverts have been found to be economical and practical under the majority of conditions for spans in the range of 8 ft to 15 ft. The technology has changed little since the early 20th century; the only noteworthy change is the increasing substitution of precast box sections for cast-in-place sections during the last 30 years (ISHC 1905b:28; 1915b:53, 1915c:53; Lichtenstein 2000:221–222) but precast culverts have been available since 1900.The best representatives of the box culvert's technological significance are the early unaltered box culverts associated with larger highway projects (ISHC 1915i–k). Figure 40C shows the replacement of a large bridge and its approaches with a small concrete culvert. Iowa was the first to introduce the flared wall or wing culverts in 1957 (Landis 1997; Center for Transportation Research 2003a–c) but the idea is much older. This innovation greatly improved water flow and relieved high water pressure. Early box culvert examples within the study routes are to be found along the earliest local highways and those that latter became state routes. This is important because the historic roads surveyor may encounter this culvert type and should know it as a possible replacement for a failed or upgraded earlier structure.

Culverts are by far the most common individual structures on early Iowa roads (Figure 41). The design and execution of culverts grew more advanced over time. Many culverts are so large that most people traveling over them consider them bridges. This is especially true if they have a steel pony truss involved or long railings. For the purpose of this study one primary consideration was made in determining if a structure was a bridge or a culvert. That consideration was whether there was a concrete bottom to the drainageway under the structure. Most bridges do not have this feature and rest partially upon some form of piling or end walls set into the drainage itself. Culverts most often are tubular or boxy constructions with a distinct bottom and sides. This was not meant as a hard and fast rule as there were exceptions. Another aspect was length. Early culverts were designed up to 12 ft in length until the 1920s. In 1922 the 12 ft wide culvert was abolished and a new 18 ft wide program begun (ISHC 1922a, 1925b, 1925c).

Box culverts may be single or multiple cells (one or more openings) with the single-cell span length rarely exceeding twice the height. Since the 1920s, box culverts have been found to be economical and practical under the majority of conditions for spans in the range of 8 ft to 15 ft. The technology has changed little since the early 20th century; the only noteworthy change is the increasing substitution of precast box sections for cast-in-place sections during the last 30 years (ISHC 1905b:28; 1915b:53, 1915c:53; Lichtenstein 2000:221–222) but precast culverts have been available since 1900.*Slab Bridges*. Nationally, cast-in-place reinforced concrete slab bridges appeared about 1905. The oldest known extant examples in Iowa date from the early 1900s to 1910s. The slab bridge concentrates reinforcing steel, in the form of twisted or deformed rods, in the lower portion of the slab where tensile forces due to bending are greatest, and at the ends where shear is maximum. As with all other bridge types the amount of steel and depth of the slab is predicated on its length and live-load capacity. Slab bridge technology has changed little from the 1910s to the present (Lichtenstein 2000:192).

Slab Bridges. The slab bridge type was featured prominently in pre-World-War I engineering journals and texts, federal Office of Public Roads technical pamphlets, and concrete manufacturers' advertising. It appeared everywhere across the country at about the same time, and there were few variations. In early Iowa, pre-World War I slab bridges were less than 20 ft wide, and many have subsequently been replaced or widened. A noteworthy early example is the Marsh Bridge (1905) on the Red Ball Route in Floyd County. During the 1920s, slab bridges were in use throughout Iowa in great numbers. Very few are over 10 ft long illustrating how predominant and economical that bridge type was for the crossing of small creeks and seasonal streams (Lichtenstein 2000:192–193).

From 1920 through the 1950s, there were few noteworthy changes in the slab bridge technology in Iowa. Some variations included the application of continuous designs achieving longer spans with an economy of material. As with other concrete bridges some variety is found in the application of railings and aesthetic treatments, such as stone veneers or arched fascia. While a number of historic slab bridges have custom railings, the vast majority of surviving slab and through-girder culverts or bridges have their railings handled in a common manner. Paneled concrete siderails and simple concrete balustrades (handrails) are very common in Iowa (Lichtenstein 2000:193).

Figure 41. A. Jockey Hollow stone bridge. B. Jockey Hollow stone culvert. C. Stone and concrete culvert with associated stone-lined drainage. D.–F. Stone culvert and details of same, Ottumwa vicinity, Wapello County (2003 survey photos).

Truss Bridges. The truss is a triangular structure where all members take either tension or compression. Loads generally come through the vertical members and are transmitted by the diagonal members into the horizontal members and back to the bearings. In the 19th century the basic truss pattern was multiplied many times over to span much greater distances than those possible with timber beam or king or queen-post truss bridges. Truss types and designs vary according to the configuration of the members (Figure 42). In the thru-truss bridge the road passes between the truss lines and is carried on the deck and floor system connected to the bottom chords at the panel points. There is lateral bracing connecting the top chords of the trusses. This type was generally used for spans more than 100 ft long (Lichtenstein 2000:65).

The steel pony truss in Iowa was seen as “a striking contrast” to the wooden ones (ISHC 1915f). A pony truss bridge is the same as a thru-truss, but it does not have lateral bracing between the top chords. This type is generally used for shorter spans 45 ft to 100 ft long. In a deck truss bridge the road is above the trusses and the deck system is on the top chords. There are a variety of thru-truss designs, and all have different ways of accommodating the tensile and compressive forces. They are frequently named for the engineer that patented the design such as the Pratt truss patented by Thomas C. Pratt in 1844 or the Warren truss patented by James Warren in 1848 (ISHC 1916b:2–3, 1918b:55; Lichtenstein 2000:65–66).

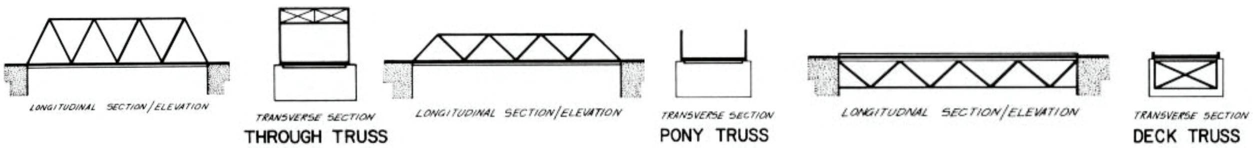


Figure 42. Simple early steel truss bridge types (Comp and Jackson 1977:3).

Historic Overview. In terms of historic road integrity the survival of the original culverts and bridges is as important as the roadways surface and cross-section. Although most culverts are difficult to see from directly above the larger ones with side or handrails often display an esthetic sense of design, style, and use of materials and could have been constructed by master builders. Like the general understanding of paving, the ability to date culverts to their period of construction makes them the best indicators of periods of road construction. They often survive long after the pavement above them has been replaced.

In 1912 Thomas H. McDonald, chief engineer of Iowa’s Highway Testing Laboratory, President of the ISHC, and nationally recognized highway designer wrote the following article quoted below from Road-Maker magazine. The article outlines the proper means for determining the size of a bridge or culvert to be built over a small drainage. The article also gives an idea of Iowa’s drainage law, what the common problems were at the time in drainage bridging, what future necessities might necessitate certain advantageous construction, with a thought towards integrating newer methods and materials, such as the steel I-beam and cast concrete bridge floors.

The general tone of the piece was to reduce the planning for drainage bridging to a formulaic approach simple enough for the most inexperienced planners, designers, or builders to get right every time. He hoped that his general approaches concerning cost, correct execution, maintenance, new or improved materials and methods, and finally with an eye towards permanence. It is interesting to note that his ideas about drainage cleaning suggesting the use of a drag boat to clean the channels was apparently never put into action. His description of how to build a bridge was centered around the expectation of cleaning the drainages thoroughly at least once, is woven into his construction plan, with the replacement of the temporary and cheap wooden deck with the permanent concrete one (Road-Maker 1912g:5–6). Between the lines it also shows that as relatively late as 1912, some builders still having problems designing and building such basic structures and were still hesitant to introduce new methods and materials such as the use of steel I-beams and concrete decks. County control of Primary Roads was still in effect and local crews were not always up to the task in some counties. It also addresses the significant point of the 15 ton weight of a traction engine as the *minimum weight* the bridge or culvert should hold. The maximum weight should be three times that.

In the following selected sections of the article MacDonald relates:

> According to the provision of the Drainage Law which requires “that no obstruction shall be placed in the drainage channel,” there has been a considerable amount of needless expense involved in the bridging of these ditches. The average depth of these ditches is dependent upon the lowest lands in the drainage area rather than upon the depth of the ditch necessary to carry the estimated flow of water from that district–

that is, the ditches must be constructed with sufficient depth to give the tile outlets from the lowest lying lands accessible to the drainage ditch. The depth, together with the bottom width, establishes the top width of the opening, and this has very generally been taken as the minimum length of the highway bridges built at road intersections. This, together with the practice of building in even lengths, which is generally followed, often means that a drainage ditch with a four foot bottom, eight foot depth, with bank slope of one-to-one, which would give a twenty-foot top opening, will be bridged, if lumber is used, with one sixteen foot span and two eight foot approach spans, making 32 lineal feet of bridge where perhaps the actual opening is not over one-third to one-fourth of this length.

A second factor then which should be considered is whether these ditches will require cleaning. It seems to be a foregone conclusion that the largest proportions of the ditches that are not being built within the next few years be cleaned and it seems too–that after its first cleaning the ordinary drainage ditch will assume a rather more permanent section which will not require cleaning for a long term of years. As yet no system of cleaning has been agreed upon as the most efficient. If it is assumed that cleaning is necessary, however, and that it may be most practical to use a drag boat of some character, any permanent bridges should be built with this end in view, and some minimum span or width adopted that will allow the passage of such a boat or machine between the abutments.

There is one other important condition that must be met in the construction of drainage ditch bridges, relative to the increased first cost of permanent construction over that of temporary wooden structures. It is a notorious fact that the bridge fund of many counties of the state is very badly involved and in some of the counties where considerable drainage is under way it seems almost impossible to provide any thing but light, temporary structures. The fallacy of building wholesale wooden structures that begin to deteriorate as soon as they are built is readily apparent, but many supervisors are face to face with a condition rather than a theory, a condition which necessitates the building of a certain number of bridges within a certain cost. Few counties are in such a condition with reference to their permanent structures each year. To insure a more uniform practice within different counties, the following rule is suggested for determining the span necessary.

The width of the bridges necessary should be specified by the engineer in charge of the drainage district and will be determined by the average flow of water, at the average flow line…This rule can be more concisely stated by the following formula: Two times average depth of flow, plus bottom width of ditch equals clear span for all ditches with bank slopes of one to one. With this rule, the ditch having a four-foot bottom and three-foot depth of flow would require a span ten feet: with four-foot depth of flow, 12-foot span. It might be well to adopt as a minimum a span which should permit the passage of any machine used for cleaning.

Taking into consideration the limits of the bridge fund and the probable necessity of cleaning, it is suggested that I-beam spans on concrete abutments would be a desirable form of construction, flooring the structure with plank which will decrease the first cost somewhat. Then the ditch is cleaned, the I-beams can be readily taken off, allowing the passage of a boat or other machine between the abutments, and replaced at a very small cost. At this time a concrete floor can be added which will make a permanent structure. I-beam spans are being used generally over the state, some set on steel legs and other on piling with wood or steel caps, but in a very few cases, if any, are the beams strong enough to stand the added weight of a concrete floor. In fact the general standards now prevailing are considerably too light to carry with safety a 15-ton traction engine which as been adopted by the ISHC as a standard concentrated load. Standard spans showing method of building such I-beam shapes can be obtained from the Commission.

The I-beam spans when properly designed are not the most economical form of bridges to build when the bridge is completed at the first operation, but where it is desirable to place a wooden floor temporarily, the I-beam spans best answer the purpose for spans up to twenty-five feet. For spans above sixteen feet steel plate girder bridges can be used economically up to thirty or forty foot spans. Riveted trusses on concrete abutments are recommended for spans thirty to eighty feet, which would perhaps provide for all except the largest ditches.

> There is considerable objection to the use of plank for floors and on I-beam spans, riveted trusses and plate girders, it is entirely practicable to build reinforced concrete floors in sections that can be readily removed. Both the plate girder and riveted truss bridge can be easily removed and replaced without injury to themselves or considerable delay [MacDonald 1912:5–6].

Study Route Bridges. Bridges constructed during the history of the two study routes were built of wood, masonry, steel or a combination of these materials (Figures 41–44). In the early days the various forms of construction resulted in a broad array of structures designed and built by counties and townships without systematic planning for the vehicles they carried. Many wagon bridges built in the 19th century have continued in use until recently. Increased rural traffic made wood plank or wooden pile bridges inadequate for heavy machinery, particularly the steam powered traction engines with their large water tanks and coal supply. The cost of timber construction was rising, and timber deteriorated over time. They could be easily undermined and washed out in high water, making wooden bridges quite expensive and dangerous.

At that time the ISHC condemned the assorted collections of steel, cement, clay tile, and iron bridges and culverts "whose best claim to recognition was the clear profit netted their sellers" (Morrison 1920:1). Further they deplored "the various forms of steel or concrete and steel bridges being built that have no claim as engineering designs" (Thompson 1989:96). After two years of study in 1913 the commission formulated standard loads for which all bridges should be assigned, and these were recommended for inclusion in state laws. Also recommended to insure compliance at a more local level was appointment of a county engineer to supervise the road and bridge building programs.

It had become evident in 1913 that the costs for bridges and culverts had to be calculated more accurately, and that contracting practices had to be improved before any real progress on road construction could be made. As soon as the new ISHC began a study of these matters, it was subject to attacks by interests which would be affected by placing bridge work on open competitive bidding. Two situations were unearthed: 1) the state had been divided into districts by supply companies, making competition impossible, 2) there were no standards or general knowledge among road officials as to the market value of bridge materials or labor, nor was there uniformity in quality or prices of the materials furnished (Thompson 1989:97).

About half of a county's entire road taxes were spent on bridges and culverts, often to the neglect of necessary grading, drainage, and dragging of hundreds miles of roads. The influence of the suppliers was so great that it amounted to blackmail schemes to control bridge and culvert funds. Not until supervisors were removed in Polk and Clinton counties and money refunded was the public aware of these circumstance. Similar conditions existed in other sections of the state, and these plus the demands for efficient and trained supervision of construction resulted in laws under which the new state highway department was organized and a new system of administration established (Thompson 1989:97).

During the study period bridges went from mid-19th century stone types to modern styled concrete and steel structures. Early bridges were rather haphazard affairs except at the major river crossings. The early ISHC bulletins decried the deplorable condition of most of the state's bridges. The majority of small bridges were made of wood, poorly maintained, and easily swept away. Iowa's climate was very hard on wooden bridges and unlike railroad bridges, which where usually professionally designed and built, Iowa's local, township, and county bridges were often built and maintained by the local farmer. Bridges often determined the route of arterial highways as few crossing structures able to carry heavy loads were available in the state and highways, including trans-continental routes, had to often leave a direct pathway in order to find a suitable river crossing point.

Early Iowa roads in general and those of the study sections incorporated a number of types of bridges during their periods of operation. The earliest bridge encountered in the study area was the stone slab bridge located in Jockey Hollow, in Henry County (see Figure 41A). This bridge was used on an arterial road from ca. 1850 to ca. 1920. It was used on the Blue Grass Route for automobile traffic and remained unchanged during the entire period. The late 19th century iron bridges along the study routes have been replaced and only the remnants of stone or concrete abutments remain in most cases. This is also true of the ones from the 1920s and 1930s. Nearly all the study route bridges were replaced from 2000 to 2005.

From the origin of the ISHC in 1904 part of its mission was the improvement of bridges, especially along the arterial routes. The early period of Iowa's automobile transportation network had to rely on many old, undersized, poorly constructed, and poorly maintained bridges and it was the ISHC's job to replace these as soon as possible. While traveling, crossing the smaller drainages in Iowa could be as difficult as crossing a major drainage such as the Des Moines River. Even Iowa's smaller drainages could become raging torrents at certain times of the year. At least the Des Moines River was sturdily bridged at known places and if one could get to the bridge it was a relatively easy crossing. This was not so on the county or locally maintained arterials where bridge quality varied widely. Most of the smaller drainages had some sort of wooden bridge across it if it was bridged at all (Fraser and Roberts 1995:Sec. E, 9–23).

While the introduction of steel wagon bridges in Iowa in the second half of the 19th century was a great boon to Iowa's road system these bridges were usually locally owned. A city or county would contract a bridge manufacturer or contractor to erect the bridge. Pin-connected Pratt truss configurations were used for virtually all of Iowa's wagon trusses in the late 19th century, executed first in wrought or cast iron and after the early 1890s in steel. Thousands of such pinned Pratts were erected throughout the state for crossings both large and small, and numerous examples remain in place today.

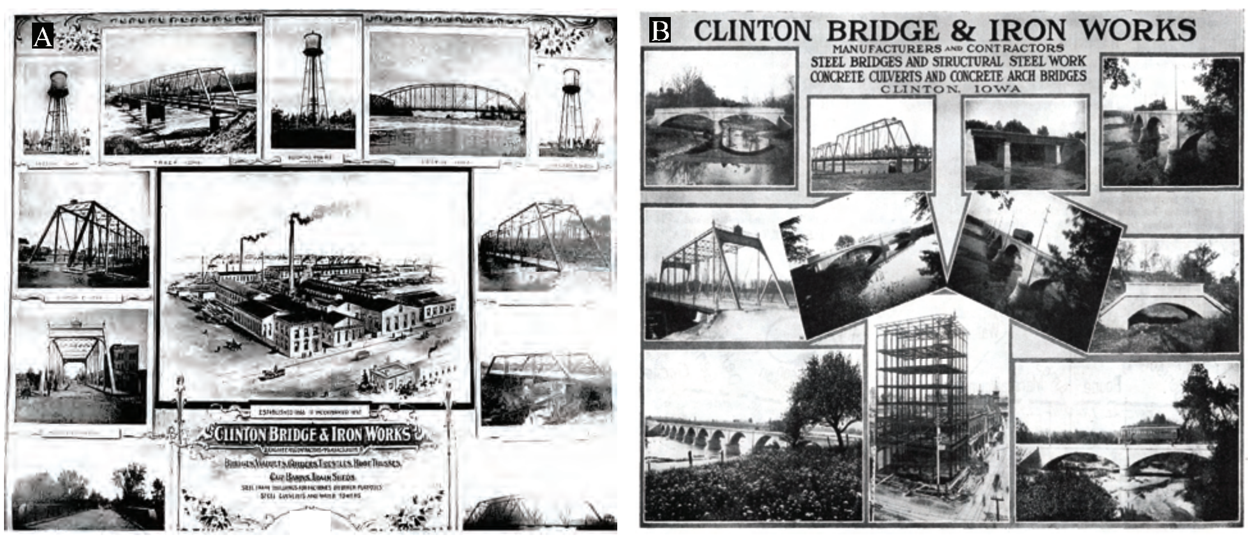


Figure 43. Ads for the Clinton Bridge and Iron Works. A. Ad from the Atlas of Iowa (Iowa Publishing 1905:pl.241). Advertisement from the Transit (Transit 1909:137). Note change from iron to concrete structures in just four years.

Virtually all of Iowa's bridge fabricators and in-state bridge contractors relied heavily on pinned Pratt's construction for roadway trusses in the late 19th and early 20th centuries. So much so, in fact, that Pratts outnumbered all other types of bridges combined in the state during this period. Half-hipped Pratt truss bridges had a disadvantage in that it was generally limited to spans from 30 ft to 60 ft. Iowa's many small streams lent themselves to this size range, and as a result, thousands of single-span half-hip pony trusses were erected across the state (Fraser and Roberts 1995: Section F:37).

Many of these bridges saw no additional maintenance for their lifetimes and usually were only inspected or repaired after something catastrophic had happened to them. While a great improvement over the wooden bridges they replaced these bridges were still subject to the same problems of poor placement, materials, and design along with washout and weathering. Additionally, many contractors did very poor jobs in bridge construction and the early ISHC bulletins are rife with examples of poorly constructed bridges and culverts and their cost to the county (ISHC 1917d:4–6). Poorly constructed bridges and culverts were usually quickly modified or replaced as soon as their faults appeared. Thus, these early and locally experimental bridges and culverts that were constructed when the understanding of concrete and poured-in-place construction were in its infancy are rare, while some successful projects stand to this day. Wooden trestle bridges were not abandoned in Iowa but they increasing were used not to cross drainages but to cross other landscape features such as incised railroad beds or small township drainages. Many such structures still stand.

In 1917 Iowa bridge manufacturing firms included the Clinton Bridge and Iron Works (Figure 43), Pittsburgh-Des Moines Steel Company, Seevers Manufacturing Company (Oskaloosa), Ottumwa Supply and Construction Company, the Red Oak Bridge and Iron Works, and others. Because many of these shops had to purchase their rolled shapes and other basic components from mills out of state, they were not at any great advantage in competing for the Iowa trade with bridge shops in other areas of the county. Purchases of highway bridges were subject to public pressure through the governmental agencies that built and maintained them. The decision-making process was spread widely at the local level, and there were many local contractors and even some Iowa manufacturers who could compete successfully with out-of-state bridge builders (Fraser 1993:22–24, HAER No. IA-88, Historic Overview of Iowa Bridges).

Along the two study corridors nearly all of the original small and moderate sized steel spans have been removed. U.S. 34 has had larger bridges on its route due to its crossing the Mississippi, Des Moines, and Missouri rivers at Burlington, Ottumwa, and Council Bluffs respectively. The bridge in Burlington is now a modern cable-stay bridge. The two deck-truss bridges in Ottumwa and the Pacific Junction/Plattsmouth Bridge (Glenwood vicinity) are extant. The two significant Ottumwa bridges are important to the road's context. While the Jefferson Viaduct (Jefferson Street) is very much operational (upgraded 1983), the second example is located within an abandoned cut-off arterial highway segment. This second bridge will be discussed later (see The Two Highways Today–U.S. 34).

The Jefferson Viaduct (NRHP) spanning the Des Moines River and rail yards in downtown Ottumwa is noted as being built 1935–1936, designed by the Pittsburgh-Des Moines Steel Company, and fabricated by the Wisconsin Bridge and Iron Company (Milwaukee) (Hippen and Vidutis 1996). Its Historic American Engineering Record (HAER) significance is noted as:

> One of Iowa's most handsomely proportioned highway trusses, the Jefferson Viaduct–a continuous Warren deck truss–is technologically noteworthy as an uncommon application of deck truss technology in Iowa. It is an important example of Iowa urban bridge construction from the 1930s with its structural integrity largely intact [HAER 90-0TT, 1-6; Hippen and Vidutis 1996].

The U.S. 34 bridge, the Plattsmouth Bridge over the Missouri River was also recorded by HAER in 1995. It was constructed in 1929, designed by the Omaha Steel Works with Modjecki and Chase, New York, consulting engineers, and the superstructure built by the Omaha Steel Works and the substructure by the Union Bridge and Construction Company, Kansas City. It was fabricated by the Omaha Steel Works, the Illinois Steel Company and the Inland Steel Company of Chicago along with the Carnegie Steel Company in Pittsburgh. It is currently a toll bridge owned by the Plattsmouth Bridge Company, Plattsmouth, Nebraska. It is significant because:

> This bridge was a regionally important vehicular crossing of the Missouri River and is the oldest extant Missouri River highway bridge into Iowa. Moreover, it is a unique example of a privately financed and operated toll bridge over a major river. It is technologically significant as a noteworthy example of cantilevered truss construction. The Plattsmouth Bridge has been listed in the National Register of Historic Places [HAER 1995: IA-67; Jackson 1995].

Many Iowa contractors used combinations of steel and concrete. The bridges on old U.S. 218 show the use of these materials together. The large Pratt truss bridge over the English River has its concrete piers and deck built of concrete with the upper superstructure of steel. The smaller pony truss bridges built by the Illinois Bridge Company most fully realized the integration of steel and concrete (see Figures 103B, 108). A number of Iowa contractors built with reinforced concrete in various forms from arches to slabs. Marsh, the ISHC, the Stark Bridge Company, and others all had early roles in the technology and execution of Iowa's bridges. Such contractors can play major roles in a road's development.

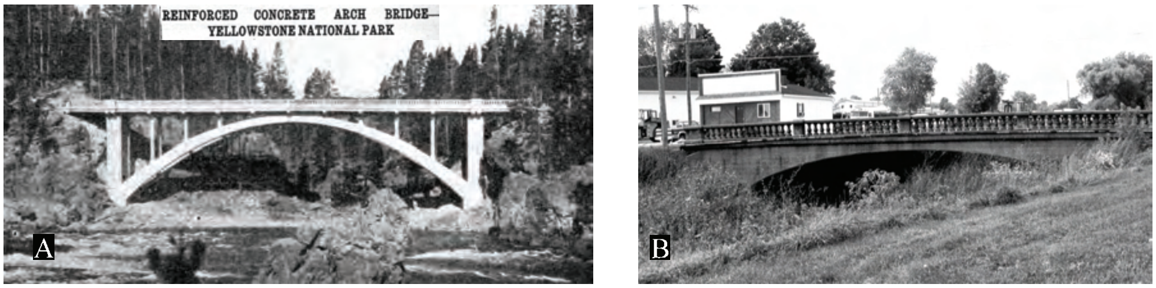


Figure 44. A. Bridge built by Stark Company in Yellowstone (Transit 1916:42; Levan 1916:40). B. Stark's ca. 1917 concrete arch bridge with handrail, West Union, Fayette County (2003 survey photo).

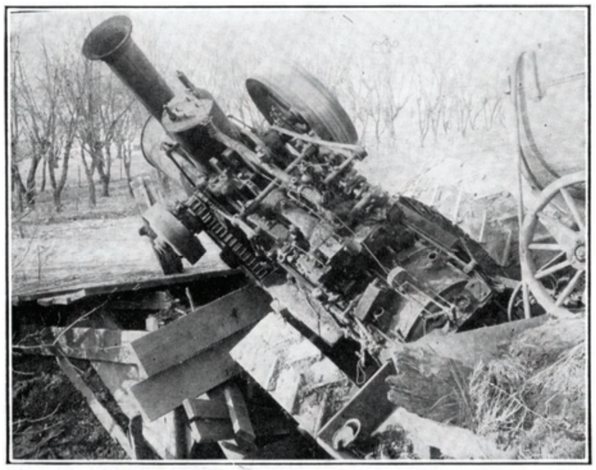
According to Clayton Fraser, Stark was unjustly persecuted by the ISHC. This was because the ISHC did not want to pay the Luten patent for concrete bridges and for supposed bid rigging that may or may not have occurred (Fraser 1993). About the Stark Bridge Company, Clayton Frasier in his 1993 statewide bridge survey results for the Iowa DOT relates:

> N. M. Stark was vigorous in his promotion of concrete for bridge construction in the early 20th century. He was one of Iowa's most prolific concrete bridge builders during this time. Stark received many non-competitive contracts around 1910. The Iowa State Highway Commission regarded Stark–with his patented bridges and monopolistic county contracts–as an exemplar of the work of rigged contracting in the state. Beginning in 1913, the highway commission aggressively attacked Stark and the Luten patent, eventually getting the Luten patent declared non-valid in court and getting Stark indicted for bid-rigging. Stark's business plummeted, and one of Iowa's most successful bridge builders soon faded into obscurity by the early 1920s [Frasier 1993].

Stark's bridges are distinctive and while he built bridges and culverts all over the state a concentration of his works are to be found in northeastern Iowa—where the alleged bid rigging occurred. Stark can be considered a master bridge and culvert builder with local, regional, and possibly national importance. He was an early advocate of concrete bridge construction, was one of the first concrete bridge builders in Iowa, he often used innovative methods such as those employed in constructing the concrete arch Luten bridges, and concrete construction itself can be considered an innovative technology for the time. The number of bridges he built during the early 20th century is unknown at present but he decidedly had a significant impact in Iowa road and bridge construction. The patent bridges and bid-rigging are now important historical elements of the road construction process in Iowa's early days. Despite the economic and political problems Stark had, his bridges and culverts are, in the author's opinion, unusually well designed and constructed (Figure 44) (ISHC 1916h:3–7). Some of his smaller bridges are still in use around the state.

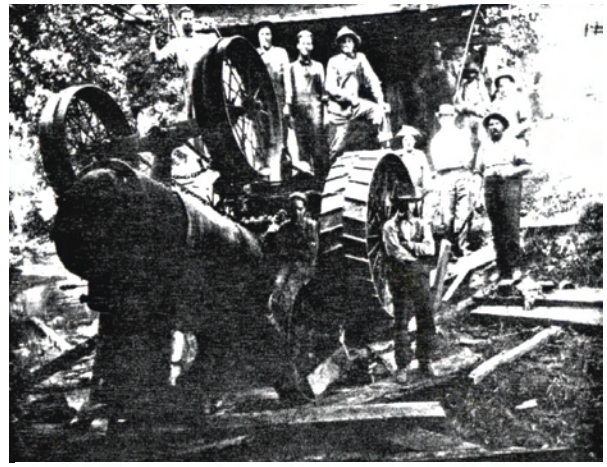
There are probably many lesser known designers and builders of bridges and culverts in Iowa that haven't been identified yet. The significance of W. F. Beard in early Iowa construction projects was unknown to the author at the start of this investigation. His structures have yet to be fully identified. His work as chief engineer on the Fredonia to Columbus Junction road alone is of note.

The introduction of concrete culvert and bridges in the early 20th century improved many of Iowa's transportation problems. A small concrete culvert could replace a much larger wooden bridge for a fraction of the cost and needed little or no maintenance. Many concrete culverts and bridges poured in Iowa from 1900 to 1930 are still in use. This permanent fix appealed to state and county officials and Iowa went through a flurry of concrete culvert construction during this period. In some counties thousands of bridges and culverts were replaced in just a few years. In other counties relatively few were updated. In fact, little or no replacement of a great many of these structures has been attempted in the last 70 to 90 years and nearly all are still providing good service. Along the arterial roads improvements, updates, and replacements proceeded faster than outlying areas. This was especially true after the introduction of the 1913 Federal Tax Act, and when combined with local bond issues, provided the money for infrastructure improvements. Roads having strategic importance saw extra shares of improvement monies.



This wooden bridge in Page County, Iowa, was responsible some months ago for the death of Joe Davis, who left a widow and six children without means of support. This was one of several similar accidents that year in Page county, which is now installing a large number of our time- and weather-proof cast iron culverts.

A



Steam engines & country bridges weren't always compatible; Pete Morgan's engine went through the Davis Creek bridge south of Riverside about 1910. Morgan is standing on pile of boards by rear wheel; others in picture include Alf Libenguth, Lawrence Motte, Ed Bushek, Ernie Rath, Dr. George Maresh, Bill Muller, Jim Wingler, Russell Cummings.

B

Figure 45. A. Steam traction engine through bridge responsible for death of Joe Davis in Page County (Road-Maker 1916m:back of front cover). B. Pete Morgan's traction engine through old Davis Creek bridge, Riverside vicinity, Washington County, ca. 1910 (Fisher 1978:31). Note captions.

Documentary sources show that the reasons for the replacement of culverts and bridges were two-fold. The first problem was that the bridges were poorly maintained and often dangerous. The second was that steam traction engines were falling through and destroying the local bridges at an ever increasing rate (Figure 45). When the ISHC issued its first set of standards for bridge and culvert construction its primary consideration was the weight of these steam tractors. On average steam tractors weighed 15 tons or more. The 1905 manual illustrates culverts designed to hold over 15 tons. This was the combined weight of a surfacing crew, equipment, and roller. This load figure was the primary one for the determination of standards for the construction of bridges, culverts, or other structures that would be subjected to that much weight. Nineteenth century highway bridges were not built to handle such loads and many early bridge types such as the bowstring were abandoned or replaced for that reason. Iron bridge construction and design changed fairly dramatically during the period from 1900 to 1930 so that highway bridges built in the 1920s were much more robust, were built entirely of reinforced concrete or used a joining of concrete and steel beams, and were increasingly no longer all metal structures.

Even the early 20th century iron pony and Warren-truss bridges combined a concrete deck with iron truss work (Comp and Jackson 1977:3, 8; Frasier 1993; Section F:50–57, Section 8:1). These precast and poured-in-place concrete and steel bridges and culverts revolutionized road building in Iowa in the first two decades of the early 20th century. Also, during this period the greatest variation and experimentation was going on. Presently, many of these structures are at a very vulnerable point in their use and on arterial roads are progressively being replaced by precast box culverts. As a result, in a historic roads study any surviving structures of this type should receive recordation and evaluation both as individual structures and as elements of larger road design and construction technology of the original construction period.

During the 1910s many counties purchased small-scale steel structures for carrying gravel surfaced roads over intermittent streams (Figure 44, also see Figures 42, 43, 94, 98, 105B, 108). These were often supported by a concrete substructure (abutments) and in some areas stone was still used. The Clinton Bridge and Iron Works and the Ottumwa Supply and Construction Company erected bridges using day laborers working for the county. The Clinton Bridge and Iron Works (Figure 43) was Iowa's largest vehicular bridge contractor and maintained an extensive catalog of steel spans in the early 20th century, ranging from the standard to the esoteric (Fraser 1993, Section 8:1). The Iowa Bridge Company of Des Moines was also a major player in the state as were branches of other companies.

During World War II the War Department developed a "Priorities Critical List" of materials deemed essential to the war effort. Steel was included on the list, making the construction of steel bridges problematic for Iowa's counties. In response, most of the counties reverted to timber construction for their small scale bridges, and timber pile bridges outnumbered all other types by a large margin in the 1940s (Jacoby and Davis 1941:78–136). During this time, when bridges and culverts washed out emergency funds could be used for replacement spans (Frasier 1993, Section 8:1).

GRAVEL ROADS

Iowa contains to this day more miles of gravel roads than concrete paved roads. The use of gravel for road paving has been used long before the start of this work's study period. Gravel and dirt were the predominant road surfacing material in the state and only in urban areas was alternative surfacing materials such as brick, stone, or concrete laid over gravel beds. At the start of the study period in 1900, of Iowa's thousands of miles of roads a tiny percentage were graveled. In 1900, while gravel was seen as the primary paving or road surfacing material and not as just the underlayment or bed, or as part of concrete aggregate, dirt was the primary surface type across the state. The move towards surfacing Iowa's roads with gravel was slow initially. While rural residents desired "hard surfaced" roads, and gravel was considered a hard surfacing material at the time, very few miles of roads were actually graveled in 1900.

In 1905, the ISHC's *Manual for Iowa Highway Officers* (3,000 copies printed) was many people's first introduction to the principles of proper road construction. While printed in simple language to reach an audience outside of the professional road design and construction community, it carried clear and simple directions for road maintenance, improvement, and construction. Since it was published in 1905 and at that time little or no concrete was used for paving, the main section of road building deals with gravel surfaced roads. For the first time everyone building or repairing roads in the state could ideally follow the manual's directions and do it both correctly and nearly identically over the whole state.

In regards to the construction of gravel roads the 1905 manual relates:

> For a certain percentage of our public highways, which will include the main traveled roads, it is the conclusion of the Commission that some surfacing material such as gravel or broken stone will have to be used…Gravel is quite liberally distributed in many parts of the Iowan drift sheet and along the terminal borders of the Wisconsin drift area. It is also found quite well distributed along the streams of theses areas and also along some of the streams that flow through the Kansan drift area.
>
> Bank gravel usually contains a certain amount of clay which makes a good binding material, if it is not present in too large quantities, and is well distributed through the material. The river or wash gravels do not always contain sufficient quantity of the binder to pack when placed on the roads and they must either have a certain amount artificially mixed with them, or they will not be thoroughly compacted until a certain amount of soil is carried on to them by the traffic. The material should be as carefully selected as possible and in hauling a man should be kept constantly at the pit to see that a uniform material is secured and that large stones are pitched out and that sand pockets, or other unsuitable material are carefully avoided.

> There is some difference of opinion and practice as to the proper way of placing the material on the road. A cross section of a gravel road is given…which is recommended by the Commission. This cross section can be secured, after the earth is graded as shown, by placing one load of the material to each nine feet, or spreading with a grader to a width of about 10 ft, making the outside edge about 2″ in thickness. After this layer is packed by the traffic a second layer should be added in the same manner as the first. It has been shown by results that this method will give excellent results, although some counties practice putting on two loads to each nine feet at the same time, dumping one on top of the other, while other localities dump two loads side by side. The gravel that has considerable binding material in it, so that is packs easily, can be spread more than one that contains little of this binder. With the first of these the traffic compacts it before there is any considerable waste, while if a gravel with little binding material in it is dumped on the road and spread, it wastes to the sides under the action of the traffic. About 15% of binding materials seems to be the proper amount to use.
>
> Gravels can be sent to the road materials' laboratory of the Iowa Highway Commission, Ames, Iowa, where they will be tested free-the binding materials determined and advice given.
>
> Before attempting the construction of a gravel road careful attention must be given to the proper grade and drainage as these are essential. The more money investing in the surface materials the better should be the sub-grade…The gravel roads are very efficient during all the year if kept in shape by continuous maintenance such as the smoothing of the roads with the King drag or similar implement and by the addition of new material when the road "wears out" in places.
>
> There is no reason why the construction of macadam or broken stone roads should not begin at once in many counties. This does not mean the indiscriminate or haphazard way of building a stretch here and there that has characterized so much of this work. Rather it means a careful, systematic selection of the roads to be improved, which will be those radiating out from the business centers and which have the most traffic over them. By building short stretches each year only a short time would elapse before a county could have a system of main traveled roads that could be used at all times of the year.
>
> A considerable part of the eastern part of the state is underlain by limestone which outcrops at the surface in many places. Many of the stone crushing plants already operating are in these areas. Much of the limestone is too soft to be used as road material and most of it, also, should never be used until it has been thoroughly dried or hardened. This is true of the stone which comes from the state quarries at Anamosa [ISHC 1905a:71–79].

Until 1917 most county and township engineers looked at gravel as their primary surfacing material for improvements and designed for such. Gravel roads were kept in shape by dragging and infrequently grading and paving. The local township was responsible for the roads within its boundaries and the county for all the township roads combined. From the 1910s to 1920s Iowa undertook the mission of providing gravel surfaced roads to improve access to and essentially connect all county seats to the capitol. During this period expenditures from the state to the counties were designated for the upgrading and improvement of these county seat towns and the capitol. The overall goal was to enable citizens to travel from any county seat to the capitol on paved roads. The era of "county seat" roads was a significant in the history of Iowa road construction.

The paving of roads was not just a simple process of laying gravel on the road surface and pressing it. During this period, and following the ISHC's manuals and bulletins, main roads, which were also often arterials, were reworked from the bottom up. The gravel paving was the last element in the overall rebuilding of the road system to expand them into a coherent system of county and state roads.

During this period the main connecting roads between county seats and the capitol were identified by the ISHC. With the routes chosen and monies allotted for their improvement construction could begin. In nearly all instances the old route had to be straightened, moved to section line boundaries, hills and valleys cut and filled, drainage structures introduced, rivers and streams bridged, and lastly the surface paved and packed. These roads and their gravel surface were generally referred to at the time as "Macadamized Roads." It was these early connecting county seat roads that later evolved into the state and federal arterial highway system.

Construction of gravel roads followed basic steps that were laid out in several period publications and were comprehensively covered in the ISHC's *Manual for Iowa Highway Officers*. The early road schools spent much time on the proper construction of gravel roads. In June of 1917 Road-Maker magazine describes how Iowa's gravel roads were constructed. It relates:

> To determine which methods of construction are most satisfactory, the engineering experiment station, in co-operation with the state highway commission, under took a number of experiments in road building with gravels. The types of construction used were of three general classes: the two-course trench method, the single-course trench method, and the single-course surface placed on top of the earth road.
>
> In the two-course method, which was used on experimental roads at Fort Dodge, Sprit Lake and part of the Rockwell City roads, the gravel was placed in two layers to a depth of about 8 inches after excavating the trench and placing the excavated material on the side to form substantial shoulders. The single-course trench method-in which the trench was not so deep nor the shoulders so substantial as in the two-course methods-was not as extensively used as the two-course method.
>
> Even though the gravels of Iowa are not as suitable for building roads as the gravels used in many other states, the experimental roads built near Fort Dodge, Spirit Lake and Rockwell City show that properly constructed roads are likely to prove very serviceable if the traffic is not too great. To accommodate increased traffic an oil blanket be applied to prevent the fine particles from being removed and exposing the larger particles which are in turn removed. A study of these roads after several more years of service will determine more fully than is possible now the relative merits of the methods used.
>
> …Serviceable gravel roads can be laid with any of the so-called gravels found in Iowa, but rigid adherence to a few well-established principles of construction and the use of an ample amount of material are prerequisites that must not be overlooked in the building of gravel roads.
>
> The trench method should always be used because the gravels pack better than when placed on the surface. The trench has a tendency to hold water and keep the gravel moist, which hastens the bonding action and helps to keep the gravel from loosening in the dry weather. Moreover, the earth shoulder prevents the gravel from being spread by traffic and wasted before it has had time to bond [Road-Maker 1917a:27].

CONCRETE PAVEMENT

Introduction. While both the state and federal roadway widths and the standards for the types of materials to be used had been mandated by law since before the National Road's construction, in reality much inconsistency was present in the implementation of these standards. Many instances were cited in the period journals decrying the use of faulty materials, poor construction, and generally poor engineering. It was for this reason that the 1905 Manual for Iowa Highway Officers and the ISHC's Service Bulletins were printed. The manual was instrumental in disseminating basic highway, construction, and implementation. It contained directions on such basic highway engineering problems as proper grading and drainage, materials sourcing, acquisition, and identification along with proper concrete aggregate ratios, forming and pouring of culverts, drains, and concrete slab bridges, along with a myriad of other solutions. For the purpose of this study the basic periods of concrete construction are outlined below.

The 1900 to 1913 time frame of the study period shows the greatest variation in right-of-way, material used, and road paving with 12 ft to 18 ft pavement widths. This was largely a result of so many new roads being built that great experimentation resulted. It also is the period with the fewest intact extant resources.

In 1900 one of the results of the Good Roads Movement was the establishment of basic right-of-way width of 18 ft in Iowa. This was not a set width and even on main roads and arterials road widths showed variation even within a few miles. A comparison of photos from the period show that the actual roadway width (or the graded or paved section) often decreased while the right-of-way width remained the same.

While in 1900 none of Iowa's arterials had been paved with concrete a select few miles had been graded and paved with gravel. This was especially true around the larger cities and in counties with aggressive road improvement programs and good resources. These roads were built by local contractors using local materials and labor. Many were intended and used for specific purposes. These included providing all weather access to cemeteries, access to local or state institutions, traversing extremely wet or sandy areas, or city to city routes when the two communities were close together.

During this time a number of paving materials were tried with varying success. During the Good Roads Movement properly graded roads with clay caps on a solidly packed substrate were generally thought of as the best roadways Iowa had to offer. There was considerable discussion in the both the popular magazines of the time and within the ISHC's standards and bulletins on the oiling of these roads (ISHC 1917c:4; Lockridge Times 1917a:4; Road-Maker 1917h:78). For nearly five years the efficacy of this method was under testing and scrutiny with the eventual conclusion that oiling, when properly applied, was an excellent improvement over dirt alone.

While road paving lagged in many areas, the need for permanent culverts and bridges found concrete structures being made around the state. Many counties and Iowa as a whole boasted on how fast they were replacing its wooden highway structures. While a discussion of culverts and bridges is covered elsewhere in this report it should be noted that some bridges and many culverts predate the improved road that goes over them. This lag between culvert and bridge construction and gravel or concrete paving may be as long as fifty years. In a number of instances, an example of which is along the Blue Grass/U.S. 34 study corridor east of Ottumwa, railroad bridges and road beds were utilized. During the earliest road building era abandoned railroad grades, road beds, trails, and other features were frequently incorporated into new roads being constructed.

Near the end of the 19^{th} century several cities in Iowa began paving their main streets with brick. Some sections of arterials were paved where they adjoined or projected beyond the city limits. One of these was located along the Blue Grass Road's route through West Burlington. This was a one mile long brick paved section of the Blue Grass Road. It paralleled the railroad yards for nearly the first mile. Later, this brick paved sections was extended with concrete paving for first three miles and eventually ten miles. The route continued to follow the rail lines but stayed on the southern side of the tracks. This limited the number of at grade crossings along this stretch.

This roadway, like that of the Red Ball Route (old U.S. 161/U.S. 218), had evolved from an earlier pioneer post/stage road. It paralleled the route of the railroad. Early Iowa roadways commonly paralleled railroad grades. Early road construction in Iowa frequently used railroad engineering applied to highways. A section of the Blue Grass Road east of Ottumwa actually was built atop an abandoned railroad grade and incorporated early drainage structures built by the railroad (Figures 95, 96). These culverts were built of stone with later concrete additions to widen them. The use of railroad methods on early highways is hard to identify but its clear that their approaches to grades, construction, materials, and methods spilled over into highway construction. This is noticeable in the early years and on roads that follow rail lines.

The earliest known concrete paving in Iowa was privately undertaken in downtown LeMars in 1904. A two block section of Eagle Street along the downtown square was privately financed by a local businessman and an auto club. This paving differs from the later methods of concrete paving in that instead of a continuous pour, with expansion joints between segments and integrally formed lip curbs, this earliest concrete paving method used precast, square (approximately 2 ft to 3 ft square), concrete slabs laid atop a packed clay substrate. This early and for its time "experimental" method of paving shows the problems and needs of early road makers. Small, precast, concrete pavers were easier to produce, required less material on hand, and fewer workers than were needed for a continuous concrete pour but were only applicable to pave a limited area. This method was later successfully applied to silo construction.

Roadway Width. Photos of Iowa's earliest arterial dirt surfaced roadways in the state indicate that the width of a road was extremely variable although the basic 66 ft right-of-way width was set as early as the 1830s for federal roads. Roads often grew wider as traffic increased and also when the skirting of trouble spots became necessary. While by the 1910s the standard roadway width was approximately 16 ft no clear standards were set for township and county roads in most places. Dirt or gravel surfaced roadway would narrow considerably where a bridge or culvert crossed a drainage or entered a different township or county (Figure 46). During the 1900 to 1912 phase of the study period great variation was present in all areas of road construction. After 1913 the ISHC has some plan sets for projects from that date due to the ISHC plan review process. Prior to that time plans were housed at the county offices. The first Iowa DOT plan set on file for the study routes dates from 1918, just after the 1917 Federal Aid Act.

With the usual width of culverts in 1910s being 12 ft or less this could often bottle-neck a heavily traveled road or lead to accidents (Figure 46; Table 3). Most concrete culverts and many bridges in the state were built 18 ft wide during the late 1910s. After 1916 the 18 ft road bed was accepted as the standard. After the late 1920s the 20 ft wide pavement became standardized for federally funded roadways. Between the early and late 1920s thousands of 18 ft to 20 ft wide culverts were built. When the standard width of the road pavement was increased to 22 ft, thousands of these 18 ft and 20 ft wide culverts and bridges were judged too narrow. The replacement of these structures has been an important and ongoing process. Most secondary road culverts are still functional today. Only those with the heaviest traffic levels and weight loads have been replaced to date and most of those were on current or recently decommissioned Primary Roads.

The earlier 12 ft to 16 ft wide pavements were built in a number of short stretches in Iowa. These 12 ft to under 18 ft concrete, and sometimes brick, paved roads were often built leading out of the more prosperous towns or cities. They were experimental roads and were used in two ways. The first were rural roads connecting nearby communities that had impassable stretches between them. Examples of this on the Blue Grass Road are the 1½ mile long Fredonia to Columbus Junction concrete road begun in 1914. The Columbus Junction to Fredonia road is a 16 ft wide concrete paved road that was built across the sandy terraces bordering the Iowa River. The area had a long history of poor road conditions. The second type was urban. In 1916 the West Burlington Road was first paved with brick for a mile fronting the train yards. It later was extended with concrete for and additional nine miles west towards Mount Pleasant (Iowa 406). Sioux City and Davenport also built extensive rural and urban connecting roads of brick.

Another basic type of early non-rural concrete paving was done in the downtown areas of moderately sized Iowa cities. These include such early projects as the half block of Eagle Street in LeMars in 1903 and the 1906–1911 Eddyville downtown and cemetery roads, all of which were paid for through private funds. A third type of early concrete construction for a roadway consists of structures such as the 1906 Marsh bridge outside of Floyd, Iowa, which was paid for privately and built for the use of an auto association (see below). The 1893 concrete and masonry arch bridge in Lyon County could also be placed in this group. Unidentified or unlocated concrete roads or structures are possibly still extant such as the "Carson Culvert," perhaps funded by Robert N. Carson, on the old Red Ball Road in Washington County.

Conclusions. The width of a roadway, both from right-of-way line to right-of-way line to the width of the pavement itself, can be indicative of a highway's construction date. The structure beneath the road bed often predate the paving and their survival is important to the integrity of the segment or route as a whole. Arterial highways in particular, especially after they became numbered state and federal routes (ISHC 1920b:3–4, 1922c:8, 1925a:8, 1925d:2, 1925e:5–16, 1925f:3–12, 1926a:front cover, 1926d:7–8,14, 1926g:4–5, 1930d:5–6), often saw the most updates and improvements over time. They also were the first to receive federal aid after the 1913 Federal Tax Act and the 1916 National Transportation Act (Lockridge Times 1916e:2–4, 1916o:6, 1917c:4; ISHC and Department of Justice 1915:5, 95–103;

Weingroff 2002a, 2002b). After this time the 18 ft pavement was accepted as the standard. With wider pavements coming soon afterward the destruction of 18 ft wide highways in Iowa has been an ongoing process.

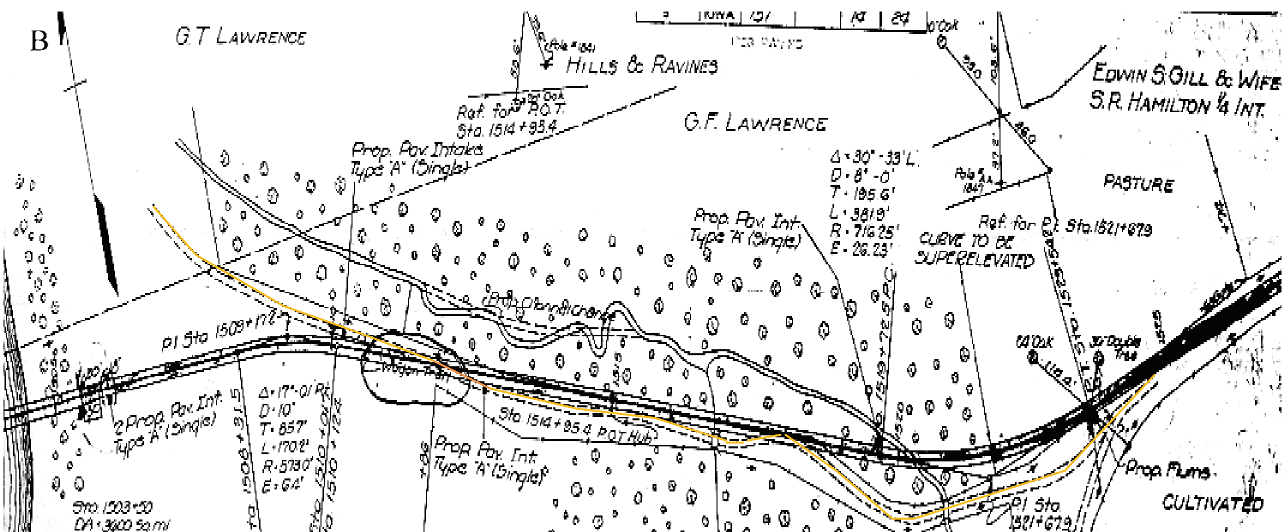


Figure 46. A. Old culvert (1910s) constricts new road width in Washington County (Iowa DOT Library). B. ISHC's 1926 plan showing changes in road location west of Mount Pleasant (ISHC Plans 1926). Note location of sinuous pioneer wagon trail in orange.

IOWA ARTERIAL HIGHWAY CONSTRUCTION ERAS

The construction of roads in Iowa can be broken down into eras. These divisions relate to the several aspects. The most important is the introduction of new technologies. They led to improved construction methods, design specifications that promoted the standardization of highway widths, and approved material. After the first era road construction was also linked to statewide and national political movements. One of basic factors is road width, which was related to the adoption of statewide standards.

1900–1912. This is foremost an experimental era in Iowa's roads. It is marked by the introduction of two important factors. These were the introduction of the King Road Drag and in 1904 the Road Schools initiated by the ISHC. It is characterized by small scale equipment powered by teams of horses and intensive hand labor. For materials, local bank and river gravels were used for concrete aggregate. In rare instances shell was used in the aggregate. Large square or twisted rebar was introduced although its use remained limited. Pavement widths were from 12 ft to 18 ft and up to 8" thick. The pavements exhibit no lip-curbs and the Baker-type iron expansion joint was introduced. During this time less than 25 miles of concrete paved roads existed across the whole state (Table 2). Individual concrete paving lengths were generally less than 3 miles. Low parapet top culverts were the most common type built. Road construction involved local contractors. The end of this era saw the beginnings of the first Registered Highways. The statewide focus was on road dragging.

1913–1918. During this era the statewide standardization of design elements and plan overview by the ISHC begins. Pavement widths range from 16 ft to 18 ft. The introduction of concrete integral lip-curbs begins, primarily located at drainage points, along with a general increase in associated drainage elements. It is the time of the greatest construction of poured-in-place concrete culvert construction in state. The early parapet culverts were still built but were being superseded by poured-in-place end-wall and drop culverts. The first influence of federal funding is felt resulting in the beginnings of the division of primary and secondary roads. The increased use of power equipment began but much hand labor and horse-drawn equipment was still present. Paving project lengths approached 20 miles. Most of Iowa's Primary Roads were still being brought to grade and graveled. Statewide and regional contractors were being used but materials acquisition was still primarily local. There were around 25 miles of concrete paved roads in state. The focus was on meeting federal standards and safety. In 1914 three Portland cement plants were operating in Iowa.

1919–1927. This era started with a period of experimentation and roads being brought-to-grade. The early focus of roads being brought-to-grade was pushed by Federal funding for large projects (Public Roads Journal 1919b:29, 32; 1920b:26). Surplus military equipment (trucks, graders, tractors) make a large impact on road county construction. While powered equipment increase in size and number horse teams are still widely used. Increasing standardization of materials, design, and testing procedures occurred. There is wide variation in aggregate components with an increase in state quarried dolomite on Primary Roads. Pavement widths of 18 ft to 20 ft become standard and pavement thickness increases to 10". Concrete manufacturers expand across state. Safety becomes a major focus in road design resulting in the elimination of at-grade crossings and the introduction of safety devices and signage within the right-of-way. The approximately 25 miles of concrete paving in the state in 1919 led to 940 miles of concrete paving by 1927. The year 1927 was also the official end of all Registered Highways. This was the dominant period of Art Deco-styling for highway structures system (Beyer and Wright 1920:42). Towards the end of the era round rebar makes its first appearance in large primary road construction projects. Culverts and bridges are large to match the increased pavement widths. Generally, those on slightly earlier roads were not retrofitted.

1928–1940. This era focused on cross-state Primary Roads construction with concrete pavement on seven of Iowa's main arterials. The 18 ft to 20 ft concrete pavement widths continue but with 22 ft pavements under consideration. Increased pavement width and heavier traffic results in even thicker pavements. Concrete culvert construction increases and the era sees the large scale replacement of major river bridges for automobile traffic. Fewer roads with integral lip-curbs being built as the cost of curb construction and their maintenance was found to no longer be effective. A general straightening of roads statewide was in vogue resulting in numerous cut-off segments from the previous eras. Heavy mechanization with caterpillar tractors and large scale machinery causes hand labor to decrease sharply towards its end. There is an increasing use of state quarry dolomite in the aggregates. Simplification of Art Deco design elements presages a switch to Art Moderne-styling.

1941–1948. Road construction was drastically curtailed during the war due to manpower and material shortages. There was some experimentation due to material shortages, especially in bridge design. The invention of the slip-form paver changes the highway construction process. A change in cement formulation alters color and texture of concrete aggregates. Iowa continues the building of local infrastructure with upgrades on arterials for increasingly heavy traffic. Highways exhibit 20 ft to 22 ft pavement widths with standardized rebar, culverts, and bridges. Art Moderne-styling on many structures persists through next decade. Most activity was focused on fixing what had been neglected during the war. A great increase in truck traffic is seen. The slip-form paver was introduced in 1947. Post-war surge in highway design and vision was leading up to the next decade's reinvention of the interstate highway system.

CONCRETE ROADS

Introduction. As noted above the earliest poured concrete pavements in Iowa show great variation in width, thickness, aggregates, and methods. From 1900 to 1912 this variation was at its greatest due both to an initial lack of statewide standards, lack of understanding of consistent concrete production, and general experimentation, both successful and unsuccessful by local builders and contractors. The basic steps to insure a proper construction were known but the implementation of these general procedures took a great deal of both practical and scientific experimentation before they were well understood. The introduction of standards for concrete construction began in 1905 with the first ISHC Bulletin, The Manual for Iowa Highway Officers. These earliest statewide standards saw a good deal of experimentation, modification, and resultant evolution as the results of previous experiences became known. This early period of experimentation ended with the formulation of the ISHC standards in 1913. The full adoption of these standardized construction methods and techniques by 1920 although for structures that were not state funded considerable leeway was still to be found. Especially important was the state's inspection of structures prior to their use.

While good drainageways are mandatory for any good road and especially for hard surfaced roads, the best underlayment for concrete paving was concrete culverts. Concrete was also used occasionally as an underlayment for brick roads. As noted previously concrete culverts and bridges frequently predated the paving which passed over them and may survive beneath a number of later repaving, widening, and other alterations. In regards to this the 1905, Manual for Highway Officers relates:

> This work deals with a field now just developing in Iowa...In two or three eastern states…all permanent improvement of the highways is under state supervision, reinforced concrete is fast superseding all other material for culverts and bridges…Here, we have had a long and disastrous experience with various materials, and yet have no fixed policy…In most of the counties townships are required to build and maintain all small bridges and culverts up to 16 feet span…There are over 4,000 men whom it is necessary to convince that a type of construction radically different from the one which they are commonly using is better and more economical.
>
> Experience with the different materials which are now commonly used for culverts has been costly. Tile and sewer culverts as originally used are not satisfactory, which is also true of cast and sheet iron, except where these materials have been used with so much concrete that it might have been more economical for the entire construction. With vitrified pipe considerable difficulty is experienced, due to their freezing full

of water and bursting during cold weather, or due to their breaking in muddy weather, when the wheels cut through to them. The cast iron culverts will originally cost more than concrete culverts of the same capacity when each is properly provided with wing walls and aprons. Lumber is becoming higher each year and the quality is deteriorating. Three-inch planks of hemlock and pine have been largely used in culvert construction. A two-plank culvert could not be built for less than $15.00. Where the lumber culvert tops and bridge floors are exposed to the travel on the main roads, the wear is very fast [ISHC 1905a:82–83].

Table 2. Iowa Primary Roads System-Concrete Surfaced Road Miles: 1900–1948

		Mileage				Mileage	
Year	**Gravel**	**Paved**	**Grade**	**Year**	**Gravel**	**Paved**	**Grade**
1900		0		1925	2,461	569	1,796
1901		0		1926	2,818	650	1,732
1902		0		1927	3,226	940	1,417
1903		0		1928	3,221	1,625	1,114
1904		0		1929	3,137	2,317	715
1905		0		1930	2,863	3,272	513
1906		0		1931	3,070	3,804	281
1907		0		1932	3,067	4,086	117
1908		0		1933	3,083	4,202	52
1909		0		1934	2,933	4,313	175
1910				1935	3,297	4,374	92
1911				1936	3,030	4,546	63
1912				1937	2,890	4,818	50
1913				1938	2,690	5,090	52
1914				1939	2,661	5,135	51
1915			462.7	1940	2,592	5,208	22
1916			625.2	1941	2,335	5,459	36
1917			879.97	1942			
1918				1943			
1919	624	25	800	1944			
1920	792	67	1,021	1945	2,471	6,316	34
1921	1,157	236	1,448	1946	2,377	6,382	38
1922	1,558	334	1,761	1947			
1923	1,889	419	2,001	1948			
1924	2,164	502	1,934				

(ISHC 1918a:2, 1921a:3–9; Thompson 1989:183

Forming Concrete Roads

Introduction. As previously noted, the use of poured concrete initiated many changes in road building. For concrete roads the substrate was laid, packed, and graded like the old dirt and gravel roads that preceded it. The two real changes in road building technology were the use of poured concrete as a permanent surfacing material and the way it was applied (Harvey 1916:6–7).

After the preparation of the sub-grade the process of pouring the pavement could begin. Concrete has a relatively short period in which it can be manipulated. This short period necessitates the speedy mixing, transportation, and pouring of the concrete. Iowa’s early poured concrete roads were formed in a simple manner that has in most regards remained unchanged for small concrete slab construction until the present. A form is a structure used to give shape to something. In concrete construction it is a structure of boards or metal into which concrete is poured to set. Forms held the wet concrete in both the desired shape and at the prescribed location until it had time to set.

Forming and Mixing. Concrete road beds were "formed" up. Just as today, the sides of the road's bed were lined with metal or most commonly wooden planks for forms that held the concrete in place. During the early period this was a hand process and required the use of multiple wagon teams, workmen, materials, and equipment. Prior to the introduction of the fully automated slip-form paver in the 1950s various degrees of handwork were required but the size, capacity, and capability of the machinery changed the process considerably as less and less handwork was employed.

Early road crews were required to mix the quarried materials into small batches of aggregate. Then in the mixer the Portland cement and water were added to make the aggregate. Much of the earliest concrete was made by hand without the use of a power mixer. In such circumstances large shallow pans or tanks were used. The mixer utilized steam and later gasoline powered engines and were designed to move along the front end of the roadway as it progressed. After the concrete was poured in place by workmen it was vibrated or further hand mixed to drive out vacuities. In pours for culverts and footings where little or no power machinery was used the workmen used their shovels, especially around the edges to get a smooth surface and mix the materials. When the concrete had been mixed and the bubbles driven out the workmen leveled it with a board, forming a crown, and then floated the surface.

In many instances no forms were used for the footings or pilings of large culvert or bridge structures. The ground was excavated to form a rectangular pit with square sides and a slightly rounded bottom. The concrete was poured directly into this hole and allowed to set. It was suggested that a pouring depth of no more than 6" be used at a time. Where erosion has undercut the surface and sides of pre-1940 concrete piling's or culvert's footings they often exhibit these molded shovel marks cast into the surface of the concrete. This construction method is almost always done at sites with deep clay soils, which are solid, impermeable, hold a clean edge, and can substitute for a built form with no difficulty.

Concrete Culverts. The box culvert was selected by the ISHC in 1905 as the type most simple and economical to design (see Culvert section below). However, within this basic type there was a great deal of variation. This form of culvert construction was also commonly known as the flat-top or slab culverts. Each side and also the top and bottom acts as a beam and the stresses imposed may be easily and accurately figured. There is no thrust tending to force the walls outward as is true with arch culverts. The dimensions of the culvert should be proportioned to the loads they are to carry and in order to do this a uniform practice was adopted. These culverts were designed to carry a 15 ton road roller and a dead load of 600 lbs. per linear foot (ISHC 1905a:83–84). Through experimentation it had been found that the basic premise of this construction was that:

> Slab or beam construction is based on the theory that concrete by the addition of a certain amount of steel, distributed through it, can be made as strong in tension as it is in compression...reinforced concrete construction…is more economical, being much stronger than is plain concrete...
>
> The forms for the concrete should be constructed of lumber so stiff that there will be no bulging when the concrete is rammed into place…The concrete should be deposited in layers not over 6″ in thickness and thoroughly rammed into place…When joints have to be made between two days work, the surface of the concrete should be left as rough as possible. Before a fresh layer is added, the old surfaces should be thoroughly cleaned and wet. Then to insure a good joint, neat cement should be sprinkled over it [ISHC 1905a:90–93].

For more on the construction and types of concrete culverts, especially those found along the study routes, see the discussion of culverts and bridges and the discussion of individual structures within the various sections of the study routes in *The Two Iowa Highways Today* below. Within local areas a wide variety of culverts and structures were produced. They reflected creative variety and stylistic preference.

Concrete Highway Grades. A good deal of practical knowledge had been learned during the construction of Iowa's 19th century railroad network. In the early 20th century this hard-gained knowledge and new methods and materials was applied to road construction. In 1905 an article appeared discussing Momentum Grade that had clear application to road construction (Transit 1905:1). In most areas of the state large scale grade construction, started around 1920, quickly resulted in new grades being built. An example is the Baker Hill grade west of Bellevue, Jackson County (see Figure 38). It was along Primary Road 62. This 5,300 ft grade required the removal of 60,000 cubic yards of earth of which 25,000 were of rock. Jason D. Jones of Cedar Rapids was to be the contractor for this massive cut-and-fill operation. So large an undertaking was it at the time that it necessitated its own small gauge railway running atop a wooden trestle and a 15 ft x 200 ft culvert (Transit 1926d:197). The dump cars were to run atop a wooden trestle that would act as a brace for the fill. This was an innovative method used on several Iowa roads.

In the early years of the study period the grades for concrete highways were treated differently in different areas of the both Iowa and the country. The original practice was not to exceed five percent, but grades as high as eight percent were built under certain conditions. The road's grade seems to be limited only by the ability of the wet concrete to run during the process of construction, by the character of the mix, and the kind of traffic to use it. Even on a steep grade the use of coarse sand on its surface prevented such roads from being slippery. It was believed that "brooming" of the surface facilitated the traction hold of all classes of traffic. Floating the concrete's surface was to be kept at a minimum on a grade as this operation brought the finer particles to the surface giving a smooth top (Road-Maker 1917b:56).

Figure 47. A. Mooned-Out curve on old U.S. 18 west of Algona, Kossuth County. B. Supra-elevated curve on integral lip-curbed section of old U.S. 20 east of Sioux City, Woodbury County. 2003 survey photos.

Prior to 1916, in order to obviate the danger of accidents on roads of 16 ft or less widths, the recommended practice was the widening or mooning out of the curves, so that in some cases for those of small radius at the center the actual curve was as much as 22 ft to 24 ft wide. Even until the late 1920s concrete arterials with supra-elevated curves were the most common (Figure 47). It was thought at the time that supra-elevated curves both helped drainage and as speeds were so slow that it made little difference to the driver. It was also thought to be good practice to give the outside of these curves a super-elevation in order to make easier the steering of a car, to lessen the likelihood of skidding, and to insure greater safety in taking these curves at speed. This was also objected to at the time as inducing people to travel round these curves at too high speed. At that time speeding was viewed as an inherent mania and was thought to be unrelated to external conditions. Certainly banked curves lessen the casualties resulting from it (Road-Maker 1917b:56) and supra-elevated curves became common as speeds increased.

Cracking of the pavement was generally due to the unequal settlement of a poor sub-grade. If the road was to be satisfactory it was of first importance that a good sub-grade be secured. In 1917, the following were considered the essentials of a good sub-grade: first: that it must have uniform load bearing power. If an old road bed was used it must be scarified, reshaped and rerolled for the entire width of the pavement, removing all large stone to a depth of 6″ (Road-Maker 1917b:56). Second, it must be dry. Ditches should be low enough to take away the water from the pavement. With unstable soil good results can be secured by providing sub-drains and spreading a layer of gravel–preferably a run of bank gravel–over the sub-grade to increase its stability. Material used for this purpose must be impervious; if it is porous it will act during wet periods as a reservoir, which, under conditions of frost, will break the pavement (ISHC 1925b:Index, 1925c:Index, 1927e:Index, 1930b:Index, 1930c:Index; Crum 1936:369–379; Bruce 1934:77–85, Stewart 1936:369–379). In 1927, a preliminary study by the Highway Research Board related that "...in a preliminary study of underdrainage…that tile underdrain, either with or without gravel sub-base, when installed at a good depth along the edge of the pavement slab, is very effective…Sub-base, unless thoroughly drained with tile, has been demonstrated to be worse by far than no subgrade treatment at all" (Transit 1927:137).

Figure 48. A. Concrete paving of Fredonia to Columbus Junction road with forms in place (ISHC 1914c). B. Pour in progress (ISHC 1914d) (Photos #2255 and #3080, Iowa DOT Library).

It was considered that the concrete should have metal reinforcements. Prior to 1916 this was to be done primarily only under very bad, that is, unequal soil conditions. Whenever the supporting power of the sub-grade changed, as from rock to earth, or passing over a trench, metal reinforcement was recommended. Experience to that date had indicated that "the expense of reinforcement is not justified in gravelly or sandy soils where good natural drainage prevails" (Road-Maker 1917b:56). This last statement appears to have been shown to be erroneous over time. Omitting the metal reinforcement was a cost saving construction approach but it was soon recognized that rebar greatly increased the strength and durability of the pavement and that it more than paid for its self in the long run.

POURING CONCRETE HIGHWAYS

Introduction. As noted above the use of concrete in highway construction necessitated the use of forms and molds. While the forms for the pavement itself were relatively simple, those for culverts, bridges, and drains varied greatly in their complexity and style. Both the ISHC bulletins and popular magazine, such as Road-Maker, provided the background for understanding the evolution of both highway pavements and drainage structures. Integral pavement elements such as curbs were hand shaped, cast, and formed with a variety of means. The use of forms for the sides of the highway or for structure construction was the primary basis for concrete highway construction (Figures 48–49, also see Figures 25B, 27, 71C).

The construction of Iowa's earliest concrete paving had progressed from intensive and almost complete handwork, to little or no interaction with the wet concrete by the time of the introduction of the slip-form paving machine, developed by James Johnson at the ISHC in 1947 (Iowa DOT 1997:30). There was a technical evolution of machinery, materials, and methods almost continuously from 1900 until 1948. Four early construction milestones appeared close together. The first was the establishment of the road testing lab in Ames as early as 1895. The second was the 1905 Manual for Iowa Highway Officers, which dealt with adopting standardized materials and techniques for constructing culverts and bridges. The third, and an outgrowth of the second, was the ISHC organized road schools (1905–1918). These taught how to build and maintain dirt then gravel roads, which became the foundation for concrete paving. A fourth milestone was the introduction of the traveling concrete mixer, which increased in speed and capacity over time. This process was greatly speeded up with the introduction of the official Highway Testing School in 1920 at Iowa State University in Ames. From this point on methods and materials were rigorously tested and the findings had a significant effect on the highway industry in and beyond Iowa.

Construction. It should be noted that while some contractors were very advanced in their methods and machinery others lagged behind with innovations slow to occur. A lot of the innovative methods were applied in those counties that had the greatest “will” to build concrete roads. This happened concurrently within the counties with the largest highway budgets. The ISHC’s and other’s highway maps of Iowa between 1920 and 1947 document the ever increasing amount of concrete paved roads in the state (Gousha 1935; Rand McNally 1923). They show that concrete paved roads increased greatly in the late 1920s through the 1930s. They also show that Iowa for the most part has changed relatively little in the paved roads of the secondary system between 1935 and the present. These maps also indicate that certain counties in the state were much more capable and efficient in getting and applying monies, whether local, state, or federal to highway construction projects. While it would first appear that concrete paving was earliest and most common in or near the state’s largest cities this was not the case.

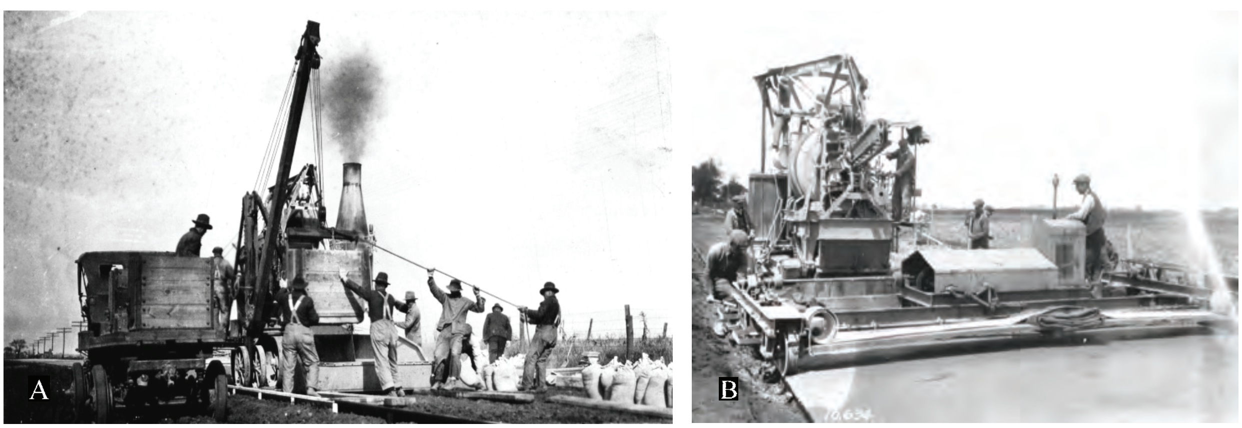


Figure 49. A. A traveling mixer (ca. 1926) ready to start pour on the route of the Red Ball and River to River roads west of Iowa City through Coralville (Iowa DOT Library–Construction Folder). Note forms and cement bags. B. A ca. 1950 slip-form paver (Iowa DOT Library–Paving Folder, Photo #10,634).

Most of the concrete highways poured were near middle-sized cities or large towns. In this vein the ten miles of paved highway between Mason City and Clear Lake in Cerro Gordo County got national attention during its construction between 1913 and 1918 (Iowan 1918b:36). At that time ten whole miles of paved road was unbelievable. This road became an important route during the Registered Highway Route Era (1914–1925) (Iowa DOT 1986). Sequentially it was part of the Pershing Way (1919), the National Parks Pike (1920), the Atlantic-Yellowstone-Pacific Highway (1923), and the Black Hills Highway (1924). Its paved surface drew registered highway route organizers to move their routes to include its paved surface. It was seen as a transportation and engineering wonder of its time by the public and by the national highway engineering community and route mapping agencies as well.

In 1920 the ISHC summary for the year shows that for all Iowa counties 66.8 miles were hard surface paved with concrete or brick (ISHC 1920a:6). Another 792.3 miles were gravel, 1,021.4 miles were at permanent grade, and 4,732.6 miles were of earth for a total of 6,619.1 miles of road in the state. In 1921 Scott County had completed 17.4 miles of brick road and was building 6.4 miles more (ISHC 1921a:3–9).

After 1920 the cities with the greatest desire to acquire and devote the newly available federal gasoline tax dollars to road construction were located along the main transcontinental roads. However, in Iowa a handful of counties dominated this monetary boon. In the early 1920s several northern Iowa counties (Floyd, Cerro Gordo, Hancock, Kossuth, O'Brien) along the Hawkeye Highway (current U.S. 18) were the most aggressive in the state towards acquiring federal transportation dollars and quickly led the state and even the nation in the miles of concrete paved highways built. Other Iowa counties with concrete or other type permanent road paving included Clinton, Scott, Polk, and Woodbury (Thompson 1989:152). Some of this paving extended into rural areas and connected nearby communities.

Engineering and Motor Car Tourism. The importance of having pavement through a community is attested by the 10 mile concrete section of the Mason City to Clear Lake Road. Begun in 1913 as one of Iowa's first federally funded projects it was completed in 1918. This was just after the second round of federal and state road aid and tax act funds became available in 1917. It was the first paved inter-urban highway in Iowa. From June 30th to July 5th of 1918, a six day period, the total number of vehicles using the road was 7,054, an incredible number. Of these 73 were horse-drawn vehicles (ISHC 1918a:8).

What stands out are the large numbers and types of mechanized vehicles. Roadster automobiles numbered 715 while touring cars numbered 5,997. Motor trucks accounted for 154. The number of touring cars present at this relatively early date (1918) suggests that cross-country travelers were coming from all points to use or just experience the road. Four registered highway associations redirected their marked routes along it. The articles in both local newspapers and national journals are plentiful about people driving long distances just to travel this and any newly completed section of paved roadway.

A like event occurred on the Fredonia to Columbus Junction segment of The Great White Way and Blue Grass Road when it was completed in 1916. People would travel from Davenport, Fort Madison, Muscatine, and as far as Keokuk to travel at the amazing speed of 35 m.p.h. and marvel at the concrete pavement, with its right angle turns in the middle of the country, through the previously nearly impassable sand dunes along the Iowa River. In 1922 Fredonia was forced to incorporate in order to control speeders on the pavement.

Similarly, around that same time a roadway was first opened along the Mississippi River associated with the lock and dam construction in Keokuk, it also drew lots of tourist traffic. The lock and dam was considered an "engineering marvel" and the road built around it was "state of the art." As noted below, both the lock and dam and the road to it became tourist destinations in themselves:

> Work is being rapidly pushed on the Iowa Boulevard along the shore of the lake which will be formed by the Keokuk dam. This road will be one of the very finest that can be built and will undoubtedly be an attraction to tourists from all over the county. A large force of men are at work…which is being cut out and graded with the assistance of a steam shovel. The road will be surfaced and will be as permanent as modern construction will permit…when completed this stretch of Iowa road will compare favorably with any in Europe [Road-Maker 1912h:12].

The Keokuk dam altered local and cross country traffic patterns just as the Mason City to Clear Lake Road had a few years later. Road associations modified their routes to include this most modern road and soon travelers and tourists were speeding through while local merchants and entrepreneurs capitalized on the opportunity (Axelrod 1979:142–143).

Aside from such state or federally built main roads, where tourism was mostly a happy accident of new road construction, park roads in Iowa were beginning to be designed to attract motor car tourism. This followed a national movement for such roads in the country's national parks. The new road through

Pike's Peak Park in Clayton County was the first of its type envisioned in the state and was the subject of an article in Road-Maker magazine (Road-Maker 1916l:3–5). The road was designed with "scenic vistas" in mind and the roadway's elements such as gates, walls, culverts, bridges, and fences were built within the then popular movement of "rustic" architecture. This architectural style complemented both the designer's romantic vision and the park's overall visual interpretation. When it was completed the new road was likened to being in the Swiss Alps in Iowa. Many such park road projects in Iowa specifically used CCC and WPA workers in their construction and many retain their rustic-styled buildings and structures to this day (Alleger and Alleger ca. 1980; McKay 1989).

Surviving sections or segments of roads of this importance with good integrity may be considered significant. This interplay of federal projects with state roads and local citizenry was of great importance to Iowa. The Keokuk dam preceded the construction of WPA dams by many years and covered the earlier government canal, which was put through the rapids in the 19th century. The roads built for the project were on both the Illinois and Iowa sides. The Iowa side had two tracks. One was for motor vehicles and the other for horse-drawn vehicles. There was some discussion about right-of-way in Des Moines County as some farmers wanted it at 60 ft and some at 40 ft, so both were implemented. Iowa county officials played important roles in this project. The lake was compared to a Scottish loch and thought very scenic. Similar, in 1916 the new McGregor Road was touted as "The Playground of the West" (Clark 1916:3–5).

CURBS, BRIDGES, CULVERTS, AND DRAINS

Introduction. Drainage along roadsides has been recognized as a critical aspect of road construction and maintenance since Roman times. During Iowa's Good Roads Era the need for drainage was promoted and many of Iowa's roads had drainage improvements as one of their primary goals. Until 1900, and for a good while after, in many areas of Iowa little in the way of formal road drainage systems were in place. The design and construction of drainage systems along all roads was left to the county engineer, township supervisor, or farmer. This led to various levels of sophistication and implementation.

All areas of Iowa through which roads ran needed some form of drainage and the seasonality of Iowa's climate left many roads impassable, especially in the spring. Topography, soil types and conditions, location, and elevation played critical roles in Iowa's desire to get out of the mud. Much of Iowa remained perennially wet and some areas of the state such as the Skunk River Bottoms in Henry County, western Iowa's gumbo, or the pothole country of the Des Moines Lobe had myriad drainage problems. Some areas such as the Skunk Bottoms had bad reputations in the east as early as the 1840s. In various sandy parts of Iowa quicksand was not unusual on or along roadways and travelers had to beware. The seasonal problem with quicksand (and sand in general) was one of the reasons for constructing the Fredonia to Columbus Junction Road.

Each of Iowa's physiographic provinces has its own drainage requirements and special problems. Certain Iowa landforms such as in north central Iowa on the Des Moines Lobe and in southern Iowa in the Southern Iowa Drift Plain (Prior 1991:31, 58) road drainage was of special importance. On the Des Moines Lobe the area is characterized by multitudinous small ponds or "prairie potholes" that dot the landscape. In southern Iowa the deeply incised drainages and rocky surfaces produced a drainage pattern characterized by numerous small seasonal streams and springs and fairly large rivers and creeks, all of which needed bridging. In northeastern Iowa's Paleozoic Plateau physiographic province high rocky cliffs with steeply incised rock bottomed creeks and rivers suffered from frequent flash floods that would wipe out every drain, culvert, and bridge in a county-wide drainage in a single night.

One should keep in mind that the culverts and structures under a pavement may often predate the road surface. Functional culverts were not discarded but were rather either built right over or occasionally expanded. Culverts for early 12 ft or 16 ft wide roads, although uncommon, were often expanded to meet the needs of an 18 ft road bed. These culverts were subsequently altered again to meet later needs. Anyone familiar with driving on rural Iowa roads has encountered the bridge or culvert that is narrower than the road or of only one lane. On one study route a good example of such reuse, reconstruction, and alteration is the section of old Iowa 8/U.S. 34 between Agency and Ottumwa (see below, U.S. 34) where the railroad grade and its masonry culverts were expanded for automobiles with concrete on either end.

When the ISHC published their Manual for Iowa Highway Officers in 1905, it devoted and entire section to culverts. Prior to that time culverts and drain pipes were made of a variety of materials. Wood, tile, brick, iron, and stone were all used with various degrees of success. Due to the lack of road money counties often opted for the cheapest forms and materials. Wooden and tile culverts were the most common in most of the state and many landowners and farmers were required to provide and maintain their own culverts, drains, and bridges along or within their property. The use of concrete quickly took over and displaced the use of earlier materials.

A

COMPARISON OF CLASSIFIED BRIDGE EXPENDITURES BY YEARS

	1914		1915		1916	
Concrete Box	4621	$1,432,849	4886	$1,675 889	5136	$1,883,066
Circular concrete culvert	820	76,813	708	68,155	880	105,754
Concrete arch culverts	213	47,349	123	23,309	167	16,229
Concrete pipe	846	78,563	2013	89,751	2768	89,614
Encased vitrified pipe	215	16,155	518	31,084	30686	721,325
Corrugated pipe	2559	146,857	27768	537,464	56	7,007
Mnoasry arch culverts	7	2,090	3	803	1566	77,925
Boiler pipe culverts	886	74,032	1859	98,018	478	41.089
Cast iron pipe	79	5,836	255	21,085	30	5 563
Masonry box culverts	0	0	23	5,421	1085	82.250
Head walls on culverts	52	7,307	594	62,284	128	165,556
Concrete slab bridges	181	199,407	138	173,036	42	73,908
Concrete arch bridges	23	67,846	15	199 556	90	91,888
Concrete abutments	32	22,914	68	60,906	23	45,143
Concrete thru girders	13	21,083	16	35,668	79	187,567
Concrete deck girders	49	115,788	55	167 273	26	12,839
Retaining walls	9	3,744	41	14,085	4	3.434
Masonry abutments	0	0	6	2,960	129	65 171
I-beam spans on conc. abuts.	245	249,576	404	64,479	411	619,114
I-beam spans on conc. abuts.	245	249.576	404	46,479	4	13 447
Steel girders	1	1,659	7	21,200	68	86 340
Pony truss on piling, wood floor	10	4,366	39	46,002	185	545,556
Pony truss on conc. abuts.	153	349,488	214	566,449	23	133,982
High steel trusses	14	52,729	23	82,309	1	4.422
Wood pile bridges	444	99,914	834	210,305	773	180,462
Miscellaneous	83	15,474	644	186,788	.....	54.834
Total	11589	$3,103,203	41364	$4,886,888	44616	$5,248,332

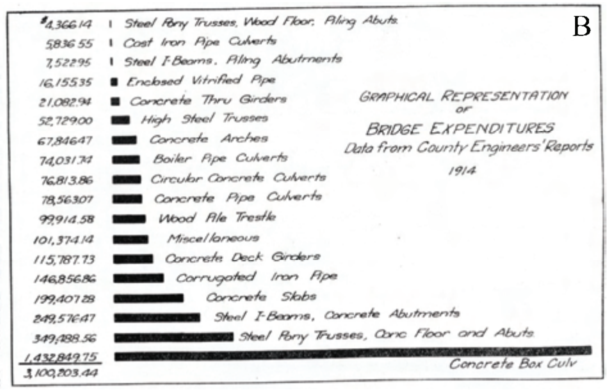


Figure 50. A. Comparison of classified bridge expenditures by years, 1914–1916 (ISHC 1918a:9). B. Graphical representation of bridge expenditures: data from county engineer's 1914 report (ISHC 1915g:4).

In 1914 over 5,000 culverts were built (Figure 50) (ISHC 1915i:cover). Between 1914 and 1917 Iowa road builders went on a concrete culvert and bridge building spree. In 1915, Iowa built 7,131 permanent bridges and culverts and 34,233 temporary bridges and culverts. In 1916, 11,116 permanent bridges and culverts and 33,500 temporary bridges and culverts. In 1917, 7,166 permanent bridges and culverts were built along with 8,572 temporary ones. These statistics show that during the years from 1914 to 1917 that Iowa experienced an unprecedented period of bridge and culvert construction. After 1917 the number of temporary bridges and culverts built dropped dramatically and the rate of construction of permanent features also slowed down. The year 1916 showed the most remarkable period of culvert and bridge construction, both permanent and temporary. With such numbers reported it seems likely that many of the extant culverts in the state date from that year or within a four year time period (ISHC 1918a:9).

Table 3 illustrates both the types and numbers of permanent structures built between 1916 and 1917. It differentiates between 10 types of culverts, 12 types of bridges, three types of retaining walls and abutments and gives an idea of the relative commonality or rarity of each type. With a total of 58 masonry arch culverts and 54 masonry box culverts it would appear that for Iowa's roads the stone masonry culvert is an uncommon form and the stone masonry box and arch culverts are rare types. Also the concrete arch culvert totaled only 208 statewide when compared to the 9,466 concrete box culverts alone. Likewise, steel girder and steel deck truss bridges are very uncommon from this period.

Table 3 also shows that while corrugated pipe culverts (35,810) were the most common, masonry arch culverts (58) were the least, while concrete arch culverts were still uncommon with only 208. Concrete box culverts (9,466) were more than double the number of concrete pipe culverts (4,584), and there were three times as many boiler pipe culverts (2,090) built compared to cast iron pipe culverts (666).

In terms of the evaluation of any culvert's, bridge's, and abutment's potential historical significance, uncommon types or forms should receive a higher degree of recordation and interpretation when encountered. Additionally, they may possibly be given a higher initial potential significance rating due to the smaller number of probable survivors from this period. While it is important that such rare or uncommon structures be correctly identified in the field it is probably *more* important that the common types be correctly identified, as these will be the types most encountered and evaluated. With the common types of culverts well known the uncommon will stand out. The low numbers of cast iron pipe culverts shows that they were not very popular in Iowa and those that were built were in specific areas of the state.

Table 3. Types of 1916 and 1917 Structures.

Type	**Numbers by Year**		**Total**
	1916	1917	
Concrete box culvert	5,136	4,330	9,466
Circular concrete culverts	880	782	1,602
Concrete arch culverts	147	61	208
Concrete pipe culverts	2,768	1,816*	4,584
Corrugated pipe culverts	30,486	5,330*	35,816
Masonry arch culverts	56	2	58
Boiler pipe culverts	1,566	524*	2,090
Cast iron pipe culverts	478	188*	666
Masonry box culverts	30	24	54
Head walls on culverts	1,085	208	1,293
Concrete slab bridges	128	115	243
Concrete arch bridges	42	8	50
Concrete abutments	90	37	127
Concrete thru girders	23	22	45
Concrete deck girders	79	64	143
Retaining walls	24	13	37
Masonry abutments	4	8	12
I-beam spans on piling abutments	129	69	198
I-beam spans on conc. abutments	411	456	867
Steel girders, concrete abutments	4	1	5
Pony trusses on piling, wood floor	68	35	103
Pony truss with conc. abutments	185	201	386
High steel trusses, conc. abutments	23	27	50
Deck trusses, conc. Abutments	1	6	7
Wood pile bridges	773	811**	1,584
Miscellaneous bridges and culverts		600**	600

*Total number does not include pipe culverts furnished to townships
**Total number does not include those furnished to townships
(ISHC 1918a:9)

Major and Minor Culvert Nomenclature. During the study period many different types of culverts and bridges were built. The distinction of major or minor culverts is mostly based on length but these terms were not used by the ISHC. If a drainage structure of any length under the road was called a culvert during that period then it should be applied to the present. One example is the 15 ft x 200 ft culvert built west of Bellevue in Jackson County in 1926 (Transit 1926d:197). It was called a culvert in the 1926 article and should retain that designation. In 1905 the ISHC based its culvert statistics on the 12 ft length as the maximum length at that time. This measurement is taken following the roadway's path and not across its width. While size or length of a culvert has some very general basis for dating, as culverts generally get larger and more complex over time, this was not a survey criterion for accurate dating due to the unreliability of using size for dating. For the purpose of the present survey and evaluation, culverts under 12 ft were considered minor culverts (ISHC 1922d:4) and those larger, major culverts. The latter might include multiple spans or be associated with large bridges of any date.

Major Culverts. For the purposes of the investigation major culverts are those over 6 ft in length and often have tall siderails. In some areas of the state during the early part of the study period (1900–1948) box culverts over 250 ft in width were being built under special circumstances. While culverts within the survey areas on the study routes were generally 6 ft to 10 ft in length a few approached the size of small bridges; which probably preceded them, or had multiple sections. Major culverts are large constructions.

Minor Culverts. For the purposes of this investigation minor culverts are drainage devices that generally are less than 6 ft long and are often much smaller. They are by far the most numerous. The figure below only includes culverts 12 ft long or less (Figure 51). There are generally two types of minor concrete culverts that are most often encountered. They are the poured-in-place and the precast box culvert. Most poured-in-place and precast box culverts have integral concrete floors.

CULVERT TOPS

Clear Span	Depth or Thickness	Reinforcing Area Per Foot	Spacing of ¾-Inch Corr. Bars
2 feet	6 inches	.72 sq. inches	9 inches c to c
4 feet	8 inches	.96 sq. inches	6 inches c to c
6 feet	10 inches	1.20 sq. inches	5 inches c to c
8 feet	12 inches	1.44 sq. inches	4 inches c to c
10 feet	14 inches	1.68 sq. inches	4 inches c to c
12 feet	16 inches	1.92 sq. inches	3 inches c to c

CULVERT SIDES

Height Above Bottom	Thickness	Reinforcing Area Per Foot	Spacing of ½-Inch Corr. Bars
2 feet	6 inches	.36 sq. inches	8 inches c to c
4 feet	6 inches	.36 sq. inches	8 inches c to c
6 feet	10 inches	.60 sq. inches	5 inches c to c
8 feet	11 inches	.66 sq. inches	4 inches c to c

FOUNDATIONS

Clear Span	Thickness of Base for a Uniform Width of 2 Ft. 0 In.	Reinforcing Area Per Foot	Spacing of ¾-Inch Corr. Bars
2 feet	6 inches	.36 sq. inches	18 inches c to c
4 feet	9 inches	.54 sq. inches	12 inches c to c
6 feet	11 inches	.66 sq. inches	10 inches c to c
8 feet	14 inches	.84 sq. inches	8 inches c to c
10 feet	16 inches	.96 sq. inches	7 inches c to c
12 feet	18 inches	1.08 sq. inches	6 inches c to c

Figure 51. Dimensions of reinforced concrete culvert tops (A.), sides (B.), and foundation (C.) (ISHC 1905a:83).

Minor culverts are much more common than major ones. Early sections of converted examples may be of stone. Many consisted of or contained elements such as iron or ceramic pipes (for numbers see Table 3). These are often held within concrete headwalls. A pipe that is horizontal, not parallel to the road surface, and drains a natural or impounded watershed next to the right-of-way is a culvert pipe built with or without headwalls. Early tile pipe culverts were only 6" in diameter but these were soon abandoned except on farm lanes. Eight inch tile pipes are very common from the 1920s and 1930s. Large pipes (greater than 10") that run under the road but not parallel to the road surface are culverts, especially when a concrete or masonry end wall is present. These pipes can be of wood, ceramic, concrete, boiler iron, galvanized corrugated iron, or cast iron. They are functionally different than drain pipes, which could be made of the same materials and used in two different applications at the same culvert. Drain pipes generally are devices that lead from the highway surface, connecting with built-in drain inlets, which direct runoff water down into a culvert or other drainage structure. The drains or inlets are collection points leading to or out of the culvert through the drainage pipes. The same size pipe could be applied in many different situations and could be a culvert liner, drain pipe, or bridge scupper depending on their use. Drain pipes from the mid-1920s to 1940s are often of galvanized corrugated pipe. Half-round metal gutters were found along U.S. 34 between Ottumwa and Albia, but nowhere else within the study routes.

Poured-in-Place Concrete Culverts. The second culvert type is the poured-in-place culvert. This culvert was made on-site and was often the bane of road makers in the early period. Early concrete technology was poorly understood and many a poor culvert was made by county crews or local contractors, often under the supervision of local officials or engineers. Examples of poorly designed and made culverts that lasted only a few months are profusely illustrated in the period journals. Often contractors failed to completely understand the effect of temperature on cure rate, dirt contamination, or the correct proportioning of water or aggregate ingredients on concrete. Variations in the quality of the aggregate produced unsatisfactory results. In 1915 the ISHC's Service Bulletin mentions, but doesn't name, an Iowa county where almost all of the concrete culverts and bridge supports built by a contractor had to be torn out and rebuilt due to faulty workmanship (ISHC 1915d:7–10). Failed culverts were common on early Iowa roads. The loss of one culvert in a critical place could deter mobility.

By the late 1920s the use of mass produced precast concrete culverts on Iowa's Primary Roads system was becoming common and standardization of size, materials, construction, and application resulted in fewer problems and a more consistent product. It also resulted in the culverts under arterial roads being nearly identical for miles and miles. The old U.S. 218 (Iowa 923) used only two types of precast culverts for its length from Henry to Johnson County (Ainsworth to Iowa City). These two types replaced all the previous culverts. In contrast, the cutoff segment section north from Iowa City through North Liberty to Shueyville retains the variable earlier handmade and signature culverts typical of the preceding era.

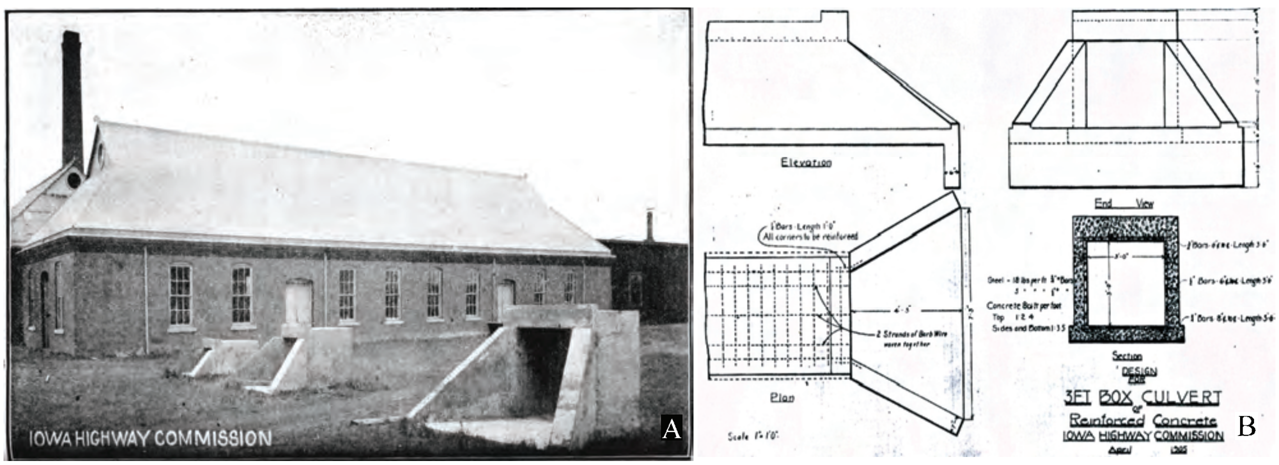


Figure 52. A. Newly introduced precast concrete culverts exhibited along the ISHC building in Ames (ISHC 1905c:30). B. Plan of 3 ft reinforced box culvert (ISHC 1905b:30).

Precast Concrete Culverts. Generally, culverts built during the study period were of two types. The first is the precast culvert (Figure 52). This culvert was built at a manufacturing plant or other location and not at the construction location. Due to their relatively small size (generally six feet or less) they could be made cheaply and transported to the work site. This type of culvert was highly promoted in the ISHC's publications and many examples are shown. The precast culvert offered a cheap and widely accessible product whose quality could be established before it left the factory. The ISHC was experimenting with and promoting precast culverts in 1905 (ISHC 1905a). Their culverts were designed to be either precast or poured-in-place. The 12 ft x 7 ft box culvert was the largest. The 1905 three foot box culvert was distinguished by its thick cap or top (ISHC 1905a). For types and numbers of culverts constructed by the state between 1916 and 1917 see Table 3.

Convict-built Culverts. During the period when convicts were used in the construction of Iowa roads they built a number of culverts, drains, bridges, roads, and other structures around the state (Figure 53). Most of the roads built by convicts were near or in Iowa state institutions but there were exceptions. One was the Fredonia to Columbus Junction road. Interestingly, that road segment has no culverts.

Convicts were used early on in Iowa's road construction and their concrete culverts were often built along dirt and gravel roads, and may still be in use near or in state institutions. Most major culverts or bridges were contracted but some where built by convicts. Many of the convict-built culverts may be similar to the culvert illustrated in the 1906 Manual for Iowa Highway Officers. They were usually small in scale with low sides that slanted from the ends to a flat area in the center. No handrail was present. The sides were recessed from the parapet-like overhanging top. Often these early culverts exhibit hand construction, early rebar, and period design. Due to standardized plans these culverts are similar appearing to other culverts built during the first quarter of the 20th century across Iowa. However, early poured-in-place culverts have individual characteristics even when spaced close together.

The sections of roads in Iowa that were constructed by convicts are limited and unless it is known or there is reason to believe that a particular road section or structure was built by them, it should be assumed that the culvert was built by a local contractor working on or for the county or township system. Any surviving convict-built culverts or other structures would exhibit a higher level of significance than the same culvert built by another provider because of their rarity and historical context. The convicts did not design these structures but rather built approved forms.

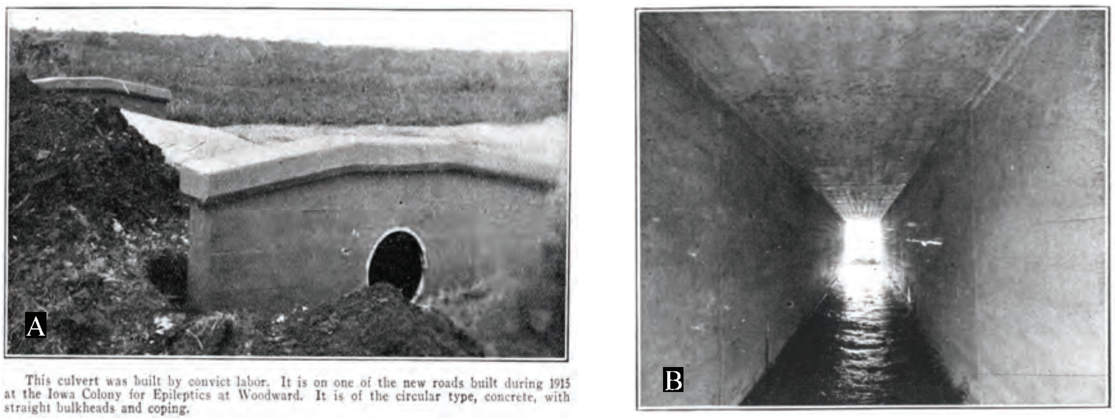


Figure 53. A. Early convict-built, parapet top, ISHC "standard plan" culvert built from 1905 through the 1930s (ISHC 1915q:15). B. Interior of large Cherokee County convict-built culvert (ISHC 1915q:15).

Drop Culverts. This type of poured-in-place culvert differs from the standard culvert in that a square shaft, often surrounded by a railing to keep out livestock, directs the water flow down the shaft to the drainage pipe or outlet (Figure 54). While most drop culverts can be considered minor culverts large examples were constructed. The plans for drop culverts were not published until around 1918 (ISHC 1918b:55). Prior to this time the use of drop culverts was uncommon, though not unknown, in the study route area but may have seen use elsewhere. The drop culvert's use increased until by the 1930s they become common, especially in hilly areas. Placement of culverts of this type is related to the size and steep sidedness of the drainage with the inlet on one side and drop on the other.

Figure 54. A. Drop culvert concrete headwall construction of Crawford County culvert (ISHC 1915c:78). Note parapet top. B. Drop culvert (ca. 1920) with raised top rails made of iron boiler pipe to prevent debris accumulation and as cattle guard near Albia, Jefferson County. C. Eroded and collapsed large tile pipe spillway culvert outlet near Albia. D. Concrete gutter from curb drain to drop culvert (top of C) with wooden rail surround, old U.S. 34, Albia vicinity, Monroe County (B–D 2003 survey photos).

Along the study routes drop culverts were uncommon on the Ainsworth to Iowa City segment of old US 218, and on the Mount Pleasant to Lockridge segment of old U.S. 34 (Iowa 8) in that part of Henry County, but are common through pre-1920 sections in Henry County of the Red Ball Route and along old U.S. 34 in Jefferson County (see below). This suggested that the decision to use drop culverts in preference to the standard culvert types was often a local decision and innovative decision at the time.

Part of Iowa's 1913 and 1916 improvements to the old Red Ball Route, now Underwood Avenue in Washington County north of Ainsworth, were the construction of a number of drop culverts. These structures were in place before the route (Iowa 961) was moved to the eastern side of present U.S. 218 in the late 1920s. Along the section of old U.S. 218 from Riverside to Hills a few precast drop culverts were encountered. All dated to the late 1920s to 1930s when that section of alignment was being constructed, and some of the larger ones may date to the 1950s or later and may be replacements.

Stone Masonry Culverts. Masonry, primarily stone, culverts are usually associated with the earliest roads but observation and literature suggests that they were built in Iowa until the 1920s. Proximity to a quarry, cost, or the practice of old but proven technology kept them going for many years after concrete was introduced. Many are railroad related. Occasionally a culvert will be encountered that is apparently of concrete but this may just be parging over the stone surface. The stone culverts used for the railroad grade beneath old U.S. 34 between Agency and Ottumwa are good examples of this type of adaptation. In Iowa, anywhere a railroad grade was reused for a highway, stone culverts and concrete covered stone culverts may be encountered. Railroad culverts, unlike railroad underpasses which are fairly distinctive, are harder to spot and are often buried or covered by ballast. More than a few have their dates chiseled into them.

An early type of stone culvert or bridge is a slab topped and dry laid structure built on a cultural road or trail that predates the automobile but whose route continued to be used through the early auto era. These types of quarry-faced stone block and slab masonry culverts may be occasionally encountered on cut-off road segments of very early routes. Although such structures exist and may be in poor condition they should be considered rare or even unique due to their hand quarried and laid stonework.

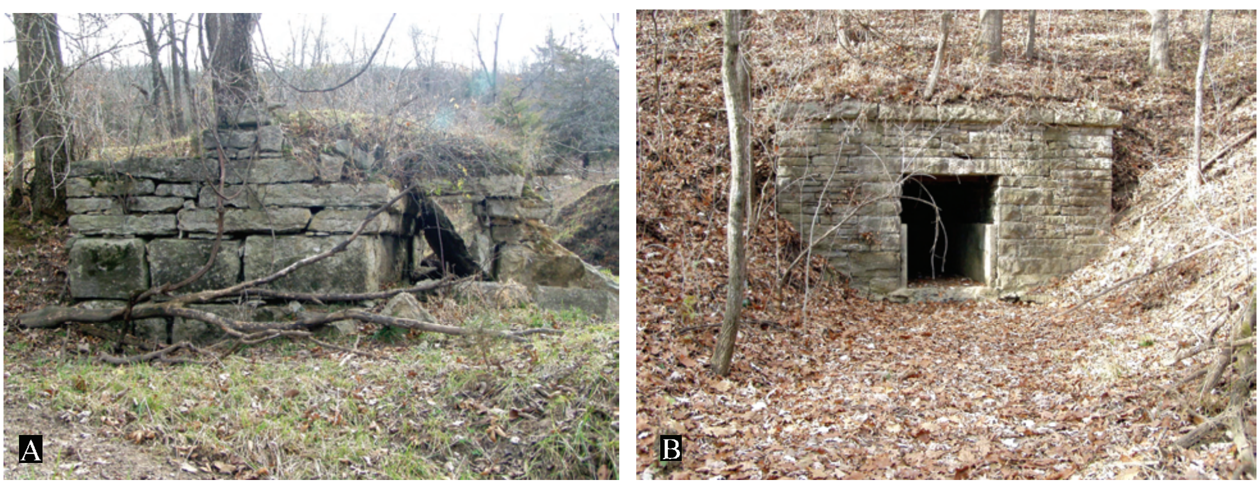


Figure 55. A. Dry laid stone slab bridge in Jockey Hollow, west of Lockridge, Jefferson County. B. Stone and concrete railroad to highway culvert conversion (1869–1930) east of Ottumwa. 2003 survey photos.

One very early stone bridge and culvert was located and evaluated on the old Blue Grass Road's route west of Lockridge (Figure 55A). This cut-off and abandoned segment dates from prior to 1900 (built 1840s–1850s) until around 1915. It is on the route mapped in 1912 in Huebinger's Map and Guide for the Blue Grass Road. In ruinous condition at present it was an important bridge and culvert in an area locally known as Jockey Hollow. It has two smaller companion culverts (see Figure 41B) from the same era just to its east. These culverts and bridges are similar in construction to bridges built on pioneer trails but are less complex than those used for railroad bridges.

As background for the stone culverts noted above the elderly landowner, whose family had lived in the area and owned the land since the 1880s, related that the valley had once been called "Jockey Hollow" (Mr. Garber, personal communication 2003). He knew about the Blue Grass Route there and pointed out the stone culverts and bridge. He related that there had once been a tavern or hotel at or near that spot and it had been named for the horse races that occurred there. He continued by relating that the railroad grade through the valley, which leads directly to the nearby Skunk River, had been too steep and that the trains in the old days would have trouble making it up the other side, and that they had raised the grade later.

He said that the stone slab bridge had fallen into ruin because the railroad had altered the drainage when they changed the grade and that this had undercut the bridge. This culvert and bridge, made of stone blocks and slabs, may be very early (late-1840s to 1870s) and continued in use until 1915. Such a well built crossing point on the old route would have attracted commerce. That it survived and was in use from the mid 19^{th} to the early 20^{th} century shows the constancy of the use, even preference for routes over time.

Signature Culverts and Bridges. Some culverts encountered on the project may for the sake of this study be termed "signature culverts." Some variation is present in terms of the types of personalization found on culverts. Generally two types of signature culverts were encountered during survey. The first are culverts that have names of places or people on them (Figure 56). These are best shown by the two sidewalls of a 1920s culvert found along the Red Ball Route (see U.S. 218 below). These culvert sidewall's tops have the name of the adjoining landowner and farm name (Figure 56A). The culvert has "LONGVIEW FARM" and "J. A. HRDLICKA" in its sidewall's tops with the recessed letters filled with reflective white rock. None had distance, directions, or drainage names, which may be uncommon.

Figure 56. A. "HRDLICKA" impressed signature livestock culvert on Red Ball/old U.S. 218, North Liberty vicinity, Johnson County. B. View of west side (A–B 2003 survey photos). C. "HENRY COUNTY 1917" culvert on Blue Grass Road. D. View of west side. Note use of standard 1913 ISHC design. E. "HENRY COUNRY 1916" Blue Grass Road siderail culvert using same template, New London vicinity, Henry County. Note edge chamfer. F. Henry County signature culvert incised "1928-Henry Co.-L.E.," New London vicinity (C–F 2005 photos). Note A–E are derived from the ISHC 1913 stand culvert plan.

A second type of signature culverts mark the county that they are in. Along the northern diagonal route of the Blue Grass Road south of Columbus City, Louisa County, near Winfield in Henry County, a culvert was impress-marked with “HENRY COUNTY 1917” (Figure 56C). Three other similar culverts were located nearby with one dated 1920 and two dated 1921 (Rebecca Lawin McCarley, personal communication 2005). Near New London 1916 and 1928 county culverts are nearby each other with the first well made with impressed letters while the later was more crudely initialed (Figures 56E, 56F).

All such signature culverts of this era are important both for their relative rarity and ability to ascribe both a personalized element along with a sense of time and place to these structures, which may be missing on the roadway itself. Signature and dated culverts that follow the approved Iowa ISHC designs are important for ascribing statewide periods, route locations, and types of construction.

A number of the metal, concrete, and stone bridges encountered during the survey portion of the project have metal plaques attached to them or names inset into the concrete. These are generally of two types. The first is the manufacturer’s plaque. These are found containing, especially on metal bridges, the manufacturer’s name and address and sometimes the date built, builder, and contractor. The second type of plaque are those impressed into some bridges and culverts that exhibit the builder’s or contractor’s name, the construction date, and the township/county supervisors, or engineer responsible for its construction. In a number of instances these placards had been removed but the pattern and placement of the bolts once affixing them to the structure are still evident. The county road commission’s meeting minutes usually record the pertinent information. Many bridges and culverts can be assigned to a maker or builder by city or county meeting records, construction methods, date, location, and stylistic elements. On old U.S. 218 a pony truss bridge over Old Man’s Creek in Johnson County has the steel maker’s logo impressed into the structural steel as the Illinois Bridge Company (I.B.Co.). Signature structures, culverts, bridges, pavements, right-of-way, or corridors may have significance beyond engineering or construction.

Figure 57. A. The signature 1912 concrete and steel bridge, with impressed “A.G. BEAR, M.B.”, Centerville vicinity, Appanoose County. B. Bronze Stark plaque, West Union, Fayette County. C. The ca. 1913 H. M. Stark & Company bronze bridge plaque in Gifford, Hardin County. 2003 survey photos.

*Dated Culverts and Bridg*es. For the purposes of this study “Signature” and “Dated” structures are not the same thing although they may overlap. Signature construction may exhibit a date but it is primarily for identifying the county, builder, and those responsible for contracting or paying for the work such as architects or designers or county board members or township supervisors (Figure 57). Dated structures are just that; dated. The date corresponds to the completion of the structure or project. Those with a county name and a date and other information such as initials are considered signature. Signature structures usually meet two simple criteria. The first is that it was part of the overall design of the structure. It should be either impressed into the concrete or steel or was provided on a plaque permanently attached to the structure by the builder or manufacturer at the time of construction. Many structures exhibit dates or names that are cut into the stone or impressed into the concrete. This occurs frequently on railroad built structures over highways in the late 19th century and on concrete bridges and culverts after the 1910s. The larger, more prestigious, or expensive the structure the more likely it was to have an identifying plaque or impressed date. Structures that have had names and dates scratched into them as an afterthought or as graffiti by workmen or others are not considered true signatures. A number of concrete culverts have had dates cut into them, some rather crudely, by the workmen on completion. These may be acceptable as informal signature structures under some circumstances (Figure 56F) rather than being simply dated ones.

While stone culverts and bridges were less frequently seen with inscriptions or plaques, dated keystones were more frequently observed. Dated bridges, underpasses, and overpasses associated with a roadway passing across a particular railroad line may be especially significant. These structures may be related to both a fusion of railroad and highway transportation contexts. Several examples of dated stone culverts and bridges in Clayton County (Elkader vicinity) have been listed on the National Register, as well as railroad underpasses (Cedar Rapids).

Figure 58. A. Cover photo of handrail culvert from ISHC Service Bulletins (ISHC 1926a:cover). B. ISHC Standard Design for handrail on concrete and girder bridges (Cedar County) (ISHC 1915c:53). C. Siderail of ca. 1911 culvert from the Red Ball Route, Dubuque Street, Iowa City (2003 survey photo). D. Balustered handrail on Stark-built arch bridge in West Union, Fayette County (2003 survey photo). E. Beehive shaped drain inlet cover made in Iowa City, old U.S. 34, Henry County. F. Hand welded inlet cover made of round rebar on old U.S. 34, Henry County. G. Welded flat grate drain inlet, old U.S. 34, Jefferson County. H. Cast iron inlet cover from old U.S. 34 near Ottumwa, Wapello County (6" ruler).

Signature culverts and bridges often mark the former routes of early Iowa highways. Examples such as those in Henry County date to the Registered Highway Era. Others may relate to both the Registered

Highway and the early state and federal highway construction eras. In some cases it may be difficult to tell as the road bed atop the culvert often postdates the construction of the culvert itself by many years. Most signature culverts and bridges represent a specific type or form whose style, materials, method of construction, and location may be related to a specific designer, event, or region of the state.

Sidewall and Handrail Culverts. Many of the early culverts built in Iowa had low sidewalls on them. Some very early examples had no sidewalls, only a small parapet. Often the parapet is only on one side. The 1905 culvert design promulgated by the ISHC was the most common small culvert form built between 1900 and 1920. It has a low angled parapet that is like a top rail or cap, which in height is little more than a curb. Forms of this culvert, with minor variations, were built all across Iowa from 1905 to after 1920, and the county and convict crews built many of these on their projects. Generally, they became too small and low for wider roadways. They are not sidewall or handrail culverts but are low parapet topped culverts

The tall sidewall was an early innovation and the 1906 Marsh bridge is an early example with tall solid sides decorated with a paneled effect. The 1905 Manual for Iowa Highway Officers relates that “culverts with solid walls were to be called sidewall culverts (Figures 58B, 58C). Culverts with decorative open sides with balusters, spindles, or gaps were to be called handrails” (Figures 58A, 58D) (ISHC 1905:78). An early design consideration was that the lower the side walls, the less material needed for the construction. Simple rectangular panels (sidewall culverts), decorated or undecorated, were more easily erected when compared to the molds and forms necessary to pour, cast or, assemble a baluster or open handrail culvert.

Slab Bridges. Slab bridges or the remains of slab bridges are often found on cut-off highway segments. The concrete slab bridge, or slab top culvert, was one of the commonest kinds of small bridges found in Iowa. The implementation of such bridges directly relates to the use of concrete for transportation structures. The perceived permanence of concrete along with its versatility and strength when combined with iron reinforcing led to its use over thousands of drainages in Iowa. Concrete slab bridges built prior to the 1913 ISHC standards are uncommon and occasionally innovative. Concrete slab bridges built after 1913 but prior to 1918, when the standards changed again to meet federal requirements, make up a second level of importance. Concrete slab bridges after 1940 are generally of least importance for their engineering significance alone.

All such signature culverts of this era are important both for their relative rarity and ability to ascribe both a personalized element along with a sense of time and place to these structures, which may be missing on the roadway itself. Signature and dated culverts that follow the approved Iowa ISHC designs are important for ascribing statewide periods, route locations, and types of construction.

Tile Lines, Drains, and Covers. Proper drainage was one of the pivotal issues of early road construction. Most arterial roads built or improved after 1905 had tile drainage lines incorporated as part of basic design. The ISHC preached loud and long on the necessity of proper drainage. Ditches along the old roads frequently have drainage tile laid beneath them. Until the late 1940s tile line access was usually by dome-shaped or “beehive” shaped water inlets. It was such a drainage feature that Artz excavated (Artz 1995b:174).

Drainage lines or tiles can be considered almost ubiquitous along roads from 1910 to 1940. When the ISHC had final plan review and approval starting in 1913, drainage systems would have been a priority and lack of them a reason for plan rejection (Figure 59B). Metal drain inlet covers often have the manufacturer’s name embossed and can be dated. Handmade flat grill examples are also found (Figures 58F, 58G). Cast iron pipes were predominately used in south central and south western counties.

Prior to 1900 the number of ceramic tile manufacturers in Iowa was very large. The use of ceramic drainage tile with interlocking bell ends was already common in Iowa and the acquisition of the tile, although a costly portion of the project, was one of the easiest elements to garner. In 1904 ceramic tile capacities from 3" to 36" in diameter were evaluated by the state. Early tests on large concrete and ceramic pipe showed cracking and crushing problems that were alleviated by the 1920s.

Two basic linearly laid drainage tiles types were needed. The first are the tiles used for farm entrance culverts and the second type was the continuous underground tiling system providing drainage for the ditches on either side (Figure 59). On some roads, especially those with banks or ditches on only one side, the tile was laid on one side only (Figure 59B) or was laid from the culvert exit directly to the creek.

Farm Entrance Culvert—Good Looking and Durable—
A 15-Inch Tile with Concrete Bulkhead

Figure 59. A. Farm entrance culvert illustrated in ISHC Service Bulletin (ISHC 1915g:6). B. The ca. 1925 Blue Grass Road west of Burlington with tile set out (Iowa DOT Library–Large Negatives Folder).

Cast Iron Drain Inlets Covers. In the study sections and along 1916 to 1940 roads in general, water or drainage inlet flow is directed to some type of cast iron drainage inlet. These inlets can be of several forms. One of the early forms are the dome topped inlets used in ditches (Artz 1995b:192–198). This form is still used today. Its shape is economical to cast, the size is easy to manipulate and install, the slits stop large materials from entering, and its domed height lets it drain to a higher point than flush drain inlets (Figure 58E). Flat slit-inlet covers were used more often over drains integral to the pavement.

As a general observation, while these drainage inlets were common on the Blue Grass Road sections after 1916 and other highways until 1930, they are relatively uncommon in road works prior to 1915 or after 1945. Most roads built or upgraded from 1900 to 1915 generally used no ditch drains or culverts due to both their short lengths and locations on either very flat or steeply pitched slopes. The domed top inlet covers are currently seeing a revival and have never gone out of use. The new ones do differ from the old.

The picture of the Blue Grass Road shows the lines of tiles laid along the ditch on one side with no inlets visible (Figure 59B). Many such drain inlets led directly to sewer tile or corrugated metal outflow pipes. Early on, the corrugated metal pipes were thought not to be as durable as the tile. They were larger in size so they had more limited applications and their costs were expensive for large projects. By the mid-1920s the use of galvanized drainage pipes increased in popularity for applications such as culvert liners that replaced the brittle tile pipes formerly used, and especially for draining drop culverts. It was a very experimental period with many forms and methods seeing application but most had limited success.

Medium diameter ceramic drainage tile could be used within poured concrete driveway entries and for drain outlets for culvert and bridge headwalls to prevent or relieve hydrologic pressure due to water saturation of soils behind the structures. Along the Red Ball Road north of the Iowa River to Shueyville medium diameter tile pipe line the small poured concrete culvert bulkheads. Due to the ridge top situation, steep sides, limited pooling, good soil drainage, and ditching, minimum side tiling was used. The use of tile laid inside the concrete forms saved the builders from having to form-in the drainage hole as the concrete could just be poured around it. Culvert drain inlets and drop pipes may be raised as the grade was raised.

The materials for underground drainage systems were generally of concrete or field tile but a variety of material, forms, and methods were used (Figure 60). Local manufacturers apparently provided the tiles. By the great construction era of the 1920s the placement of tile was part of the planning process and like other elements the expected length needed was documented on the front of the plans. In 1918, the amount of tile for a 21 mile section of Iowa 8 (Blue Grass Road/U.S. 34) was 16,900 linear feet (ISHC 1918a:2).

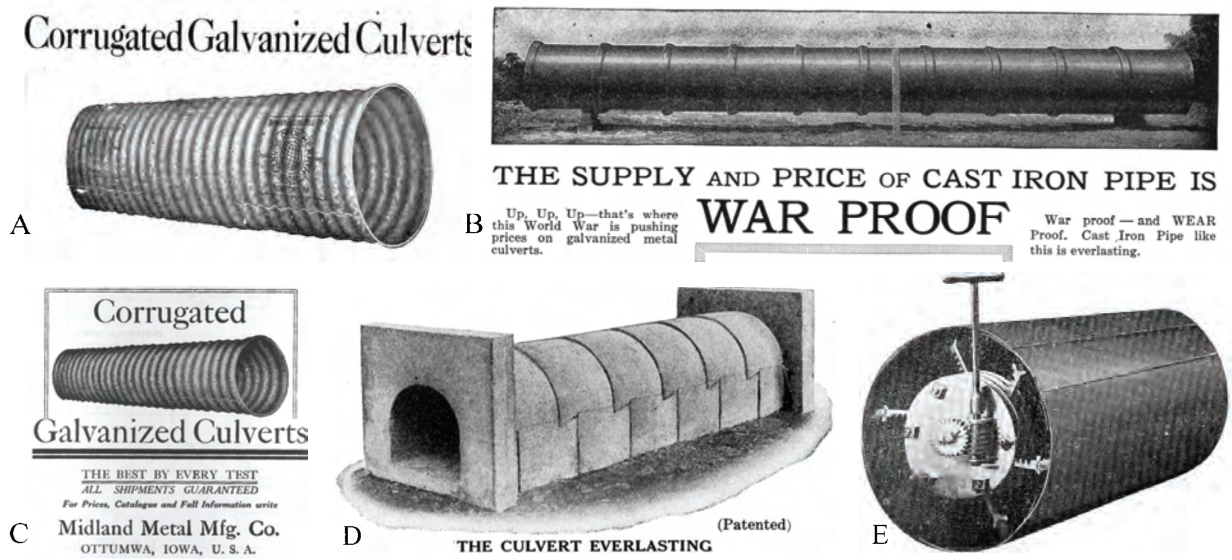


Figure 60. A. Midland Metal's corrugated galvanized culvert (Huebinger 1912a:108). B. Iron pipe for the war effort (Road-Maker 1916j:back cover). C–D. Various steel forms for culverts (Huebinger 1912a:48e). D. Advertisement for a patented interlocking precast concrete culvert (Road-Maker 1912:11). E. Expandable metal culvert form advertisement (Road-Maker 1914:18).

CURBS

Introduction. The appearance of concrete curbing on Iowa's highways began in the 1910s when the use of poured concrete roadway construction came into common use. The very first use of curbs on a rural poured concrete roadway in Iowa is unknown to the author at present. Certainly curbs on urban streets in Iowa generally date to the era of brick paving and often are of stone. Curbs on concrete rural arterial highways are built integral to the road bed itself. They were not added or poured separately from the road bed (also see *Pours, Molds, and Forms* below). Curbs integral to the pavement are called lip-curbs (Figure 61). Pavements may have also incorporated steel edging to protect their edges (Figure 62).

Curbed Sections. The literature of the period shows that curbs on rural highways evolved for a two-fold purpose. They were not, as many assume, built strictly to keep the car on the road. Curbed sections appear on hill slopes and curves and may be interspersed with uncurbed sections on the straights and flats. Some Iowa highways from the 1920s–1930s may have curbed edges for nearly their entire length. People also believe their function was an obvious drainage device for the pavement surface. However, curbs were not designed originally primarily for roadway surface drainage control. They were designed to prevent "cavitation."

The theory of the time was that when cars drove off the side of the road's pavement there was wear. This wear led to low spots which filled with water. Tires running off the edge of the road enlarged these low spots into mud holes that grew progressively deeper. As the hole along the roadside enlarged and deepened once it became deeper than the pavement it would allow water to percolate under the pavement and even the road bed itself. This passage of water picked up small pieces of the road's substrate and carried them off downhill. As particles were removed an open area or "vacuity" or "cavity" formed under the pavement. Over time this cavity could expand to considerable size and when a heavy load ran over the vacuity the concrete could not bear the weight with the substrate removed and it cracked. So, while the curbs were present to promote and direct good drainage their primary function was to prevent cavities forming under the pavement and subsequent road bed damage, cracking, and collapse.

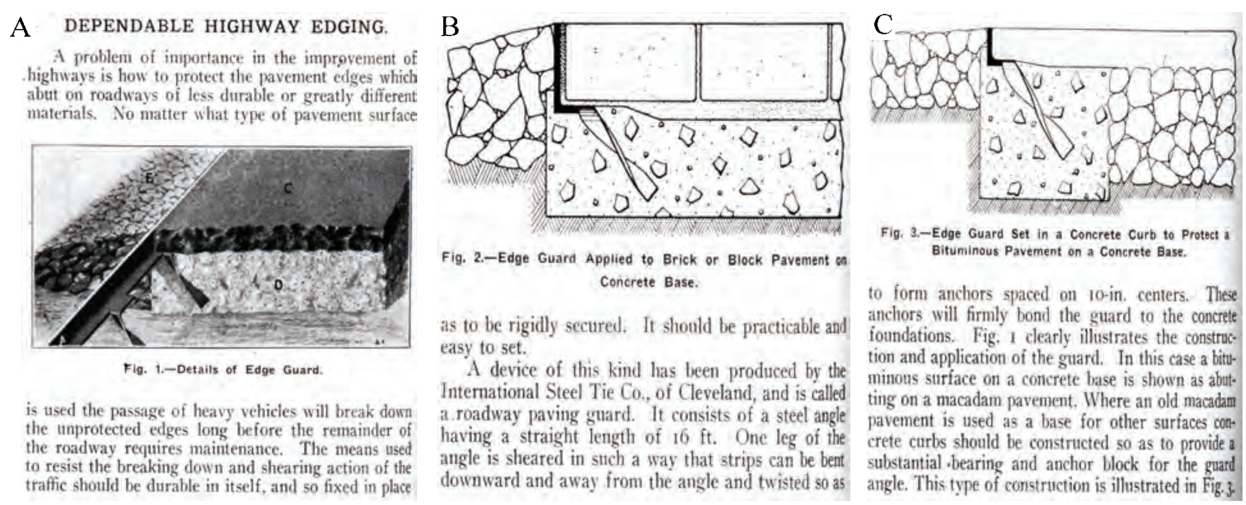
Figure 61. A. Circa 1926 integral lip-curbed rural highway (Iowa DOT Library–Paving Folder, Photo #13,244). B. A 1920s below grade curbed crossing and new overpass. Note pavement's covering of earth and wet burlap (Iowa DOT Library–Paving Folder, Photo #11,722). C. Integral lip-curbed rural highway segment with integral drains along old U.S. 34 near Albia (ca. 1928). D. A ca. 1928 integral lip-curbed rural highway segment along old U.S. 218 (Red Ball) near Mount Pleasant (nonextant 2003). E. Current intersection of integral lip-curbed segment of old U.S. 34 cut by current U.S. 34 with replacement paving, approach, and bridge. F. Old U.S. 218 (South Curtis Bridge Road, Johnson County) exhibiting integral lip-curb with integral drain inlet just past culvert. Figures C–F are 2003 survey photos.

Many advertisements are seen in the popular highway builders' magazines of the day advertising various shapes and profiles of curbs. Around 1912–1914 the ads begin showing the change over from hand-formed curbs to those made by forms integral to the road bed's forms. The early public literature such as Road-Maker magazine had advertisements in it for numerous molds and forms. Contractors could either build their own or purchase a ready-made form through an advertisement. After the Federal Transportation Act and with plan review from the ISHC (1913) curb profiles became increasingly standardized although variation was still evident.

Until the early 1920s curb profiles varied somewhat depending on what form was used in their construction. Contractors often made their own forms. On the Blue Grass Road, rebuilt and paved between 1924 and 1928 (Iowa 8), the curb profile varies between Jefferson and Henry counties where apparently different contractors were used, with each contractor having his own curb form. The spot where the two curb types would have met at the county line has since been removed. In whatever contour, the concrete of the curb was identical to that of the road's pavement and was poured at the same time. Also, the curbs in nearly all cases ran to or were integral with some kind of drainage feature such as a drain or drop inlet, which directed the water away from the pavement into culverts or other drainage structures. Any curb's concrete that does not match the pavement's concrete is most often a replacement.

Thus, by the mid-1910s, although some variation in curb profile and construction existed, most curb construction had become part of, or integrated into, the overall road bed's pavement pour. The shape of the curb was determined by the shape of the form used to make it and in the early decades each contractor would have his own curb form. Changes within curb profiles are most likely to be seen at either township or county lines because different construction crews would often begin or end at such political boundaries. Some rural sections have curbing that runs for miles.

Some highway's curbs would become worn, damaged, or collapse in areas and would be replaced. Period replacement generally shows the same type of workmanship, profile, and similar materials. In later replacements the concrete material or aggregate differs substantially and its texture and color differences within the aggregate, as well as the often less careful construction, are the most obvious signs of alteration or replacement. In many urban or high use areas curbs could be protected or strengthened by metal curb guards, which were set into the concrete.


A

DEPENDABLE HIGHWAY EDGING.

A problem of importance in the improvement of highways is how to protect the pavement edges which abut on roadways of less durable or greatly different materials. No matter what type of pavement surface

Fig. 1.—Details of Edge Guard.

is used the passage of heavy vehicles will break down the unprotected edges long before the remainder of the roadway requires maintenance. The means used to resist the breaking down and shearing action of the traffic should be durable in itself, and so fixed in place

B

Fig. 2.—Edge Guard Applied to Brick or Block Pavement on Concrete Base.

as to be rigidly secured. It should be practicable and easy to set.

A device of this kind has been produced by the International Steel Tie Co., of Cleveland, and is called a roadway paving guard. It consists of a steel angle having a straight length of 16 ft. One leg of the angle is sheared in such a way that strips can be bent downward and away from the angle and twisted so as

C

Fig. 3.—Edge Guard Set in a Concrete Curb to Protect a Bituminous Pavement on a Concrete Base.

to form anchors spaced on 10-in. centers. These anchors will firmly bond the guard to the concrete foundations. Fig. 1 clearly illustrates the construction and application of the guard. In this case a bituminous surface on a concrete base is shown as abutting on a macadam pavement. Where an old macadam pavement is used as a base for other surfaces concrete curbs should be constructed so as to provide a substantial bearing and anchor block for the guard angle. This type of construction is illustrated in Fig. 3.

Figure 62. Advertisement for Dependable Highway Edging (Road-Maker 1919:54).

Curbless Sections. Sections of rural highway pavement without curbs generally are of two types. The first are sections that were designed and poured without curbs, with curbed sections nearby. The second involves once curbed highways that have had their curbs removed. While some rural arterial highways exhibit curbs along much of their lengths many other highways exhibit curbs only in specific sections.

These sections occur primarily along drainages, low spots, or low sides of curves and are very often associated with various types of gutters and drains. The construction of curbs added additional expense to the road's construction. In most cases observed curbs predated highway shoulders. Curbed rural highway sections, with thin or no shoulders, are more common in the eastern section of the state due to the rolling terrain, while shouldered roads were built in more level terrain. It appears that as the construction of functional shoulders along main highways progressed the need for curbs decreased accordingly.

As a general observation it appears that in Iowa, on the Primary Roads contracts let in the late 1930s and which were completed by 1940 or early 1941, curbs on rural highways were generally no longer built. Wider road widths, the introduction of wide shoulders, the savings in concrete and forming labor, increased speeds and safety factors, and curb's propensity to cause cavities under the concrete road beds, even though they were intended to prevent it, led to their demise in Iowa. During the years of the Second World War nearly no road work was done. After 1945 at the ISHC, due to all the engineers and personnel being in the war effort, it took a few years of reorganization and reintegration of personnel but generally in Iowa post-war highways omitted curbs on rural section. In the late 1950s the Iowa DOT made a concerted effort to remove the curbs from most of the highways in the state (see curb removal below).

Curb Removal. Although curb removal in Iowa first occurred just after World War II, in 1957 a statewide program began with the intent of removing the curbs from Iowa's Primary Roads. The thought at the time was that this would add two feet to the width of the highway, make possible additional road widening pours, and keep cars from bouncing off the curb into oncoming traffic, which contributed to many head-on accidents. This was especially true in the rain when water ponded along the curb further aggravating the problem. A machine was used that chipped off the offending curb (Figure 63). After the curb was knocked off, the road surface was often, but not always, ground smooth. Some roads were chipped and ground but not subsequently widened.

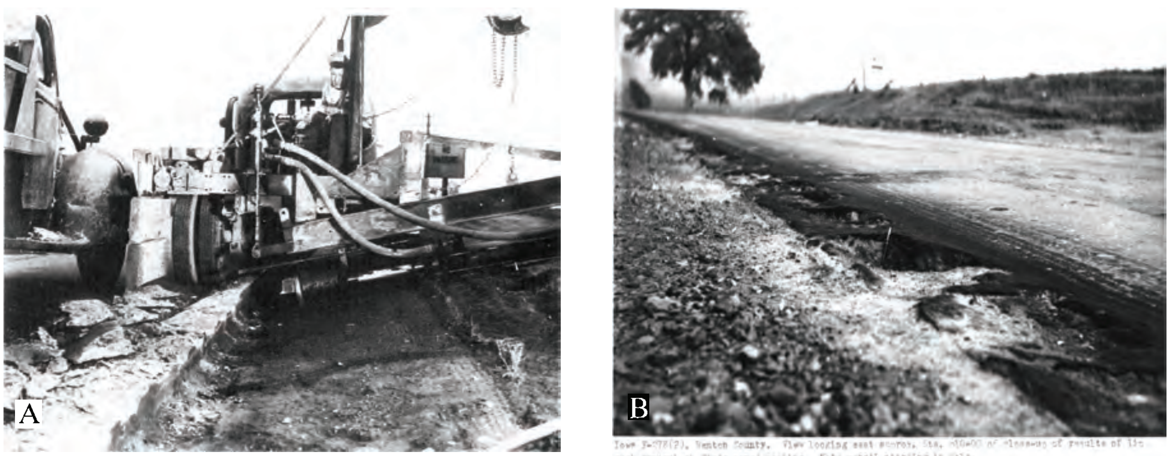


Figure 63. A. Curb removal machine ca. 1950 (Iowa DOT 1997:41). Note size of spalls removed. B. Benton County highway showing scars of curb removal in 1949 (Iowa DOT Library–Photos).

This statewide program resulted in the removal of curbs from hundreds of miles or more of Iowa's early highways. The edges were filled with concrete and ground smooth. Highways sections that had been cut-off prior to that time or that had been returned to local use, such as old U.S. 34, retained their curbs. Old U.S. 218 on the other hand was in use as an arterial prior to and after that time and has had its curbs removed. The scarring of the pavement, which results from curb removal, is clearly visible on many of Iowa's surviving pre-1957 highway sections. The removal of curbs was a statewide program with significant engineering and construction effects. For highway segments which have had their curbs removed in most cases the curb's removal significantly affects their integrity. The removal should predate the 50 year cut-off date to be eligible to the National Register as part of the road's evolutionary process

GUARDRAIL FENCES AND MARKER POSTS

Introduction. During the early days of highway engineering the use of guardrails, posts, and fences was an integral and innovative aspect of highway design. Always within the right-of-way limits, these items were designed to protect the traveler from dangerous situations (Figures 64, 65). While signage was a relatively late development some original signage related to the routeway may survive. The miles of guard fences once in common use on Iowa's roads are gone but an occasional series of posts, fence fragments, or other remnant may survive. Guardrails were a development resulting from testing experiments in the late 1910s. The general construction date of a guardrail may occasionally be discerned and may help date a section of roadway or a structure. Original elements such as these add a great deal to the period integrity of the road in general. A few old fence posts, drainage markers, reflector posts on curves, sparkle signs, and other such elements within the right-of-way still survive along Iowa's old roads. Important aspects of these roadway elements are related below.

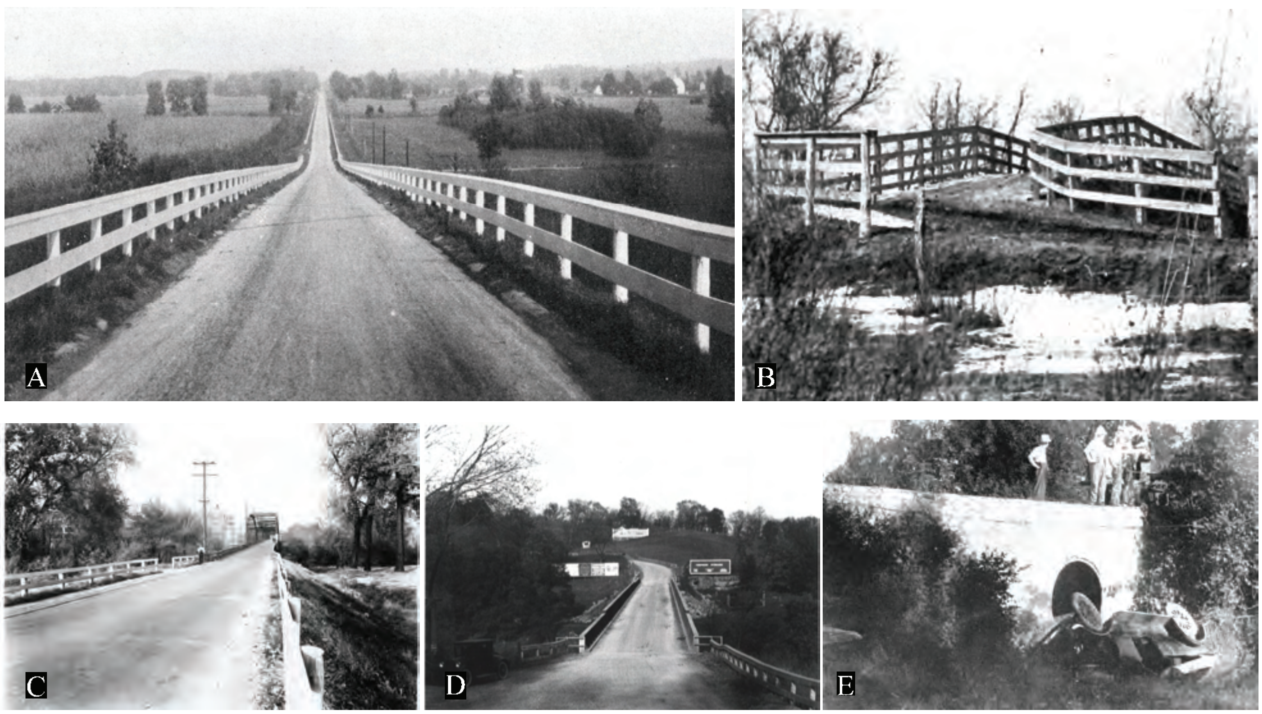


Figure 64. A. Wooden highway fencing (ISHC 1923f:8). B. Plank topped fencing used on overhead railroad crossing. Caption reads "Dangerous Turn in Overhead Crossing–Van Meter Crossing, Dallas County." C. Fencing atop berm on approach to unknown bridge location ca. 1928 (Iowa DOT Library). D. Plank top fencing used on approach to unknown bridge location ca. 1930 (Iowa DOT Library). Note poor design as fencing does not meet edges of bridge sidewalls. E. "No Rails" (ISHC 1922a:9).

Guardrail Fences. In Iowa, during the period from 1915 to 1925 any road grade higher than five feet above the ground surface was required to have wooden fencing along it. By 1920 accounts increasingly relate how the cost of implementation and upkeep for this feature was taxing on the local, township, and county road funds. A 1918 plan for highway improvement on the Blue Grass Road (old Iowa 8) expected to need 9,000 linear feet of guardrails for a 21 mile long section of highway improvement (ISHC 1918a:2).

Prior to 1930 wooden fencing was the standard protective device. As noted above, for many years any grade of five feet in height had to be protected on both sides by board fencing. During the 1910s to 1920s the concrete handrails and bridge abutments also had wooden posts or rail-and-post systems to attempt to stop crashes into the structures. Most low culverts were unprotected and in general road designers did not feel it was their responsibility to protect careless drivers from themselves. Safety was an emerging issue in the early 1910s but not nearly the overarching issue it became in the late 1910s and 1920s. The numerous accident reports and statistics in the literature bear testament to increasing need for highway safety. By the early 1920s steel cable-and-post fence were being tested by the ISHC. During the 1950s and 1960s these often dilapidated roadside wooden "safety" fences were removed and were not replaced.

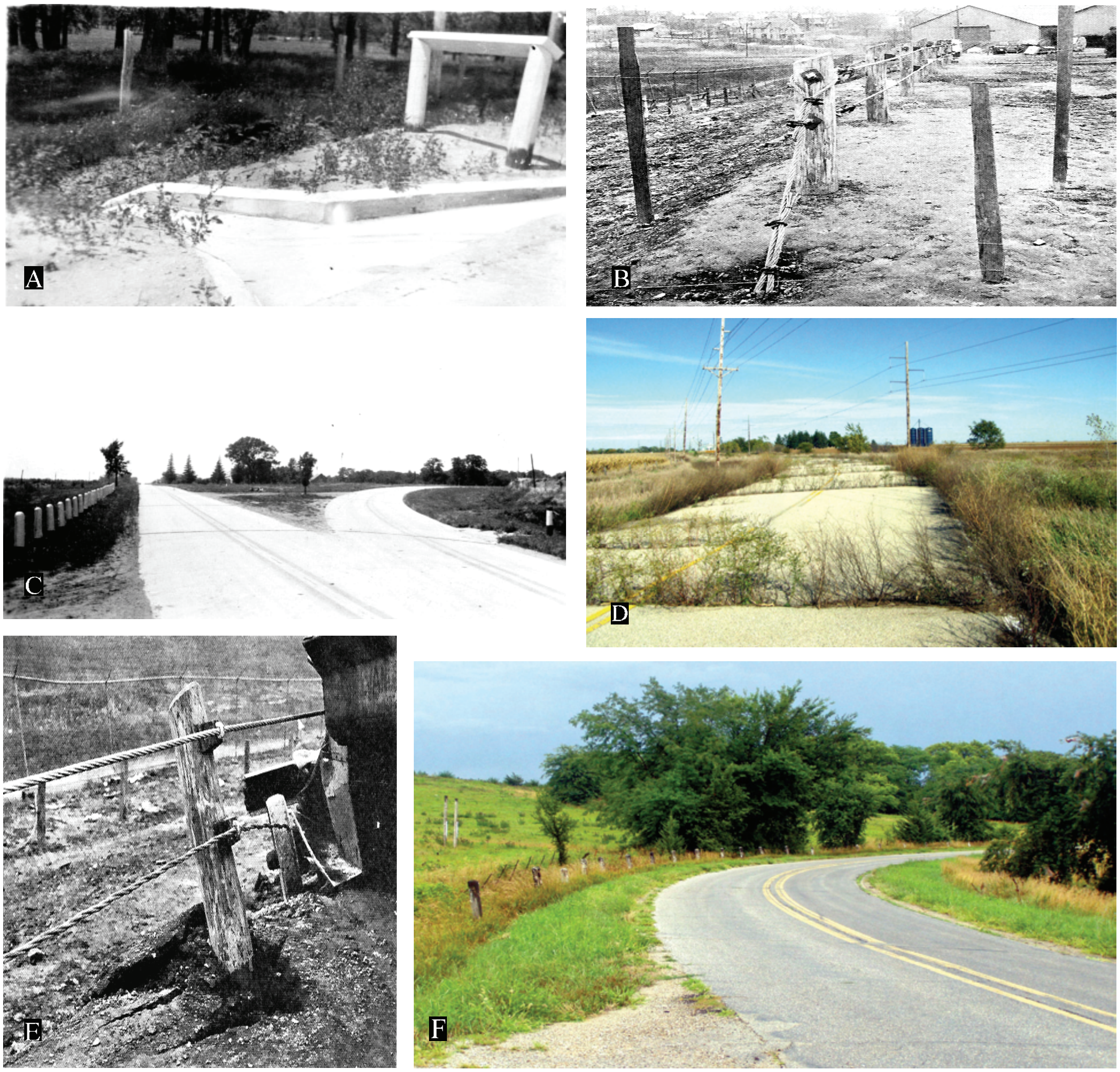


Figure 65. A. Late 1950s photo of a 1920s, integral curb drain, double marker post (Iowa DOT Library–Photos). B. Guard fence testing photos (Crum 1928:268). C. A 1935 cable-and-post safety fence in use along U.S. 65 at intersection with Iowa 175 near Green Mountain, Hardin County. D. Photo of same in 2003 looking northwest along now abandoned curve segment. 2003 survey photo. E. Cable testing photo (Crum 1926:270) F. Converted cable rail guard fence near Clarinda, Page County. Note remnant white painted posts with black tops still in use as visual aid (2003 survey photo).

By 1924 extensive testing by the ISHC and national Highway Research Board had developed a steel cable and wooden post guardrail system, which was much more effective (up to 24 mph) than previous measures. This data was published in 1928 in the Eighth Annual Proceedings of the Highway Research Board, held in Washington, D.C. While the guard fences helped deflect cars running head on into the ends of bridges, pilings, and culverts the steel cable system had wider applications and could be used for curves, banks, bridge and culvert approaches, and a number of other applications at a reduced cost. The cable guard fence system could actually stop a car in a dangerous situation. However, implementation of this innovative system took decades to complete and there was a long period where several types or variants of these systems were used at the same time (ISHC 1921e; Crum 1928:265–283, 1930–1936).

Generally, while guard fences protected the motorist from slipping off raised road sections, guardrails were expected to stop potential accidents at specific location along the roads. However, the line between what was a fence and what was guardrail was never clear and by the mid-1930s the term “fence” began to be dropped from ISHC plans. As guard fences were dropped from the right-of-way landscape they were progressively replaced by guardrails, although there was considerable overlap. The introduction of guardrails ahead of bridge abutments was a primary safety focus. While guard fences could be made of wood, metal, or concrete, from 1900 to 1925 most were wood fences. From 1926 to 1935 most were post-and-cable fences. Concrete bridges and culverts from this period may show a type of guard built in as part of the abutment or sidewall. In many areas of the state earlier concrete culverts had had very low or no sides or handrails at all and cars frequently pitched over these. Most early guard fences were of wooden planks, thick, and deeply set. During the late 1920s the steel guardrail was introduced and appears on mostly large or dangerous urban constructions. By the 1940s the idea of steel guardrails was becoming well established. They were being tested during the late 1940s and 1950s, with their introduction in the late 1950s, and commonly accepted in some conditions by the 1960s. Surviving cable posts are larger (6” to 8”) and have evenly spaced bolt holes in their sides near the top while marker posts do not.

Marker Posts. The marker post with its 3" to 6" diameter and conical or rounded top is probably the most frequently seen but seldom noticed or appreciated roadside marker (Figure 65A). Of all the original roadside markers it probably has the highest survival rate at present but is disappearing fast. Along the old roads nearly every culvert, drain, tunnel, or below grade structure has a wooden marking post above it. While these still function now primarily to alert mowing and snow removal crews their use was ubiquitous during the study period and persisted into the 1960s even along state highways. A series of the larger posts, painted a reflective white, often marked the edge of a curve before standardized signage was introduced, and continued on many sections of road long after traffic control signage was common. In a more general way they served as visual markers along the route. Many were once decorated with reflective rocks, glass, or metal reflectors on top. Such decorative tops are often related to specific areas of road, which themselves related to a particular farmstead, town, or county crew. The sheared-off bases of these posts are commonly found alongside the road’s drainage structures.

Under Passes and Overpasses. Few early Iowa roads had elevated structures along their routes. Most crossings, either automobile or railroad, were “at grade crossings.” This means that no effort was made to elevate the roadway or railway over one another by a trestle or bridge. Until the 1920s Iowa’s at grade crossings were the nemesis of motorists and car into train collisions were a major contributor to the state’s highway death toll. In many instances at Iowa’s at grade crossings visibility was obscured, grades were steep, and road conditions poor. By the mid-1920s the need for a different type of intersection had led to the design of underpasses and overpasses. Underpasses allow traffic to pass under the railroad track or other obstruction. Overpasses take the traffic above. In Iowa, during the study period underpasses appear to be most common during the 1910s to 1920s. This is especially true along raised railroad grades where roads more easily passed beneath them. By the late 1920s Iowa’s Primary Roads and highways generally started to pass over the railway unless they were on elevated grades. The two, wooden, railroad overpass bridges along old U.S. 34 near Lockridge, Jefferson County, that cross the railroad tracks and date to the early Blue Grass Road (ca. 1910) are of a type that may have not been previously evaluated (see Figure 92).

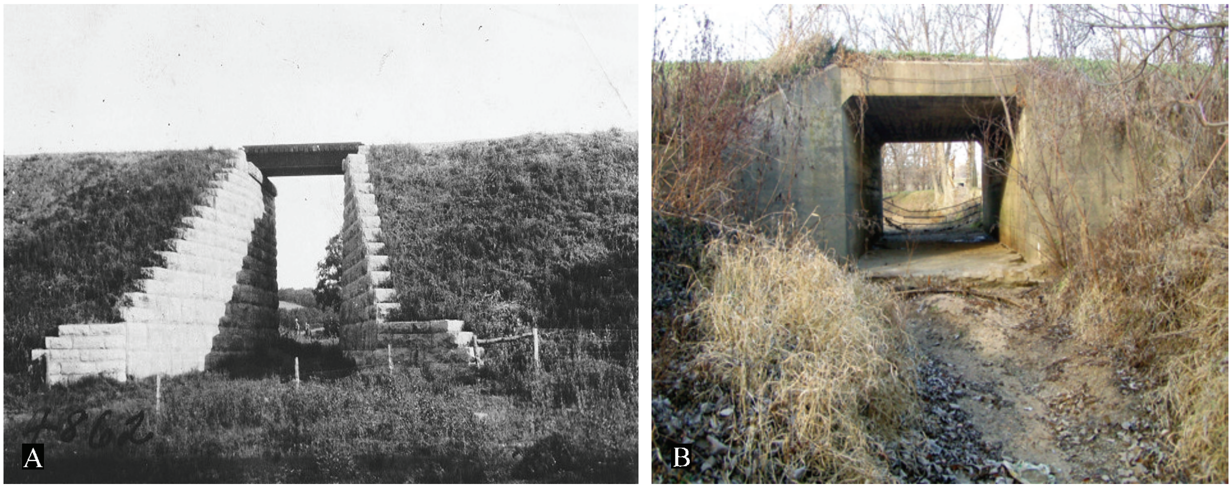


Figure 66. A. Highway and cattle related stone masonry railroad underpass on old Blue Grass Road/U.S. 34, east of Lockridge, Jefferson County (photo ca. 1926, #4862) (ISHC Library-Miscellaneous Folder). B. Large cattle crossing culvert under old U.S. 34, Albia vicinity, Monroe County (2003 survey photo).

In many areas automobile roads paralleled the railroads. This was a product of early road design, placement, and construction utilizing the advantages of following a previously established grade. Three overpasses and six underpasses are present on the Blue Grass Road (old U.S. 34/Iowa 8) (see Table 4). The underpasses on the Blue Grass Road allowed automobiles (and livestock) to cross safely under the railroad tracks east of Rome (concrete) and west of Lockridge (stone). Two concrete bridges also crossed over the railroad tracks just west of Mount Pleasant and just west of Rome.

In contrast, the Red Ball Route currently exhibits no large over or underpasses but was well known for its numerous at-grade crossings between North Liberty and Shueyville. As it followed the railroad tracks it crossed frequently from one side to another, often three or more times in a single mile. The difference between the number of bridges, overpasses, and underpasses seen in the two study routes' rural sections seems directly related to the topography. The Blue Grass' east–west path cut across many drainages and railroads, going against the topography. The Red Ball's northerly path kept to the flat areas, divides, and ridge tops as much as possible thus greatly eliminating natural opportunities for over and underpasses.

Livestock Underpasses. Many Iowa highways and roads still have livestock underpasses (Figure 66). While these may function as culverts many also functioned for the passage of cattle, horses, and even pigs. Some exhibit grooved concrete floors and ramps. One culvert found along the Red Ball Route near North Liberty was specifically a hog culvert and was not designed to carry water (see Figure 112A). Large railroad stock underpasses also often functioned as an early roadway. Two of these encountered on the old Blue Grass Road (old U.S. 34) under the rail lines were of stone construction and not concrete (Figure 66A). Most of these have been filled in and are not clearly visible except for the ends of the stone retaining walls projecting out of the gravel ballast. A third crosses a 19th century road or stock path.

Signs, Lines, and Markers. A seldom appreciated but vital part of highway design and construction are the early Registered Route and ISHC signs along the sides of the road, and eventually by the 1920s the painted lines down it. Roadside signage in the very early part of the study period was very local and very haphazard. The few official signs present were wooden and not necessarily along the edge of the right-of-way. Until the mid-1920s route signage was maintained by registered highway associations on major routes and these were generally painted on the telegraph and phone poles (Figure 67) and concrete structures such as railroad underpasses. Until the introduction of Iowa's Primary Roads system the counties were responsible for marking the main routes. The county, township, advertisers, or local farmers would put up signs on secondary roads. Many a confusing or just plain wrong sign was put up by local businesses or towns to steer travelers through their towns. Route information was often written on private signage and the Registered Highways used simple painted symbols (Figure 67B).

Figure 67. A. One of two known surviving original Blue Grass Road signs (1910–1918). Both were found on a concrete underpass east of Rome, Henry County. B. Painted sign for Iowa Primary Road 2 (ca. 1922) on concrete pier in downtown Ainsworth, Washington County. 2003 survey photos.

As travel was generally local from 1900 to 1920 most people knew where they were going without signage. The stage and post routes were the earliest arterials and the various landmarks along the way were well known. People who had seldom left the county could give a verbal description of the route to the next county seat or nearby towns. The 1905 Manual for Highway Officers (ISHC 1905a) gives no specific directions for signage along roads. Signage largely remained a local, township, or county concern until 1915 to 1917 when county and Primary Roads began to be marked. In 1915 in Henry County fifty metal signs were to be placed by county officials at the intersections of the main traveled roads. The signs were bought by the county, were of sheet metal, painted blue with letters in white, and three inches high. The signs were to be clamped to steel posts set in solid concrete 3 ft in the ground (ISHC 1915l:12).

The marking of lines on the pavement were nonexistent even on early concrete roads and were useless on dirt or gravel. There were no traffic control signs such as stop, speed, curve, or danger. Part of this attempt at signage also relates to the introduction of signature concrete culverts and bridges (see also Figures 56 and 57). Signature structures acted as markers for a route through a county. Some counties had very few marked structures while others, especially those on a registered route, often had many.

The first official Iowa Primary Roads signage was started in 1920. July 12 to 17 was to be road number painting week on Iowa Primary Roads (ISHC 1920b:3–4).

> State road officials have adopted a numbering system and a standard road number symbol. Iowans and those from outside the state traveling within its borders have long complained at the inefficiency and lack of signs upon the main highways, and this in the state, which originated the painted post tourist trail [ISHC 1920b:3–4].

All official Iowa road signage can be said to have been completed after July 1920. As a result the Blue Grass Road became Iowa 8 and The Red Ball became Iowa 40. The Primary Roads system comprised 6,422 miles of highway selected from the county and township road systems. The state Primary Roads system was designed to ignore county or township lines. This system was to be improved and maintained entirely with the proceeds of the automobile license fee, and the federal aid money allotted to Iowa. The signs were to be 10" x 15" in size. To show turns at intersections, an arrow, bent to right angles, would point to either the right or the left turn. With no arrow in sight, the driver would know that the route lies straight ahead (ISHC 1920b:3–4). While telephone and telegraph poles were used initially, standard posts were to be permanently affixed (ISHC 1921b:12, 1921g:9, 1922e:13, 1923g:9, 1926e:cover, 1926f:3).

Those interested in the organized tourist routes found that mostly their routes would still be following the primary system. They were numbered as to make it convenient for trail users to keep track of both trail route symbols and primary system numbers. The primary system numbers were to be painted on the poles in a uniform manner over the entire state. A yellow band was to be painted on the pole first. Then the route number stenciled with the words “Primary Roads.” These signs were not always placed on sheet metal and today the only surviving symbols found were on concrete structures.

There were no laws governing the erection or placing of road signs. Jurisdiction lay with the township trustees, boards of supervisors and the ISHC. There were numerous rulings on advertising signs. It was forbidden to paint advertising signs on bridges and culverts, guardrails, and construction work. Outside of the right-of-way the road officials had no authority. Portable barriers and danger signals would be put where new bridges and culverts were being put in or dumped gravel left of the highway, and would be placed a considerable distance down the road, as well as on the actual obstruction.

> If the engineer county and resident during construction, will give more heed to the placing of road sign and markers and danger signals of all types, it will certainly materially aid in the safety of the highways. It may go against the grain to take extra precaution to protect a fool driver against his own carelessness but it is best for all concerned to do it [ISHC 1921g:9–10, 15].

Figure 68. A. Center line painting in 1923. Reverse of photo notes car as a Maytag (Iowa DOT Library–Photos). B. Center line painting truck in 1926 (ISHC 1926f:5). Note motorcycle wheel in back.

In 1923 the state began marking black center lines on some highways (Figure 68). In 1925 marked black centerlines were placed on all of its Primary Roads system. It was to be a reminder that “the place for you, and your motor vehicle, is on the right hand side of the road” (ISHC 1926e:cover). An old war surplus White truck was fitted out as the first line painting vehicle run by the state. In order to keep to the exact center a motorcycle wheel was used as a guiding device, which could be adjusted on 18 ft, 20 ft, 22 ft, 24 ft, and 26 ft wide pavements. In the 1927 season both black and white paints were used. In 1926 three counties within the study routes had centerlines painted. These were Des Moines (8.8 mi), Johnson (3.2 mi), and Linn (20.8 mi) counties (ISHC 1926f:5). A special black paint was formulated although much of the reason for its acquisition was cost and accessibility from the supplier. No surviving black lined highway segments were found during the statewide or study section surveys.

The first official federal signage imposed on the Blue Grass Road changed the numbers from the Iowa Primary Roads numbering system (Iowa 8) to the federal system (U.S. 34). These signs were placed along the study route in 1926 as noted by an October 18th article in the Fairfield Ledger which states: "The new federal road markers which turn State Primary Road No. 8 into Federal Highway No. 34 are now being placed in position" (Baird 1989:35; ISHC 1920b:3–4). Until the end of the Registered Highway Era in Iowa in 1927 there was some overlap in signage systems on the Blue Grass Road and Iowa 8.

In 1926 U.S. route markers, along with caution, danger, and warning signs, were affixed on all Iowa Primary Roads following the federal system. Placed county by county on the first days of October of 1926, around 50,000 new signs were erected. Of Iowa's 6,654 miles of Primary Roads around 3,000 miles had been selected by the U.S. Joint Interstate in 1926 and designated part of the U.S. interstate system of through routes (ISHC 1926f:3–5). This was not the 1957 Eisenhower Interstate System.

The ISHC first marked the roadway with center and side lines in 1926 (Figure 68B) (ISHC 1926f:3–5). The first speed limit signs were put in place in 1926 while the first stop signs were installed in 1927 (ISHC 1926f:3–5). State approved signage was to have been placed at specified locations and have easily identifiable standardized color schemes. Due to their rarity, if found, early signage can be a very important component contributing to the integrity and interpretation of a historic road segment. During the statewide survey only three original signs from the Registered Highway and early state Primary Roads eras (Figure 67) were found along the study routes, and both were painted on concrete structures.

INTEGRATING THE PRIMARY ROADS AND REGISTERED HIGHWAY SYSTEMS

Introduction. During the years from 1920 to 1925, Iowa's newly created Primary Roads system and the old Registered Highway Route system overlapped. Additionally, much of Iowa's Primary Roads system was still maintained by the counties. During that time there was some interesting interplay and conflict between the ISHC's Primary Roads system, the Registered Route systems, county supervisor's road jurisdiction, and local cities and enterprising businessmen along the routes. Correspondence between Robert N. Carson of Iowa City, President of the Red Ball Route Association, who wrote a number of letters to members of the ISHC, and others, illustrate this formative era (Appendix C). These are the only such period letters or archival resources found that outline the interplay between the Registered Highways, the ISHC, county engineers, and local communities (Brown and Mossman 1913; Carson 1913–1925, Crum 1915; Ford 1919a, 1919b; Gearheart 1920; Harrison 1925; ISHC–Letters 1913–1925; Jones 1923–1925; Loper 1916; Morrison 1920; Thomas 1917; White 1919a–1922). They provide a rare insight into the early organizations, their interplay, route changes that were both approved and unapproved, local civic competition and county improprieties, along with explaining the impossibility with dealing with the registered route system.

Changes in Registered Highway Routes. Registered Highway routes in Iowa were not fixed on the landscape as were the later Primary Roads system of the ISHC. As noted above, while the Registered Routes often preferred to run with the Primary Roads there were various reasons where they didn't. Generally, when new sections of roads were graded and surfaced or bridged the registered route would change. A change in registered road routing was common and somewhat involved. Through a series of letters, and maps with routes changes or corrections on them, the official "route" recognized by both the registered highway association and the ISHC were filed in Ames (Figure 69). As a result a segment of road may have been part of an arterial highway, registered route, or a trail only a few years. As noted on the map below, near number 110 there are two routes in use at the same time. The southern route is Rice Lane which changed from the original route (Tupelo Boulevard) to connect with old U.S. 218 located one section over.

New auto routes caused some towns to bloom and other to die. Routes down a particular street provided business opportunities and many a route sign was opportunistically moved for just such a reason (Appendix C). New route and short cut openings were common (Press Citizen 1916:8). As the registered routes contended that they alone determined their pathways and markings, and these didn't always coincide with the Primary Roads, or run where local businessmen wanted them, there was a lot of room for contention. Things were much better for you if the main road ran past your filling station, auto dealership, repair shop, or restaurant. In many a bypassed Iowa small town the original road can be plainly seen splitting away to the original town core. These road segments have sometimes been cut-off at both ends with only part of the old segment remaining (see also In-Place Cut-off Segments, Figures 13, 14, 87).

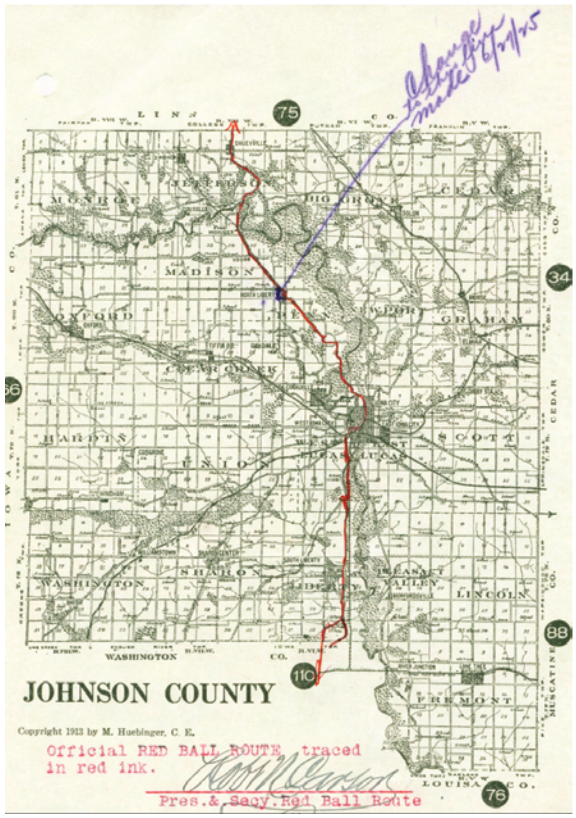


Figure 69. Map of Red Ball Road's route (1925) showing Robert Carson's hand notes and changes (Iowa DOT Library–Red Ball Folder; Carson 1922–1925). The diagonal route near #110 above is Rice Lane.

Some of this interplay was very competitive between the organizations involved. Primary Roads in a county meant federal tax dollars pumped into road funds but such good roads were often not advantageous to the towns and villages which had been bypassed. The registered highways preferred to go through such places, especially between long expanses of open country so that food, fuel, lodging, and repairs could be provided. It was not the Primary Roads system's requirement to design its route for such necessities. They were built and routed to provide the best and quickest road between two points, often county seats, and only went through towns or villages when necessary. Often, when a route was moved or decommissioned an Iowa small town dwindled. This pattern had happened in an earlier era when the railroad missed a town or even earlier when steamboats changed loading points or no longer came.

Automobiles and Trucks. It was the automobile that changed Iowa's highways, and highways were outstripped by automobile engineering. Highway engineers needed to meet progressively higher traffic speeds and ever larger vehicles. Although bicyclists were important advocates in the late 19th century's Good Roads Movement it was the introduction of the automobile that altered the face and pace of America. While many early car makers such as Winton, Deere, Crosley, Stanley, and others filled the needs of the early ranks of motor enthusiasts, such cars were clearly for the wealthy enthusiast and did little to meet the needs of the common citizen or the farmer. It was the introduction of mass produced automobiles such as Buick, Olds, and Ford that has had the greatest affect on American life.

While Buick and the Olds brothers made and sold affordable automobiles it was clearly Henry Ford's Model A that set the standard for automobiles in America. With the introduction of his assembly line Model A in 1903 the stage was set for the mechanized transportation era. Its derivation from buggy chassis is evident in its open construction, wooden body and spoke wheels, pleated leather bench seats, and carbide or kerosene lamps. Its two cylinder eight horsepower engine with two-speed transmission, chain drive, and differential all bespoke of the future. It changed gasoline from a cleaning solvent to a motive power. Its price of $850 for a two passenger and $950 for a tonneau top version put it in the price range of the middle class.

The introduction of the Model T in 1908 further expanded the market and affordability of the automobile. By the 1910s used models were becoming available and the prices kept dropping. Ford introduced a tractor line in 1917. While a box added to a Model T served as a truck bed Ford also developed in 1917 a truck using its own frames called the Model TT. The Model T's frame was often converted to farm tractors or implements when stripped of the chassis and iron wheels added.

On the Red Ball Route the first bus line in Iowa was begun in 1911 (Appendix D) (Iowa DOT 1999; Ingalls 1996:1–20). Who manufactured this bus is unknown at present. It ran from Waverly to Charles City. In addition, it was the first such line operated by a woman. Although in operation for only a couple years it marked an important change from strictly auto and truck traffic to intercity commercial passenger transport that had previously been done by the railroads and later the interurban railroad. The Red Ball ran over a surviving graveled section of the Red Ball Route in Bremer County that is well marked and drivable.

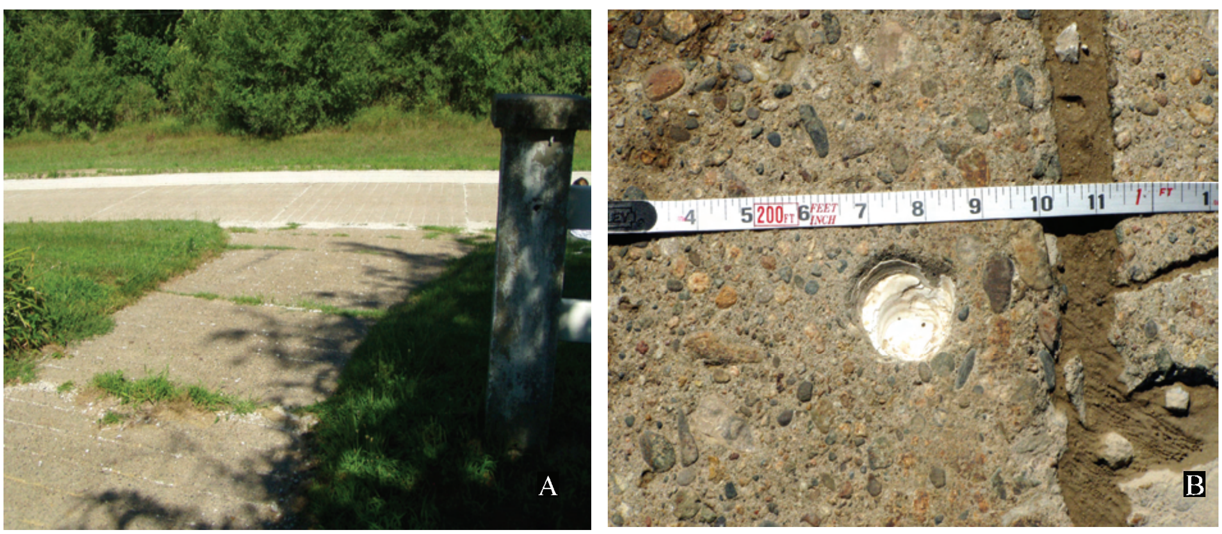


Figure 70. A. View of Eddyville Cemetery's concrete pavement (2003 survey photo) with scored 14 ft long sections. B. Detail of Eddyville cemetery pavement. Note shell in aggregate. 2003 survey photos.

While the Eddyville roads were not "arterial highways" they were the oldest continuous pour concrete roadways in the state, near the study routes, and set the bar for all of Iowa's subsequent concrete highways. They were the principal highways into the towns for their time, when a 1½ mile stretch of concrete road was a marvel and as good as it got. The surviving section, the cemetery road, is a valuable comparative artifact from the early age of concrete pavement construction as well as a historic resource for social and technological road history in Iowa.

PRIVATELY FUNDED AND EXPERIMENTAL ROADS

Introduction. During the formative years of road construction in Iowa a number of projects and structures were privately funded by both communities (Eddyville) or individuals (Marsh and Coleman). The first concrete paving done in Iowa in 1903 was funded by two LeMars businessmen. The known surviving pavements and structures from this era are important for comparative purposes. Three significant ones are along or near the study routes. They played a significant role in the advancement of road construction in the state and their contributions are briefly discussed below. These roads are comparable to other very early concrete roads in the Midwest (Ingalls 1978).

The Eddyville Roads. The Eddyville cemetery and downtown roads are the two of the best extant examples of Iowa's earliest type of concrete roadway. The Eddyville cemetery road is the most comparable early road built near the study area in 1908 (Figure 70). The extant historic concrete of the Eddyville cemetery road is 12 ft in width, 6″ in depth, with surface scoring along its length. This facilitated the traction of horses and was not intended for automobiles. It could be construed that Iowa's very first concrete roads were special purpose horse and buggy roads and not auto roads. In fact, the original road grade and surface testing done at Ames used horses and wagons and not automobiles to come up with their data. Whether this important early concrete road through Eddyville's downtown has been either resurfaced, covering the early pavement, or completely repaved is unknown at present.

It was generally thought that the Eddyville Cemetery Road was the earliest public poured concrete road in the state and the only section of scored surface and shell aggregate roadway surviving. It was found that the Currier Mill Road, also in Eddyville, which was concreted two years earlier then the Cemetery Road in 1906, consisted of street-wide cement from the river bridge through the main business district and possibly up the hill to the cemetery. A period article relates that "a delegation of engineering students with their tutors came from Ames at frequent intervals to see how this country paving was holding up" (Baker 1992:244). It is interesting to note that this was considered county paving by the ISHC. The likelihood of the main street segment having an aggregate that also contained mussel shell seems high.

The Fredonia to Columbus Junction Convict-Built Road. This cut-off highway segment was once a major arterial (Figure 71, see also Figures 23, 25B, 27B, 48). It is one of the earliest roads of its type in Iowa and is part of one of the study routes: the Muscatine/Davenport Diagonal of the Blue Grass Road. This extant concrete road runs through Fredonia on the eastern side of the Iowa River. It once ran across a bridge to Columbus Junction on the western bank. It was begun in 1916 utilizing convict labor and was partially funded by the first round of the 1916 state and federal road tax appropriations. This 16 ft wide road, which was made of 6″ to 7¼″ thick poured concrete, is a National Register eligible example of an early experimental rural road type built by a specialized ISHC crew over a bad area of sandy river terrace. It was constructed during the transition from local to state funding and incorporating the first introduction of federal dollars to Iowa's road projects funds. It was a good choice for a road project. Until the new road was built the sandy river bottoms in the area were often impassable making transportation mobility between Fredonia and Columbus Junction difficult. When this 1½ mile long concrete paved marvel with a right hand corner in the middle of it was completed people came from miles around to drive on it.

It was so important a project to the ISHC that a special report, special photographs, and a movie were made of its construction (ISHC 1916c:94, 1916d:3–5, 13). It was noted in a national transportation oriented magazine (Road-Maker 1915b:17; 1916c:12–13). It quickly pulled most of the Registered Highway Routes in the area to it. These included along its route the 1917 Grand Line, the militarily important River to River Road (post-1910, registered 1918), the 1924 I.O.A. Short Line, the 1914 Great White Way, and the 1917 Burlington Way. For the study route's context the Blue Grass Road's North Diagonal was established in 1917 (Huebinger 1910, 1912a, 1912b, 1913, 1915, 1924; TIB 1918; Kenyon 1919; Iowa DOT 1986). By 1924 the Bee Line route ran along it (Huebinger 1924:76) but due to the grading and surfacing improvements the registered routes changed to more direct routes. Only the

Burlington Way and the Great White Way still followed this old route. So between 1914 when completed, until 1924, it went from one of the most traveled route sections in the state, and the path of several Registered Highway Route arterials, to a local road. Now a cut-off section of old U.S. 92, it was a significant part of the Blue Grass Trail and Iowa's transportation history.

Figure. 71. A. The Fredonia to Columbus Junction sand road prior to experimental 1916 concrete paving. Photo by Baker (ISHC 1916c). B. Current view-shed photo of west end of pavement (2003 survey photo). Note B is the same view as A. C. Paving in progress using convict labor (1916) (ISHC 1916c, Photo #3079). D. Current view-shed of west end pavement (2003 survey photo).

The Coleman Road. One of the best examples of privately funded highways in the state and within the study routes is the Coleman Road. Its path followed the route of the Fort Madison Diagonal section of the Blue Grass Road. This road (Figures 72, 73) was part of the Blue Grass Road from around 1919 to 1929. Its concrete paving was funded in 1927 by Alexander Coleman who was described as a "…wealthy bachelor and ardent good roads booster, donated a quarter of a million dollars for the constructing of an 11 mile paved road connecting his home town of Hillsboro (population 281) with Primary Roads No. 161" (Van Buren County Register 1982). Mr. Coleman came to Lee County Iowa in 1848 with his family. A 1927 article relates Coleman's personal history, motives, and road evolution:

> Old settlers of Hillsboro and community will hardly recognize U.S. highway No. 161. So long as the old timers live it will remain, in their minds at least, as the old Mount Pleasant-Fort Madison trail. Its present yellow and black Primary Roads No. 40 markers borne now for five years past are to be surrendered soon for the new black and white U.S. shield and its new U.S. number. The neighborhood folk familiarly call the road which is to be built past the old homestead and leading to the main road, the Blue Grass Trail. It

> is only a county road but when the pavement is finished it will undoubtedly be christened the "Coleman Road" and be distinguished perhaps for years as the longest stretch of secondary road pavement in Iowa. The Lee County road, specified by Mr. Coleman in the terms of his gift, enters the county in the northwest corner of Cedar township and follows the route of the Blue Grass Road as indicated on the accompanying diagram to a point east of Houghton where its connects the present Primary Road No. 40.
>
> In order to accept the gift it will be necessary for both counties to bring the road…to a proper grade. It is specified that "any highway engineer of the state appointed or designated to act or carry out the provisions of this gift is to have power to act in all matters in both Lee and Henry counties." Mr. Coleman desires that the State Highway Commission shall determine the cost per mile of the paving connecting the two counties.
>
> Following the customary procedure in Iowa it is likely that the grading will be completed during the present 1926 season, allowed to settle and pack during the winter and spring months and the contract for the actual paving be let in the spring of 1927 for completion next year...His gift is unique and unusual…It is doubtful if any man ever devised a better or more practical type of memorial to build for himself than has Mr. Coleman [ISHC 1927c:7].

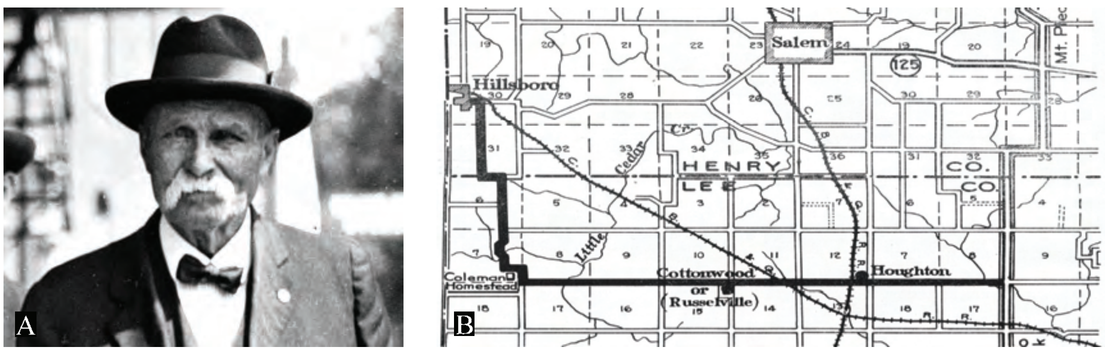


Figure 72. A. Alexander Coleman ca. 1926 (ISHC 1926b:7). B. Map of Coleman Road (ISHC 1926b:6).

According to the article, "Doc" Rombeeler of Keokuk was doing the excavating with three-mule dumpsters (bucket scrapers) early in 1927 (ISHC 1927b:12). Cameron Joyce of Keokuk was responsible for the four bridges and Harrison Construction of New Jersey had the paving contract. Supplies came to Hillsboro by rail, with a special siding added in a nearby pasture. The road was built 18 ft wide and 6" thick at the edges, which was the primary traffic standard until the late 1920s (ISHC 1927b:12).

The road was completed in 1928 (Figure 73A) and was the scene of great festivities on July 4th of that year. The article relates:

> A grand tour of the highway from end to end ran…with Mr. Coleman riding in the lead car. He cut the ribbon at the Houghton end…making a brief speech mostly addressed to the little girls from the neighborhood dressed in white for the occasion. "God bless you", he said. Then he got into the automobile–one of the few times he rode in a motor car–rode in the official motorcade over the new paving which finally ended at his old home place [ISHC ca. 1927:7].

In 1930, Coleman added a second codicil to his will. The state had paved Primary Road 40 (a.k.a. The Red Ball Route/U.S. 161), adding the missing footage to connect with Coleman's road, and had paved further into Lee County. With no need to fund further paving on the Blue Grass Road, but still determined to spend his money in the manner of his choosing, Coleman decided to pave the dirt road running south from the curve, just east of his homestead to the Thornton farm.

Mr. Coleman died in 1933. When his will was probated, his relatives applied for a temporary injunction, restraining further action on any paving project. A fourteen year court case ended in the Iowa Supreme Court decision depleting his estate some $48,000. Additionally, the costs of paving were high. The township trustees circulated a petition to all the taxpayers in Cedar Township to determine their course and finally received permission to build one nine foot lane. Now called the "Half Slab," the strip was completed in 1948 (Figure 73B).

Figure 73. A. View of Coleman Road ca. 1927 (Iowa DOT Library–Coleman Folder, Photo #11,750). B. Survey photo of Half Slab completed in 1948 after settlement of lawsuit by heirs (2003 survey photo).

In conclusion, the article relates that:

> Mr. Coleman's donation was a major factor in the economic and agricultural development of this area. Mr. Coleman's financial contributions gave his neighbors 10.75 miles of new concrete pavement many years before Lee and Henry counties would have been able to provide the same benefits from taxes [ISHC 1926:7].

The "Half Slab" is a transportation legacy and historical asset almost three miles in length. This intriguing anachronism is possibly the last of Iowa's privately funded highways and at nine feet wide is unique. The Half-Slab is still extant as a rural public road southwest of Houghton, Cedar Township, Lee, County.

In 2000 an article from the Iowa Scene relates the Coleman Road story once again (Given 2000:1–2) but has an important postscript added by an Iowa county engineer. It relates that:

> The Coleman Road projects from Hillsboro south and east through Houghton to U.S. 218 were 6″ thick, 18′ wide and used Class 2 durability coarse aggregate for 1927 paving. In 1964, a 2″ ACC overlay was added using Raid Quarry LST. In 1988 a 3″ BAC was required, followed by a 1½″ ACC resurfacing. By 1990, the Iowa 16 Section from Jct. W-46 (Henry) easterly 4.0 miles past the Coleman homestead was realigned and paved with "PCC LST of Class 3 durability coarse aggregate from Huntington, MO. Henry County also reconstructed their 1.5 mile stub into Hillsboro.
>
> Lee County Engineer Dennis Osipowicz acknowledges that "the half slab" conditions are poor…and surface maintenance difficult but preservation of this last Coleman Road segment is very important to the people of Lee County [Iowa Scene 2000:1–2].

Marsh Bridge. Other privately funded roads and structures exist in the state. Very few are recorded or evaluated. A previously evaluated structure falling within this category, built within the study period, and located along a study corridor (Red Ball Route/old U.S. 218) is the Marsh Bridge (13-FD-1H) located in Floyd County, near the Floyd Cemetery, and is located approximately one mile south of the town of Floyd on the old road (Figure 74). This bridge was built and financed by James Marsh, an important early Iowa bridge designer and builder, for the use of the local automobile club of which he was a member. Marsh used his own funds, and maybe some of the club's, to build this significant 1905 concrete slab bridge, which was determined eligible to the National Register in 1992 (Bear Creek Archaeology 1992a–c; Ingalls 1994:5–40). An oval bronze plaque with his name is set into the bridge's handrail. It crossed a troublesome little creek next to an important local cemetery. It was part of the Mason City auto club circuit. Much of downtown Floyd was built during the early auto-touring era and reflects the area's early transportation era prosperity linked to local touring clubs and an east–west arterial route (U.S. 18).

James Barney Marsh was a significant bridge designer with statewide and possibly national significance. He was a civil engineer who graduated from Iowa State College, in Ames in 1882. He went to Des Moines and in 1883 became contracting engineer for the King Bridge Company, of Cleveland, Ohio. In 1889 he was made general western agent of that company and continued in that capacity until 1896, when he began designing bridges on his own. About that time he organized the Marsh Bridge Company, of which he was president. It was succeeded in 1909 by the Marsh Engineering Company. In his 1916 biography he is noted as a founding member of the Hyperion Field and Motor Club. He was the inventor of the rainbow arch bridge, which he patented in 1912 (Bringham 1916:663–664).

Soike and Panning in their discussion of the 1914 Coon River Bridge, a Marsh rainbow arch bridge near Lake City, Calhoun County, Iowa relate:

> …that about 1900 James Marsh evidently began to specialize in designing reinforced concrete bridge structures. The cities of Kankakee and Peoria, Illinois, and Kenosha, Wisconsin commissioned Marsh to design concrete bridges during the years 1902 and 1903, followed later by consultant commissions for reinforced concrete bridges from three Iowa cities—Des Moines, Cedar Rapids, and Waterloo. *Additionally, Marsh Engineering undertook numerous contracts for the ISHC* [Soike and Panning 1988:8, italics added].

Carson Culvert. During research at the Iowa DOT library a ca. 1928 photograph was found showing the construction of "the Carson Culvert" in Washington County, on the old Red Ball Route (Figure 40C) (ISHC Library–Culverts folder). It was the only titled photograph related to an individual. The back relates that it was a 6 ft by 8 ft by 40 ft long concrete and steel culvert with an 11 ft approach.

Robert Carson was the president of the Red Ball Route and the River to River Road highway associations. He also was head of the Iowa City automobile club. The photo suggests that the culvert was named for and may have been privately funded by Carson either by himself or for the Red Ball Route Association. The photograph shows a small but perhaps troublesome drainage with a small, steel, pony truss bridge with wooden plank approaches being replaced by a poured-in-place concrete culvert. It demonstrates how such small concrete culverts, that needed minimal maintenance, could replace the old high maintenance bridges. It also relates to the private funding of road projects by individuals, road associations, and automobile clubs.

Auto Club Routes. During the 1900s and especially in the 1910s automobile owners formed clubs and organizations to enjoy the genteel sport of motoring. Driving in itself was quickly becoming a commanding activity amongst those who could afford it and especially before the introduction of assembly line cars. Singly or in groups, locally or cross country, people traveled for the pleasure of it. The locations of auto camps and service stations were situated to meet this market and auto dealerships grew almost exponentially. One of the first three Registered Routes in Iowa was by the Center Point Motor Club in 1914 (ISHC 1919a:23). This suggests that the Center Point Motor Club route was in use and well established perhaps as much as a decade prior to that date. This route is not listed in 1923 and may have been incorporated into another highway route (Rand McNally 1923).

Touring clubs or unusual motorcars or groups traveling through a community often drew attention and became news (Baird 1989:20). In Fairfield on the Blue Grass Road it was remarked on April 21, 1922, that "An automobile from Texas and one from Montana have gone through Fairfield this week in the van of the rush of tourist traffic. From all over the country reports are coming of the starting of touring which seems to indicate that this is to be a big year for auto travel" (Baird 1989:20). Auto clubs were responsible for showing the newest innovations. One 1922 notice relates, "A Gregory automobile with a front wheel drive is attracting much attention on the streets here whenever it stops, a crowd at once collects around it attracted by the novel power plant" (Baird 1989:20). On Saturday, February 9, 1924, the Fairfield Ledger related that "The new balloon tires that have been creating such a sensation will be shown for the first time in Fairfield at the Auto & Accessory Show at the Armory." And on Monday, March 31, 1924, "The first car in Fairfield to be equipped with balloon tires was by Hannah Auto Co. to Mayor Sanford Zeigler" (Baird 1989:25). Even in 1932 touring cars were newsworthy as it was reported in the Fairfield Ledger "that nine cars with out-of-state licenses were sighted on the square yesterday after noon by one passerby. An Ohio and a Wyoming car were the farthest from home" (Baird 1989:46).

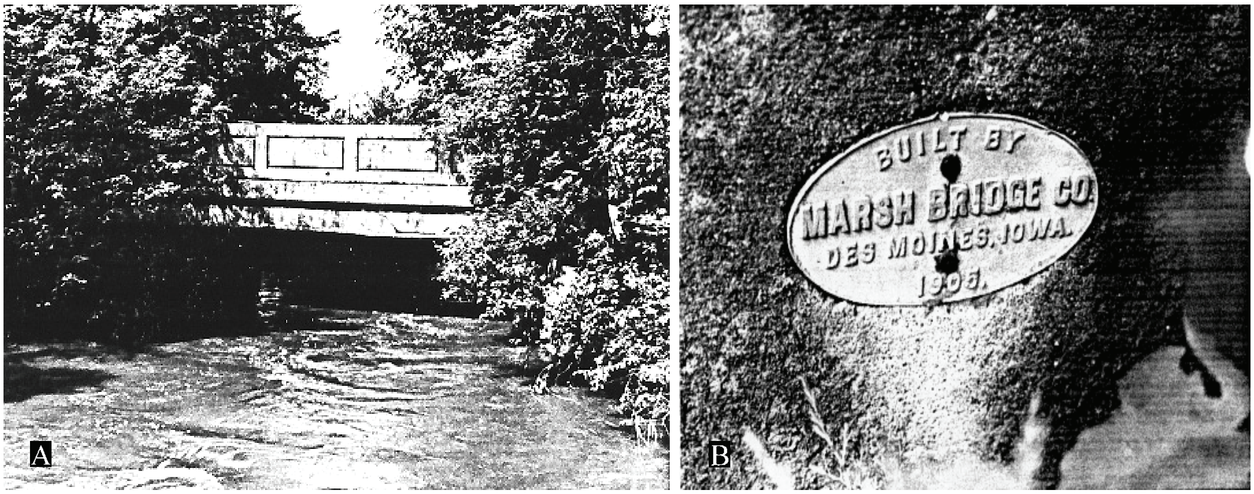


Figure 74. A. View of 1905 Marsh concrete bridge. B. Detail of original plaque. 2003 survey photos.

Besides innovative cars and accessories auto touring clubs often improved local routes. The bridge noted above (Figure 74) was built and designed by Marsh at a very early date (1905) out of his own pocket so that he and the local auto club, probably from Mason City, could have an easier routeway to tour on. This was the oldest, well identified poured-in-place concrete slab bridge encountered by the author on the study routes. Its rectangular form and geometrically decorated sidewalls presage what was to become a common bridge form in Iowa and is similar to the standardized ISHC bridge design of 1913. It may have had some experimental use for Marsh other than just crossing a troublesome creek as a touring route for the wealthy. The first concrete paving of a half-block in LeMars in 1904 was also initiated for the local automobile club.

Bridges, culverts, road sections, and other structures associated with local auto club courses, such as the Marsh concrete slab bridge noted above, built for driving pleasure over a personal automobile touring circuit, are especially rare and notable. Such auto club route's contexts relate to early automobiles and automobile touring, road and bridge materials and technology in an area, association with a person significant in the early automobile transportation movement, and local auto clubs and their routes that grew up in and around Iowa cities and county seats.

The routes of auto club routes may have extant sections with eligible structures built independently of the ISHC, counties, or local governments. These routes were often later incorporated into arterial highways. Such structures relate to the time when individuals donated roads and related structures at their own expense, mostly for the public good. Some of these structures were built by master craftsmen whose innovative designs or stylistic elements are of historical significance in addition to the auto club context.

The Marsh Engineering Company's privately funded bridge was constructed on what became the Red Ball Route in 1912, near Floyd. It is associated with several potentially contributing resources that could comprise a historic district. This intersection helps to illustrate the interrelationship of at least three distinct routes and maybe more (Figure 75).

Segment A has two possible routes dating to the Registered Highway Era and the early State Highway Commission Era road. Segment C, although divided by current U.S. 18/218, retains sufficient integrity of cross-section and paving, while running the mile from Oakwood Cemetery to Floyd, to visualize the road's look from 1913 to 1948. The early auto route's cut-off segments date between 1900 and 1912 and their abandoned routes relate to the bridge, cemetery, and the original road (Red Ball/Iowa 18) into Floyd. Segment A ran up the creek bed. Marsh must have had enough difficulties at that stream crossing prior to 1906 to have conceived the plan for the bridge's construction (Ingalls 1994:5–19). Not often do structures relate to a significant individual's personal experiences and enable us to see their solution to a personal transportation problem.

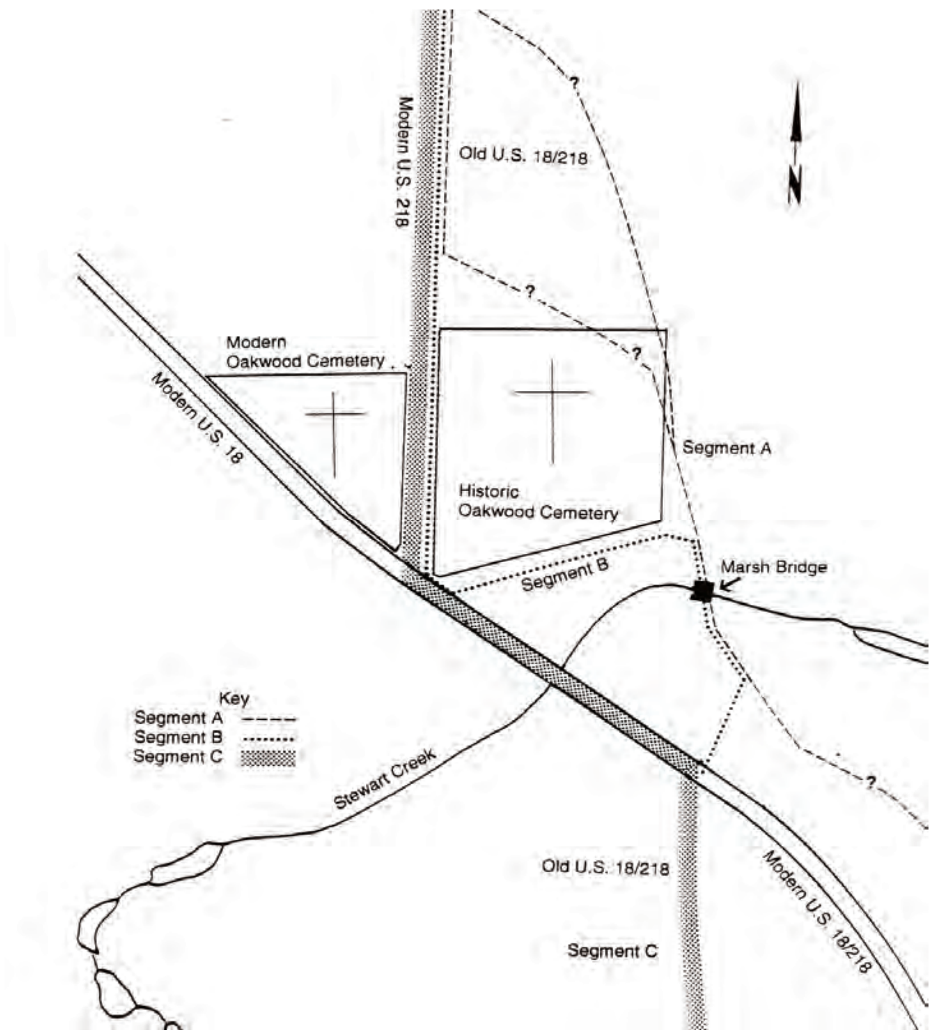


Figure 75. Map showing historic relationships between historic roadways, bridge, cemetery, and modern U.S. 18/218 south of Floyd, Floyd County (Ingalls 1994:5). Segments A and B were part of a touring route from 1900 to 1913 and the Red Ball Road from 1913 to 1927.

Conclusion. Privately funded, innovative, significant road segments, and structures related to touring clubs were encountered along and within the study routes, and others may be found across the state. They are often located near larger cities and county seats with active clubs at that time. Many elements have been incorporated into current roads while others lie abandoned. Touring clubs played a significant formative part in Iowa's early transportation history. As such, significant period structures, segments, and routes may be National Register eligible under Criteria A, B, and C or a combination of historic contexts.

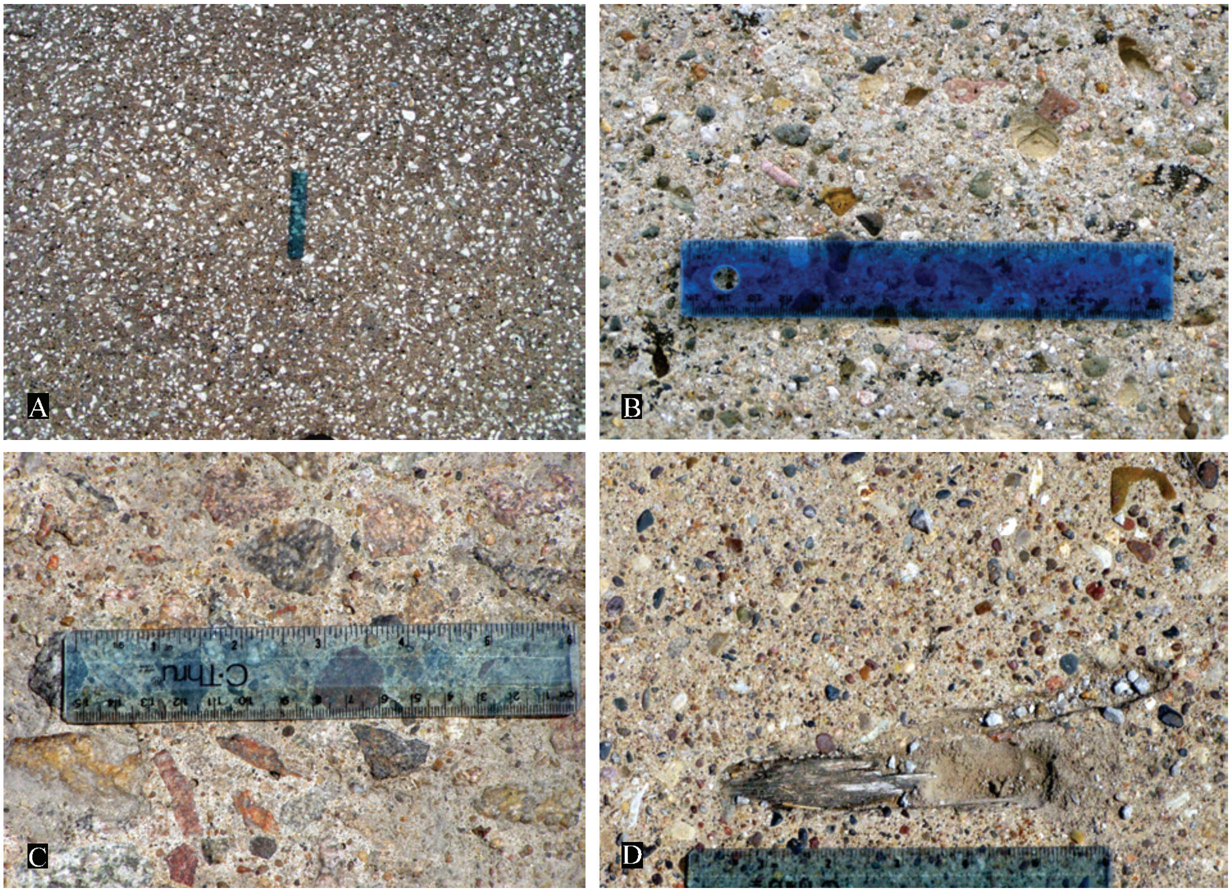


Figure 76. A. Mixed crushed dolomite and size sorted river rock concrete aggregate from old U.S. 34, Lockridge vicinity, Jefferson County. B. Aggregate from Iowa 175, Ida County, Ida Grove vicinity. C. Aggregate from old 281, Dunkerton, Black Hawk County. D. Aggregate from old U.S. 2, Cantril, Van Buren, County. Note wood chips. 2003 survey photos with 6" ruler.

CONCRETE AGGREGATE

Introduction. For the evaluation of concrete pavements and structures a general knowledge of concrete materials and technology is necessary. As concrete use grew and evolved through the study period it can often be possible to determine the date of construction of a particular road segment or structural element by the type of concrete used. Early concrete culverts and drains often underlie later earthen, gravel, and concrete paved roads. By looking at the concrete in terms of its changes in technology, shape, color, texture, and aggregate over time makes it possible to evaluate when such elements were first built, improved, and when various other road features were added, replaced, or reconstructed (Figures 76–79, 80, 83, also see Figures 70, 81B, 85B, 94C, 104C).

Overview. Iowa's early concrete roads and structures exhibit a variety of surfaces and show great variation in the aggregate materials used (Figures 76, 78, 79). From 1900 to 1930 the types of material used in the aggregate were much more dependent on what was available in the immediate area. This was especially true in very early highway (1900–1920) construction when rock and gravel sources were very local and often immediately adjacent to the road. The use of local materials, hand construction, and a pavement or roadway width of 16 ft or under can be evaluated as an early highway.

Concrete aggregates can be made in nearly an infinite variety depending on the sources and proportions of sand, gravel or rock, cement, and water. The earliest concrete structures have often been replaced due to age, poor construction, or small size. However, a number of early concrete and stone structures are still present along and often within or under arterial highway corridors. On the earliest and most important routes stone or concrete structures were often put in place when it was still dirt surfaced. Culverts, bridges, and drains can predate the earliest gravel and concrete road beds for a particular section. An aggregate type, bridge or culvert type, curbing, or other element may run for only a few miles or be seen only in certain places. This was often due to local contractors using differing mixes and getting rock from different quarries. It also had economic connections to local industry along with political ones.

Local materials used in aggregates prior to the mid-1910s consisted of sand and clay, river or bank gravel, shell, and occasionally some other material such as cinders. The river and bank gravels and rocks are rounded pebbles. Until around 1916 naturally sorted materials or beds were most commonly used. Some river gravels were crushed. The highway literature usually differentiates between bank gravel and stream bed gravel sources until around 1930. These gravels preferably consisted of basalts, granites, and the occasional piece of quartzite. In some areas in Iowa cherts, jaspers, and agates are major constituents. These two gravels generally do not contain soft limestones, shale, or iron ores but in some sections these undesirable elements are found. Clam shells have only been observed in Iowa in the Eddyville Cemetery Road but they could have been used as an early aggregate component in any of Iowa's river towns.

Figure 77. A and B. Details of ca. 1913 concrete railroad underpass of the Blue Grass Road off old U.S. 34, Rome vicinity, Henry County, showing (A) wooden inserts and (B) wooden base plate holding ceramic insulator (top left). Note painted but weathered Blue Grass sign in lower right. 2003 survey photos.

At a number of Iowa's river towns, especially along the Mississippi, large shell middens resulted from the late 19th to early 20th century shell button industry. These provided ready made materials for roads. Early transportation literature advocated the use of shell in road construction both for berm construction, dirt road paving, and in the concrete aggregate itself. It can be noted that the shell in the Eddyville road has held up well. Although pieces of shell have weathered out they have not produced the intense spalling that large amounts of shale, hematite, limonite, ironstone concretions, or other iron-based or soft minerals do. The shells observed in the Eddyville road were not byproducts of the shell button industry as they appear unaltered. It is possible that they were a natural component found within the local riverside sand and gravel banks quarried for the road. The species type(s) was not identified although numerous shells under 2¼″ are visible in the aggregate. The shell selected is very thick and solid. This may be either a result of size grading or species selection. Any Iowa public road of any length with concrete containing shell in its aggregate or shell as a paving material should be considered historically important.

In contrast, the river gravels used in the convict-built Columbus Junction to Fredonia road shows an extremely high concentration of quartzite, jaspers, and agates in the aggregate. No shells or shell fragments were observed. These gravels produced an unusually hard aggregate with a distinct translucent and reflective surface when wet. The gravels clearly came from a deposit that was of very high quality and well sorted before use. As previously noted this road segment displays an extremely high degree of handwork in its construction, which is one of the hallmarks of identifying early Iowa concrete pavement and structure construction.

Wood in aggregate was observed in old concrete surfaces (Figure 76D, 77A). Many underpasses, bridges. and large culverts exhibit pieces of wood sticking out of their sides, or in the case of one underpass running beneath. Most was in the form of boards, sticks, and chips. Boards (Figure 77) were set in to attach telegraph, telephone, or power line insulators to large structures. Most appear to have held wire insulators. The sticks were usually the result of detritus blown onto the wet surface or were accidentally mixed or pressed onto the surface of the aggregate. Some wooden chips appear to be part of the aggregate's original mixture, even if accidental. Often wet wood chips were laid atop wet concrete as it cured and may be pressed into the surface. While not a large percentage of the aggregate mix they may appear with some regularity on some highway segments. The evidence of wood chips both atop and in the pavement was especially noticeable in the south central part of the state.

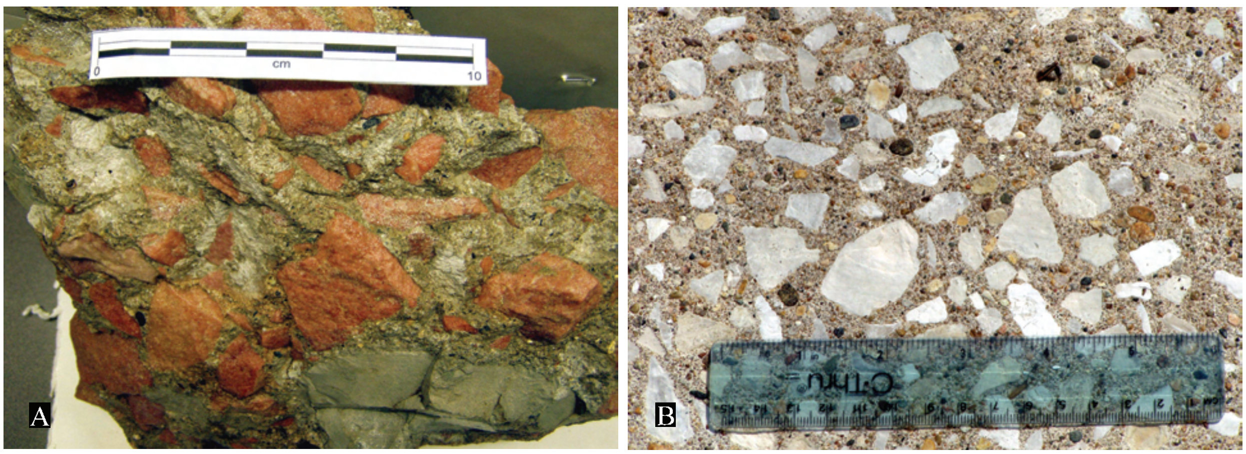


Figure 78. A. Wet aggregate detail with crushed quartzite aggregate from old Broken Kettle Road, Sioux City, Woodbury County (T89N-R47W, Sec. 6) (2006 photo). B. Aggregate detail with crushed dolomite from old U.S. 6 North (W38), Oxford vicinity, Johnson County (2003 survey photo with 6" ruler).

While crushed rock was relatively uncommon in highway concrete aggregates from 1900–1916 the proliferation of rock crushers for counties, and later the state run quarries and crushers, provided an ever increasing supply of crushed rock. Crushed river and bank gravels were used as well as crushed dolomite. However, by the late 1920s ever more crushed rock from state quarries was being used in aggregate. The crushed river and bank gravels were usually very hard. The limestone sources in the state varied significantly in hardness and the dolomite in the eastern part of the state was consistently used in large quantities. In the western part of the state Sioux City quartzite (Figure 78A), distinguished by its pinkish/purple color, is the preferred material due to its angularity and hardness. By the 1930s both local quarry materials and the use of river and bank gravels significantly decreased in highway aggregate, although not abandoned until after 1945.

For most of the roads built in Iowa and for the two study routes in particular, the use of crushed dolomite (Figure 78B) in the road surface became nearly ubiquitous by the early 1930s. Concrete highway paving sections built during the late 1920s may show crushed limestone in the aggregate for a stretch and then river or bank gravels for a stretch. Occasionally the two were mixed but most aggregates are either one or the other. Most of the quarried dolomite was mixed with small sorted river sands and bank gravels to fill in the voids and provide a better bond. In general crushed rock aggregate was stronger or superior to river gravels in terms of the ability of the mortar to bind with the rock surface. This was due to the crushed dolomite rock's larger surface exposure, partial absorption of the mortar, and better binding and packing potential due to its angularity.

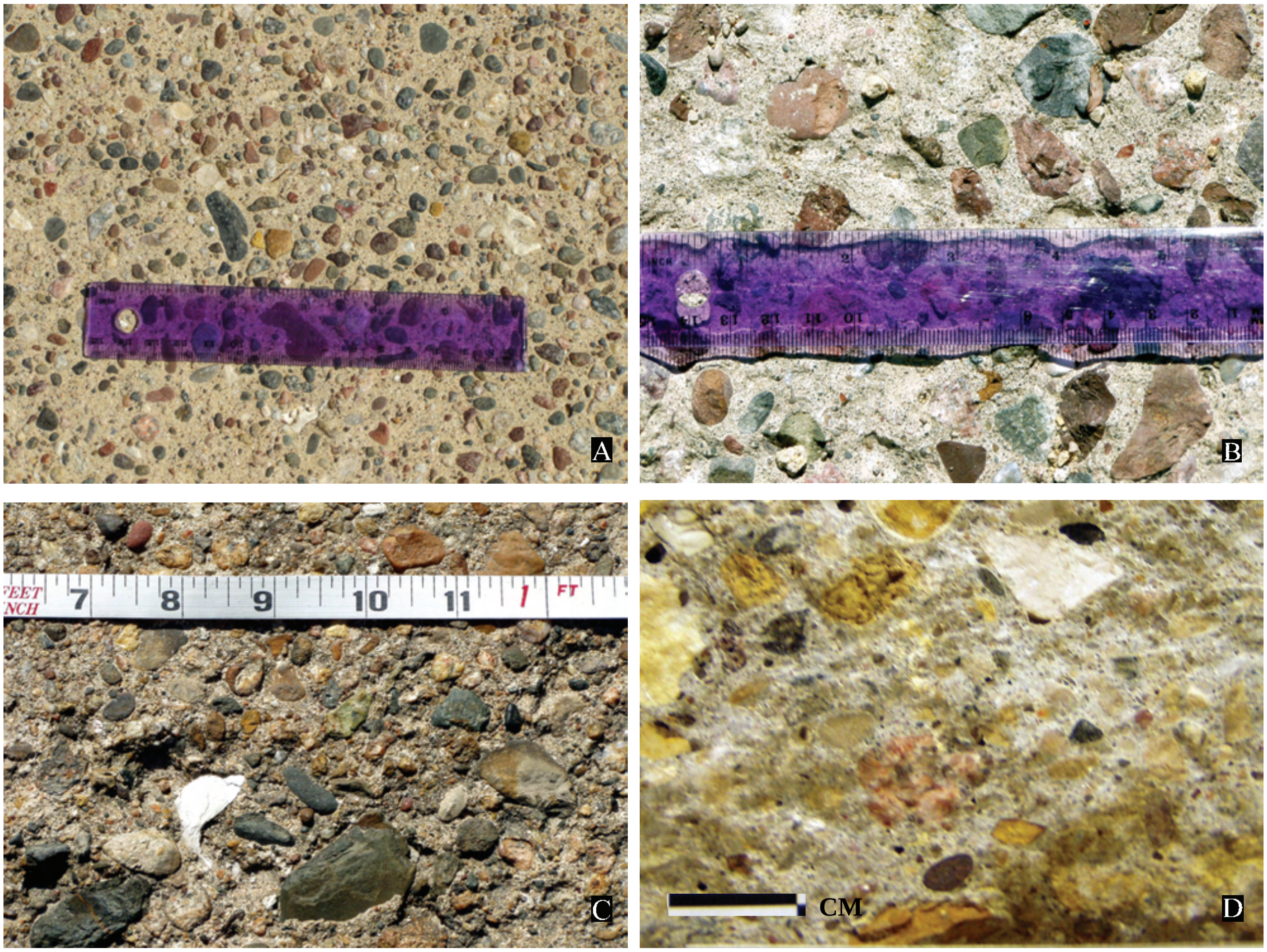


Figure 79. A. Well sorted bank gravel in aggregate from old U.S. 61, Zwingle vicinity, Jackson County. B. Crushed river gravel in aggregate from old U.S. 61, Dewitt vicinity, Clinton County (A–B 6" ruler). C. Sorted river gravels from Eddyville Cemetery Road, Wapello County. 2003 survey photos. D. Aggregate from the Lincoln Highway Seedling Mile, old U.S 30, Mount Vernon vicinity, Linn County (2005 photo).

Ill-chosen and poorly sorted materials were used in concrete aggregate in Iowa roads throughout the study period. While ISHC standards were to be applied to all large scale road construction after 1913, and Federal guidelines after 1916, the reality was different. As not all concrete is created equally strong, or wear and weather resistant, the variation in roads built until the late 1930s is evident. An endlessly varied mixture of engineering, materials, construction, weather, and other factors have produced the variability of Iowa's surviving concrete paving and other road related structures.

The colors and textures of early Iowa concrete were the result of the following factors, which are 1). from the use of local materials, 2) its being mixed in small variable batches, 3) the degree of handwork employed, 4) the inherent nature of the cement used, 5) surface applications or floating of the wet surface, 6) weathering exposing the underlying aggregate.

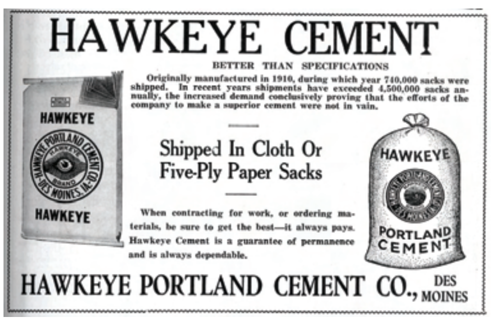
In the late 1940s a general change occurred in the formulation of concrete aggregate. This change in texture (finer), color (lighter), and hardness was mandated. White dolomite was almost always used after that time. Compared with the pre-1945 concrete the later concrete is visibly different having a lighter color and smoother texture.

CONCRETE PAVING

Concrete paving from 1900–1940 often exhibits several identifiable attributes and has a distinctive appearance. This includes both color and texture. Color and texture of concrete is a combination of the aggregate materials used along with the cement. Early Portland cements often have a distinctive dark gray coloration. In some cases the concrete aggregate's source materials can be traced to a specific quarry or manufacturing plant. These too can be color specific. In some instances the color and texture of the roadway's paving itself can be seen to change, often suddenly, where the materials from a different quarry were used. The color of the paving materials used determined the color or shade of the completed pavement. This is especially noticeable when the concrete is wet and it is useful to examine or photograph it when wet. It is recommended that historic concrete be examined in both dry and wet conditions.

While the state opened and operated numerous materials quarries they do not appear to have operated a Portland cement manufacturing plant in Iowa during the study period. However, the Portland Concrete Association had large plants in the Midwest with sales offices in the larger cities. Mason City was one of Iowa's first cities to set up a cement plant and others followed. Early Iowa concrete roads used imported Portland cement before manufacturing plants were opened in Iowa around 1910 (Transit 1910). Some of the early cement was of very high quality but the quality waned over time. It was shipped in barrels at first, and sometimes in bags, and these barrels and bags can be seen in the road's construction photos. The barrels were reused for setting pole-barn posts from 1900 to the 1930s, and in other applications. By the mid-1930s concrete in bags appears to be the most common. Bags were cheaper and lighter and a better value if properly stored. It appears that ready mix concrete was making inroads in the 1930s (Figure 80).

A



B

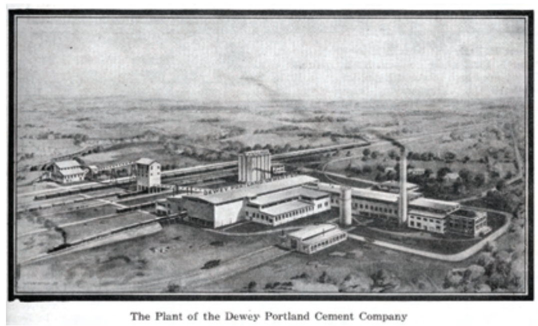


Figure 80. A. Advertisement for Hawkeye Cement, Des Moines (Transit 1927:81). B. Dewey Portland Cement factory in Davenport (Transit 1910:43).

All of these elements lend themselves to a high degree of variability in early concretes. Finally, often to the experienced eye the color and weathering of the concrete itself can be indicative of early construction. Early Portland cements often display an even dark grey coloration or tone. This is especially noticeable when compared with post-1940 concretes. Again, this is primarily due to the cement used, although the aggregate does affect the color once the original floated surface has weathered or worn away. Concrete aggregate from 1900 to 1920 made with Portland cement may have the darkest color, is harder, and often has objects within the aggregate that are not seen today. Post-1930 Primary Roads and arterial highways that are paved in the light colored, state-quarried, crushed dolomite are very consistent throughout all regions of the state in color and texture. In western Iowa the Sioux City quartzite is very common. As paving materials both types are almost ubiquitous in some areas for the later time periods. As such, a later concrete pavement should not be historically evaluated as highly as an earlier concrete paving that uses local materials.

Due to the comparatively primitive technology used in the early part of the 20th century, early roadway's paving materials were mixed in small batches amounting to a few wheel barrows full or the capacity of a small mechanical mixer. An example of this construction method found along part of the

Blue Grass Road's study section is the 1914 construction of the Fredonia to Columbus Junction Road. It is also known locally as the "Convict Road." This 1½ mile long roadway displays intensive handwork in the grading and sorting of its aggregate materials (gravels), the mixing of small "batches" of concrete, and the intensively hand finished surface. The road's paving exhibits the individual pours and wheelbarrow loads, the variability in the mixing of aggregate ingredients, individual shovel and trowel marks in its floated finish, and the hand cutting and placement of its rebar and expansion joints within the cement.

The comparison of the Fredonia road's batch size with that of the earlier Eddyville road helps relate the batch or pour size to the technology. The period photographs of the Fredonia to Columbus Junction road (Figure 71) taken during the construction document road construction techniques employed from 1910 to 1920 and especially those from 1913 to 1916. The small crew, the small scale of the machinery and road laying operation itself, along with the details of small batch cement mixers, the shoveling of raw materials, local water sources, and laying loose earth atop the finished pavement can be widely applied to Iowa highways from that period. Traveling cement mixers quickly evolved from small wheeled and hand drawn tubs to steam behemoths. This road was poured as a test case by the ISHC using some of the earliest federal aid in the state. Its supervisor and master builder was W. F. Beard who went on to build a currently largely unknown number of other structures across the state.

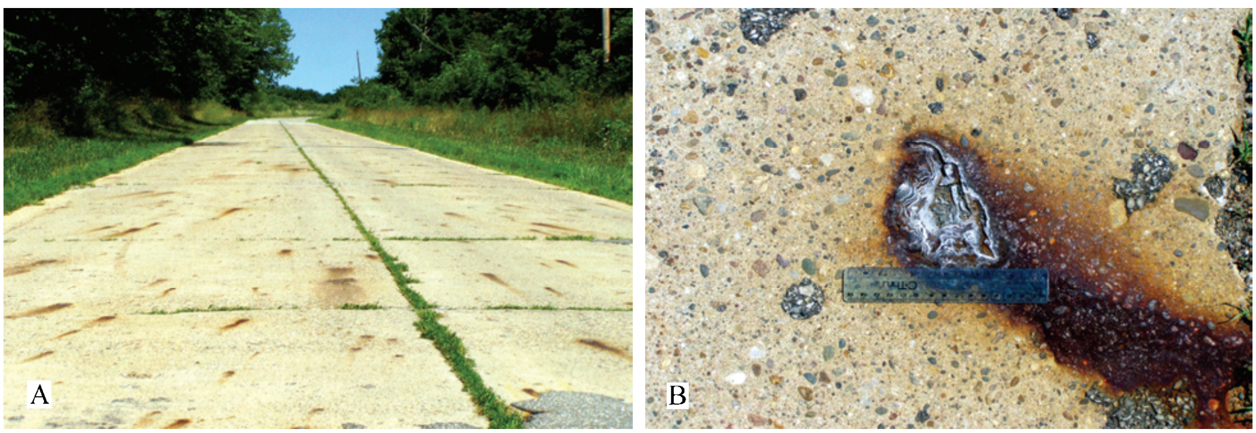


Figure 81. A. Paving of old Iowa 92 with high hematite content, Bellefontain vicinity, Mahaska County. B. Detail of aggregate of same showing oxidation and spalling effects. 2003 survey photos with 6" ruler.

One of the most interesting of the early road building and materials acquisition attributes is the very local sourcing of materials. It is clear that river gravels were used in the project, but not just any gravels. Size sorted gravel with an unusually high amount of jasper, quartzite, and agate was chosen. The use of such a hard aggregate component resulted in a very long wearing roadway paving surface. Even today the pavement itself exhibits minimal wear for its age. It is clear that the choice of the gravel bed was selective and that its use was an important consideration in the road making process. Gravel beds of lesser quality surrounded the roadway construction site and abound in the general area but these were not chosen. One source suggests that because it was a test road for the ISHC that the gravel was brought in especially for the project from the Mississippi River (ISHC 1914a–b). It makes sense that with the number of prisoners involved and ISHC oversight, that a very competent foreman would have been placed in charge of the project. This would be a person experienced in selecting a top quality material and was fortunate to have such a material source available. The location of the gravel quarry for this highway is unknown at present.

The letters M. B. appear after the name of A. G. Bear on a 1913 signature bridge in Appanoose County (Figure 57A). It is speculated that the letters stand for Master Builder. It is interesting that a bridge builder would include these letters in his bridge signature as an expression or recognition of his mastery of his trade. Older traditions surviving into the early part of the study period may include such designations for accomplished lay persons who have attained the old guild designation of “Master.” A master builder is a person who has attained proficiency in one of the building crafts and is qualified to supervise building construction (Merrian-Webster 1981:1,390). A die template to be set or impressed into the wet concrete form must have been made. The significance of A. G. Bear in Iowa road building is presently unknown.

Examples of Iowa highways with poor materials selection and sizing are seen in many places. Old Iowa Highway 92 from west of Oskaloosa at Bellefontain to Knoxville has a cut-off segment approaching the Des Moines River from the east that exhibits an aggregate using gravels with an unusually high hematite or iron mineral gravel content (Figure 81). A section roughly three miles in length is especially typical of the road’s aggregate content and the distinctive effect weathering has had on its surface. This visible oxidation resulted both from the concrete aggregate’s high iron content and large pieces, which resulted from poor material source choice and sorting. Such pavements often relate to ISHC oversight standards. All early roadways have both their relatively well made and poorly made spots.

The unusually high amount of ferrous minerals have led to the road’s surface spalling and pitting with numerous rusty-looking holes in the concrete’s surface. Although the pavement appears to have held up well despite the poor materials selection, it is clear that the makers either did not understand the weathering affects an Iowa climate would have on certain gravels or had to use inferior gravels. Highway segments can exhibit very large pieces of gravel in the aggregate used in the road’s paving. These are much larger than those recommended by the ISHC and one wonders about the size (if any) of the sorting screens used and the level of both materials knowledge and supervision, or the lack of a rock crusher to reduce the gravels used. Another factor is the use of wood in the concrete. While shell is known and even cinders are common enough, along a section of old Iowa 2 near Centerville in Appanoose County large chips of wood (see Figure 76D) are still visible weathering out of the highway’s surface. The use of poorly separated or graded materials, poorly or expediently made forms, rough finishing, and bad general construction are indicative of early roadways, inexperienced labor and supervision, cheap contractors, and other elements suggest the old Iowa 92 roadway near Bellefontain dates to the 1920s or 1930s. Poorly constructed dirt or gravel surfaced roads are harder to find as they were more quickly remedied.

Starting in 1905 the ISHC provided handbooks and bulletins that repeatedly review the correct procedures for mixing concrete. Formulas for specific applications had been tested in Ames by the university’s Engineering Department for the ISHC and that information was disseminated to contractors and engineers. The use of correctly sorted and mixed materials for concrete production was heavily stressed. This was due in part to local contractors and builders often not following proper ratios of mortar, sand and gravel, and water. Many early concrete structures quickly failed due to the improper mixing, or the mixing of poorly sorted or substandard materials. This problem was often compounded by inexperienced workers and supervisors, an inadequate sub-base, and cold or wet weather.

Along old U.S. 34 west of Mount Pleasant there are a number of limestone and gravel quarries of which some are abandoned. One of these is a gravel quarry that lies directly along the highway route and was used during its earliest construction episodes (see U.S. 34). It contains high quality river gravels which were the primary early choice for concrete aggregate. Quarries such as this that can be shown to have provided the raw materials for a specific roadway’s construction during its period of significance can be evaluated as a contributing element to the roadway itself.

The aggregate’s quality may be greatly altered onsite simply by the choice of inferior gravel. Concrete that looked perfect when poured too often could quickly develop problems. The general lack of knowledge about quality concrete construction was widespread in Iowa and many examples of state highways built to a lesser standard in some areas illustrates the interplay between construction factors and cost effectiveness. For the production of good concrete the following factors are listed in order of importance, which are 1) knowledgeable foreman or master builder, 2) quality of choice and storage of materials, 3) correct mixing and deployment of concrete aggregate, 4) proper curing due to weather and temperature, 5) good design and form building. The best designed road will not hold up if the materials were poorly chosen, cleaned, mixed, or laid. A bad choice in any of these parts affects the whole. While most of the worst sections or structures have been removed, surviving segments that exhibit these factors may have interpretive value.

CULVERTS AND BRIDGES

Introduction. There is great variation in the shape, sized, materials, quality, and finish of Iowa's concrete culverts and bridges. While the early period (1900–1910) usually exhibits low topped culverts that express a minimal and functional aspect to their style or design, culverts dating slightly later (1910–1920) often can be very elaborate. Stylistically, early and middle period examples often express or display Colonial Revival, Classical, or even Greco/Roman Revival stylistic elements. Those of the 1910s to the late 1920s into the 1930s may have strong Art Deco design features. Those from the late 1930s, 1940s, and extending into the 1950s may have or display Art Moderne or Modernist decorated sidewalls or rails. The recessed rectangular panel sidewall design was one of the first styles advocated by the ISHC in 1905. Their *Bulletins* have as the cover photo a bridge with a baluster handrail. This may be the arched culvert at West Union in Fayette County built by Stark. The ISHC's standard culvert bridge design was adopted in 1913 leaving some design variability for the side walls. This was to adapt the plan to the situation.

The best quality culverts, even those built in the early part of the century, are often in good shape and are still used today. Those that have failed over the years have generally been replaced. Some bridges and culverts, especially those built by the large contractors such as Marsh or Stark, are especially well built, have crisp or sharp edges, and often a sanded or "sugared" surface. The Stark and Marsh companies were under attack by the ISHC because of patents and bid rigging, and not because they built bad structures. Stark and Marsh built some of the most masterful structures in the state. Culverts and bridges from around 1906 to 1926 built by these and other companies often have their surfaces, especially the top of the sidewall or handrails, coated or "sugared" with finely ground marble dust or a finely sorted sand of a particular color (Figure 83). This can be an aid for attributing a structure to one of Iowa's better builders.

When examining and evaluating concrete culverts the concrete's color (Figure 82), texture, aggregate, the general size of the structure, and the type of reinforcing rods used can often be a guide to the structure's construction date. From 1890 to 1906 concrete culverts were most often built on private property and not on arterial roads. Poured-in-place regular or drop culverts generally date from 1906 to 1925. A great many were built between 1914 and 1917. However, a few late 1890s concrete culverts were probably built in Iowa on local farms or roads. The concrete and stone arch bridge dating to 1893 in Lyon County is one of the earliest on a main road (ISHC 1915a:75; Fraser 1994:25; Iowa DOT 2005). Precast concrete culverts temporally overlap with poured-in-place culverts starting in 1905, continued during the high concrete paving activity of the 1920s and 1930s, and their use continues to the present day. By 1948 precast concrete culverts, especially the box culvert, were common while poured in place construction was used mainly on the slab bridges still being placed around the state.

Culverts made until the 1930s, especially by county crews, may incorporate buggy axels, fence wire, bedsteads, springs, or early factory-made rebar of various types. The oldest structures almost always have some damaged area where the rebar is exposed. Any culverts using buggy axels in their construction are especially significant for their early construction date, innovative use of materials, and relationship to the change from horse-drawn to mechanized transportation. The progressive abandonment of small local foundries ends the large variation of rebar and the use of odd materials for reinforcement. These represent early and experimental technologies. Both successful and unsuccessful experimental technologies are important. Early material manufacturers and road builders learned from their mistakes.

Drop culverts with railings made of large iron pipes (1½"+), similar to those used for steam piping, are the most frequently seen and generally date from around 1916–1930 although some may be earlier (Figure 54). Later examples generally having railing of pipes which are not as large or thick as earlier types and the pipe railing may be galvanized. In Iowa, examples from the late 1930s to the 1940s often have railings of two or three large, metal, horizontal pipes whose ends are set into concrete abutments and are braced in the middle. The use of such boiler pipe was mostly abandoned by 1940. Later drop culverts have smaller pipes and some were added later so it cannot be assumed that the pipes and culvert date to the same period. This type of pipe was also commonly used for bridge railings and for other purposes.

Figure 82. Pre-1920 concrete color variation examples. A. Circa 1913 Red Ball culvert, North Liberty, Johnson County. Note wooden wagon axel hub used as survey point. B. New concrete over old from the 1911 Red Ball culvert on Dubuque Street, Iowa City, Johnson County. C. A 1915 culvert just west of Correctionville, Woodbury County. D. A. G. Bear's 1913 bridge rail, Centerville, Appanoose County. E. Circa 1913 bridge handrail, Gifford, Hardin County by Stark Co., nonextant 2008. F. Detail of ca. 1913 Marsh arch bridge rail and panel, Dunkerton, Black Hawk County (2003 survey photos and 6" ruler).

Culvert elements such as drains, inlets, iron and ceramic pipes, and drainage tiles can also be evaluated to their period of construction, quality of construction, materials, common or uncommon, engineering and design, stylistic elements, and survivability. In general, culverts got larger over time, but this was most clearly evident for little more than a decade (1905–1915) as the technology quickly evolved. Generally, large cast iron drainage pipes were not widely used in Iowa and rural examples may be uncommon.

Culvert forms such as the corrugated metal pipe culvert and the precast concrete box culvert should be evaluated as common and unlikely to add any interpretive value. By the 1920s a great number of these structures were in place in most Iowa counties. However, if intact they may contribute to the overall interpretation and evaluation of a longer route. One should be aware that such common types may be interspersed with older or more significant examples. One possible exception to this general construction trend is in the counties that did not subscribe to the bond issue approach to good roads (Thompson 1989:156–157). These counties may exhibit a later start in general and Primary Roads construction, may show fewer, more poorly made, and later structures than other counties, and may have built obsolete, cheaper, or archaic structure types after these had been dropped in other areas. Lastly, these counties comparatively may exhibit fewer and more poorly built total structures in place than more progressive counties of the same era.

Lichenometry. One of the sometimes important clues to relative dating of Iowa's culverts and bridges is the size or diameter of the lichens that grow on them. These primitive symbiotic plants grow very slowly, dissolving the concrete as they expand in diameter. As a general observation, culverts or other structures that date from 1900–1930 have well established lichen with individual colonies two or more inches in diameter (also see Figure 81F). Observationally, the more lichens and the better developed the colony rings, the older the structure (Dooley 2004:115). This approach to dating road structures is supported by *lichenometry*, or the dating of a stone's exposure on the surface according to lichen growth. This has the potential to be an effective means of establishing relative dates for concrete surfaces.

> Lichenometry is based on the slow, and nearly regular, growth rate of certain crustose lichens. An exposed stone [or concrete] that has remained in conditions favorable for lichen growth for longer periods of time will demonstrate greater lichen thalli growth than a stone situated in similar conditions for shorter periods of time. In localized settings, features [structures] that exhibit greater overall lichening were likely constructed at an earlier time than those that demonstrate less overall lichening, allowing the relative dating of stone features. All stone features within the study area were classified according to an ordinal scale from one (low) to four (high). Areas demonstrating more variation in feature lichening likely exhibit greater temporally extensive reuse than areas that exhibit less variation in feature lichening [Dooley 2004:115, parenthetical remarks added].

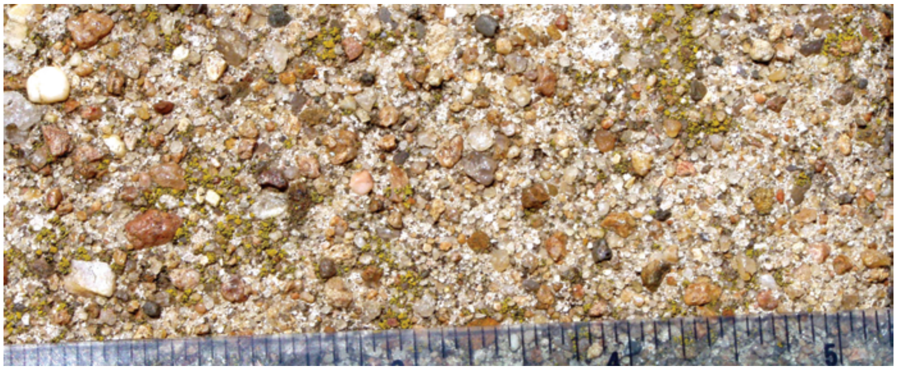


Figure 83. Detail of "sugared" handrail surface from concrete arch Marsh bridge at Marble Rock, Floyd County. 2003 survey photo with 6" ruler.

Sugaring. From the 1910s to the 1930s concrete bridges and large culverts with elaborate handrails were surfaced with a fine dust-like or sandy coating. Silica sand, small and finely sorted and colored river sands and gravels, and marble dust were commonly used (Figure 83). The application of such a surface coating was both for aesthetics and function. It has been noted long ago that if a brick or tile surface is coated with sand, or "sugared," it goes in and out of the mold more easily. In a sense this was applied to concrete construction on the better structures by the better builders who finish-coated their structures with a sugary appearing texture coating. It also helped the structure come out of the form or mold with crisper lines or edges and it may have helped the overall durability of the structure. It is this coating that makes many Stark concrete bridges and culverts so light in color. This quality finish was preferable to the dull grey color of Portland concrete of the era. Sugaring is different than merely floating the finer particles to the surface. Iowa's concrete bridge contractors often had rather specific ways of finish coating a structure and many unattributed bridges and culverts may be attributed to specific builders or contractors by examining their surface coating, edges and bevels, handrail design, aggregate type, and location.

REBAR AND EXPANSION JOINTS

Rebar. During the early phase of Iowa's concrete pavement and structure construction it was not a common practice to place rebar in the concrete. From 1905 to around 1913 it was recommended by the ISHC that rebar only be used in pavement over unstable ground. For culverts and bridge abutments and headwalls the use of iron wire was often recommended. The gauge of the wire and the number of twists needed to make small wires into usable support elements was experimental. In addition, the use of buggy axels and bedsteads in construction was commonly employed by county crews. By around 1910 iron foundries were producing a variety of rebar. The lack of or type of rebar used in the construction is very indicative of the period of construction. Dated bridges and culverts were examined during the project and compared with documentary sources such as contemporary advertisements. The ISHC recommended three types of rebar in 1905 and these were in common use in some form until 1916 and after.

Expansion Joints. The very earliest concrete roadways in Iowa such as the Eddyville Cemetery Road did not employ expansion joints in their construction. By 1914 the Fredonia to Columbus Junction road used Baker-type expansion joint that used tar paper sandwiched between vertical strips of metal forming channels that held and protected the butted edges of the 16 ft concrete slab (Figure 33A). This joint protection method was called the Baker expansion plate. In a 1914 article they are described, relating:

> Every thirty feet the concrete body is broken by an expansion or contraction joint. These joints are for the purpose of allowing the concrete to expand under heat and dampness without cracking in an irregular manner. To form the joint tar paper is used. Three thicknesses, about 3/8 inches, are placed in one strip across the roadway so that the two sections of concrete can not run together but must remain as two separate and distinct blocks. The edges of these joints are protected from cracking and chipping by metal strips on each side of the tar paper. In this work the Baker expansion plate is used [ISHC 1914c:94, 1914d:3–9, 13].

This type of expansion joint was used in some areas of pavement construction in Iowa until around 1930. At that time purely bituminous based joints with no metal backing or channels were used. While metal expansion joints were found on late 1920s highways in southern Iowa none were observed in northern Iowa although this does not mean they were not used. Such tar paper and metal expansion joints were expensive, difficult to cut and place, and often unavailable from suppliers. Bituminous joints were cheap, simple to insert, and widely available.

Metal expansion joints (or Baker expansion plate) in Iowa should be associated with the early concrete paving in the state and may be seen on integral lip-curbed, hand built roadways. Their use over the state should be limited. They were an important technological step in concrete highway design and construction and are found on cut-off highway segments of some length. Most should occur on 16 ft to 18 ft wide concrete pavements. A large surviving segment exhibiting this joint type was observed during statewide reconnaissance survey on the Cantril cut-off along Iowa 2 in Van Buren County. There may be some variation in the types of iron expansion joints employed and their manufacturers but at present too little is known to be able to compare the differences.

POSTS, GUARD FENCES, AND GUARDRAILS

Posts, guard fences, and guardrails are safety structures that were once common throughout the state but identifying the early ones can be somewhat difficult. They were used along Iowa's arterial highways dating from 1900 until 1941. While early sign posts should be present none were found along the study routes or during the statewide reconnaissance survey. Generally, those in place on Primary Roads prior to 1941 were made out of wood while those after 1945 are of steel.

Through the early part of the study period guardrails were essentially fencing designed to keep cars on elevated road sections and were not associated with bridges and culverts. Prior to the 1930s Iowa highways were required to erect guard fences on roads whose surface was elevated five feet or higher. By the 1930s maintenance and cost on such structures became too great and such wooden guard fences were allowed to deteriorate. Many fences were removed leaving the bases of the posts as a visual marker. Occasionally, a series of white painted poles around a curve or along an elevated berm are all that remain of a once common roadway element. Any surviving period guard fences would have potential significance due to their rarity. They frequently are not visible due to tall vegetation along the right-of-way edge. Some old marker posts along highway fence lines mark the location of old utilities.

A number of guard posts remain extant. These are usually located on either side of culverts and drainageways or on curves. All are remnants of earlier design elements and have survived for a number of years on both in-place cut-off segments and occasionally survive along abandoned segments. Generally, these marker posts still provide a function in that they mark culvert ends and drops for mowing and snow plow crews. They are disappearing fast as they are generally either simply not replaced or are replaced with modern metal posts rather than wooden poles. At one time nearly every culvert, drain, drop, inlet, curve, corner, drive entrance, and elevated road bed was marked with such posts.

Beginning in the 1920s metal cable-and-post guard fences were being tested. These began to become common place by the late 1930s and ubiquitous by the mid to late 1940s. Metal guardrails were retrofitted ahead of bridge and culvert abutments, along steep grades with curves, drop offs, and other features. Beginning in the 1950s and continuing to the present the insides of handrails, walls, and bridges were frequently lined with retrofitted wooden and metal guardrails. This was carried out especially on narrow or one lane structures with high sidewalls. Early experimental guardrails may be hard to identify.

Sections of roadway with surviving 1920s or 1930s original wooden and metal guard fences and rails should be recognized and evaluated as possibly important safety related technological developments, which add to the integrity and significance of a road segment. Examples that were retrofitted more than 50 years ago should be evaluated as possibly being a contributing feature or element to the structure's integrity and as examples of change, redesign, or reengineering over time. In general, it is considered that the more of these elements that survive along a roadway the higher its overall integrity.

NATIONAL REGISTER EVALUATION OF CULVERTS AND BRIDGES

Bridges and culverts may have distinctive design elements or exhibit superior or masterful elements. Those built by Marsh, the Stark Construction Company out of Des Moines, the Clinton Bridge works, or other Iowa and out of state companies may have superior design and execution and deserve greater evaluation considerations. Others exhibit inferior construction elements or materials while most are of good construction but of a nondescript or common type. While many bridges and culverts were built by local contractors or county crews and have limited merit in this regard some structures found did exhibit unusually high merit. The merit was first assessed by early construction dates or era, innovative design and execution, signature structures, critical crossing point, contributing elements to a longer route, and integrity. Documentary evidence and previous research also provided important evaluation elements.

One of the best references is Clayton Fraser's 1993 Iowa bridge survey undertaken for the Iowa Department of Transportation. It lists many of the culverts and bridges by county and cites who constructed them. His research material often came from the county supervisor's office, the county engineer's notes and plans, or from county meeting notes still available at the county court house. He identified and made National Register eligibility evaluations on all of these. These were primarily Criterion C evaluations but some Criterion B evaluations of eligibility were included. One should note that Fraser’s 1993 study only identified and evaluated structures currently owned by the Iowa DOT at that time. Structures that had been released from Iowa DOT ownership or abandoned were not included. Many county structures of possible significance were not counted in this study.

While most bridges and culverts were built by local contractors and have limited eligibility potential some structures found did exhibit unusually high merit and possible National Register eligibility on the local level. Some local crews built great structures. Additional elements are the bridges or culverts which have not been previously evaluated but which exhibit potentially eligible architectural design, stylistic, or construction elements. Many concrete structures, especially bridges built during the 1920s to 1940s exhibit strong Art Deco and/or Art Moderne-styling. Lastly, a series of simple but well executed structures along a length of roadway all contribute more to the roads integrity and survival than individually interesting or scenic structures.

Structures that date prior to 1913, were the first in the area, were innovative, can be shown to relate to important individuals, or use unusual materials or construction techniques should receive special consideration. These may require additional research as they are not as easily delineated as visually striking constructions. They should be evaluated for their engineering and stylistic design elements, along with possible attribution to a particular master builder, contractor, or materials provider.

An original structure built within the period of significance even if modified should preliminarily be considered contributing to the evaluation of a historic road. Culverts and bridges that were built after the period of significance but older than 50 years of age *may* be considered contributing elements to the overall significance of the routeway as a whole. The replacement of parts of a roadway is a normal process. In the early days, and in many instances only the drainage systems and basic cross-section were meant to be permanent. The permanent road surface was to come later but in some cases never did as segments of routes were cut-off or abandoned due to route change, improvements, or decommissioning. Such elements or remnants are still present on the Iowa landscape today and can contribute to the interpretation, study, reuse, and reconnection of significant early historic roads.

The Iowa Highways Today

INTRODUCTION

An important purpose of this study was to use two Iowa arterial highways as comparative models in order to study and evaluate historic roads and cut-off highway segments. It was outlined in the MOA that one north-to-south and one east-to-west highway were to be chosen and the choice was up to the discretion of the author. The selection process has been outlined previously. The following section explains the histories of how each highway came to be, how they appear and compare today, what elements survive and in what condition, what contexts are related, and how to evaluate various sections of the roads for National Register significance.

The two roads chosen run border to border but selective portions of each were analyzed for two reasons. The first was they were chosen because they have extant cut-off arterial highway segments covering the entire study time period of 1900 to 1948 for comparison and evaluation. The second was that a multi-county length for the study was possible. Most Iowa arterial roads have very few surviving cut-off segments and those that have survived lacked sufficient length and/or information potential. Lastly, these two roads, and especially the Bluegrass Road, had routes near the Muscatine County project identified by Artz. Thus, they were the best comparable routes related to that section of Iowa at the time of that road’s construction and abandonment.

THE STUDY ROUTES

Highway U.S. 34 was chosen for the east-to-west route arterial highway. The route of U.S. 34 has also been known as, and contains cut-off segments of, the Agency Road and the Plank Road during the Territorial and Early Statehood eras, the Blue Grass Road before and during the Registered Highway Era; Iowa 8 and the Harding Highway during the Iowa Primary Roads Era; old U.S. 34 as it remains from the Federal Highway Era; and current U.S. 34. Highway U.S. 218 was chosen for the north-to-south route arterial highway. The route of U.S. 218 has also been known as, and contains cut-off segments from, the Territorial and Early Statehood eras, the Red Ball Route before and during the Registered Highway Era; Iowa 40 then U.S. 161 during the Iowa Primary Roads Era; old U.S. 218 as it remains from the Federal Highway era (Iowa 923 & Iowa 965); and current U.S. 218.

Both routes have evolved from prominent territorial era roads. They were important arterials from their beginnings and are under heavy and continual developmental pressures to this day. It was a fortunate coincidence that they intersected at Mount Pleasant in Henry County. The results of the archival research, reconnaissance and intensive survey, data analysis, and resultant National Register evaluation follow.

U.S. 34 (The Blue Grass Road/Iowa 8/Harding Highway/Old U.S. 34)

Introduction. Fortunately, for determining the Blue Grass Road's history and routes over time a wealth of period maps and documents dating from the late 1830s until the early 20th century were available for comparison. The concept for the Blue Grass Road as a river to river automobile highway was developed by C. H. Thomas prior to 1910 (Huebinger 1912a:78). By 1912 the route of the Blue Grass Road had been established and it became a Registered Highway in 1917 (Iowa DOT 1986), although its registration had been applied for in 1913. Its route was mapped and published by Huebinger in 1912 (Huebinger 1912a). This travel guide provided invaluable information for the road's path during its early period. The route was named for the bluegrass meadows growing across the southern belt of Iowa counties, which the route passed through.

The Blue Grass Road. In Iowa the Blue Grass Road ran from the Mississippi River to the Missouri River. It started in Burlington and ended near Glenwood, south of Council Bluffs. The road reputedly began as an Indian trail and was subsequently developed as a military or Dragoon Road during its territorial period in the late 1830s and early 1840s. It carried many Mormons during their westward migrations of the 1840s and 1850s. The route was traversed by the 49ers on their way to the gold fields of California. During the mid to late 1850s (started 1853) it had a brief period as a plank road from Burlington to Mount Pleasant and was vitally important to the settlement of southern and western Iowa (Ingalls 1990:18–20; Peterson 1970:back cover; Wilson 1935a–c:305–335). It has followed an evolutionary path in its development over time that few other roads in Iowa have followed. It has cut-off segments of varying lengths, integrity, and periods of significance that made it the best candidate for the east–west study route.

Origins. The Good Roads Movement had been underway in Iowa since the 1880s (Brindley 1912:184–216; Thompson 1989:69–82; Marriot 2004:25, 61–66, 68, 76–78, 104, 173, 181). While boosterism kept the concept of good roads in the public eye little was accomplished on a statewide basis in Iowa to greatly improve its public roads. In 1900 all rural public roads in Iowa were of dirt. With the coming of the automobile and the freedom it provided a new emphasis was placed on good roads. This was concerned both with the basic place-to-place transportation aspect but also the accompanying economic changes good roads would invoke. Good roads boosterism was so strong that in 1912 Huebinger's *Automobile and Good Road Atlas of Iowa* was published containing a good deal of input and sympathetic assistance from the ISHC's head Thomas MacDonald.

About the ISHC's contribution to the atlas Thomas MacDonald is quoted as saying that he:

> …did not feel that he could go to much trouble or expense personally or for the state if the purpose was to prepare only an automobile atlas, but if it were to be also, and chiefly a work to assist and stimulate the good roads movement, he felt that it was not only a pleasure but a duty for him to do all that he could to insure the complete success of the enterprise [Huebinger 1912a:3].

The connection between the ISHC, the American Automobile Association, and the Huebinger map making company resulted in an Iowa atlas filled with good roads information. The atlas went beyond the usual county atlas format to become an excellent auto-guide, outlet for period advertisements on road building materials and equipment, a booster for progressive roads issues, and in total contains a short overview history of the Iowa's road movement from a mostly non-ISHC point of view (Huebinger 1912a:3). Until the ISHC began publishing its own maps in 1920 the atlas's accurate maps provided the basis for early automobile route registration, national travel guides, and general Iowa demographics.

One important historical account in the atlas relates the desire, in the late 1890s to early 1900s, for a dragged dirt highway from the Mississippi River to the Missouri River. It was thought that such a road could be made and would be made, with the assistance of the people of the towns and farms along its line. This movement gathered strength until county seats and towns along the route from Davenport to Council Bluffs formed an association. Prior to that time the only recognized and officially endorsed cross-state route was what was then known as the Iowa Official Trans-Continental Route, extending from Clinton to Council Bluffs. The promoters of this line said that on account of natural conditions of easy grade and other advantages, their route would continue to be the one principally used by tourists crossing the state. However, when the Glidden Tours of the 1910s crossed the state they chose the Davenport to Council Bluffs route then known as The River to River Road (now U.S. 6), which started in 1909. Tourists gave a glowing account of this route and it attracted further attention from the increasing number of eastern people seeking a way to and from the mountains. The River to River Road ran through Des Moines, the state capitol, and much local boosterism there promoted that road's improvement (Huebinger 1912a:23).

After this had been going on for some time the people living along the main line of the Chicago, Burlington & Quincy Railroad, through the picturesque southern part of the state, decided that they might as well be promoting some of the advertisement and the other benefits that came from having a cross-state road. Accordingly, the Blue Grass Road Association was formed, with Joe Long of Osceola as its president and chief enthusiast. Other promoters of the Blue Grass Road were Thomas D. Murphy, the noted art calendar publisher of Red Oak, and C. H. Thomas from Creston. It was Thomas who was willing to do anything to push along the Blue Grass route project, and it was he who gave the road the name, which is a poetic description of it on account of "the fact that the country through which it runs largely owes its prosperity to the blue grass on which it feeds the cattle that have made the people rich" (Huebinger 1912a:3–4).

The Blue Grass Road Association proceeded quietly to make improvements along the route so that it could better compete with the other cross-state roads. The idea was not only to drag the road carefully over the hills of southern Iowa from Council Bluffs to Ottumwa, and along the flatter country from there to Burlington, Fort Madison and Muscatine, but to substitute for the temporary culverts and bridges those of concrete placed so that they would not form obstructions to the passage of automobiles running. Their bid and the advantage of the Blue Grass Road was to be based on good dragging, supplemented by "perfect" or "state of the art" culverts and bridges. A great deal of enthusiasm was shown by the populace so that both farmers and city dwellers helped promote and improve the road. The dream of the perfect "dragged" road all the way across Iowa was born and began maturing (Huebinger 1912a:3–4).

What was being done in southern and central Iowa awoke the organization of the Iowa Official Trans-Continental route, and its organization took up improving that already designated route (The Lincoln Highway), keeping it in the same class as the other highways. In competition the Blue Grass saw continued improvement. When the dollars from the Federal Transportation Act started reaching Iowa, Green, Carroll, and Story counties, all located along the Lincoln Highway, took the lead in the use of

Iowa's road building funds. Other eastern counties along the Blue Grass were not to lag far behind (Thompson 1989:152; Huebinger 1912a:4).

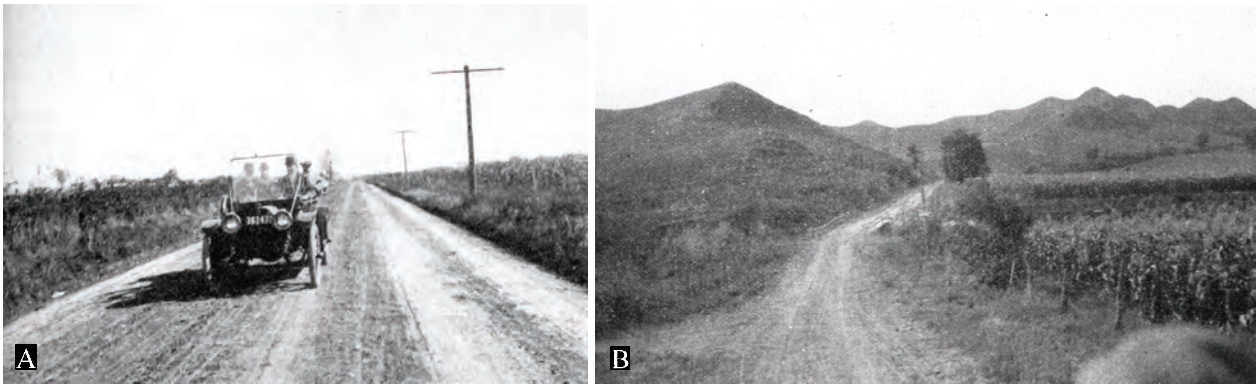


Figure 84. A. Photo of the Blue Grass Road in 1912 near Mount Pleasant. Caption read "A stretch of Blue Grass Road near Mount Pleasant, Iowa on the day it was built with a power grading unit" (Road-Maker 1912i:3). B. A 1912 photo of the Blue Grass. Caption read "A Mountain Scene in Iowa: A View on the Blue Grass Road a few miles southwest of Council Bluffs (Road-Maker 1912i:4). Note center bridge.

A number of early but segmented trans-state and trans-continental routes in Iowa were attempting to capitalize on the new road movement all at the same time. Most were long standing east–west arterials. They had advantages in that they were generally early, well traveled, and long established routes. This gave them a better chance for drawing transportation projects, movement, and the related prosperity. In most instances during this period it was the local businesses and banks that provided much of the impetus for good roads. Business increased when rural isolation decreased and more people could make it into town more often. Additionally, many of the rural communities and farmers near good roads saw the ease with which agricultural products could be gotten from the farm to market.

Many counties and good road associations tried to promote their local roads and interests. Other roads following this early pattern and which predate the Blue Grass Road are the Hawkeye Highway and the Waubonsie Trail. The Hawkeye Highway ran from Dubuque west through a number of county seats to end at the Missouri River bridge in Sioux City. Another evolving route was the Waubonsie Trail through southern Iowa (now Iowa 2). A far northern route from McGregor to Canton and Sioux Falls on the Missouri River was also developed called the North Iowa Pike (Iowa 9). However, the land along this proposed North Iowa Pike's route was so flat and wet that intensive ditching and tiling was required and this somewhat delayed its operation as a trans-state route (Huebinger 1912a:4).

The general thought among much of the population across Iowa was that there was soon to come an era of permanent road building in Iowa. It was not known in 1913 if national aid in the surfacing of the cross-state roads was available or not. This was the effort the Good Roads Movement was pushing for (Huebinger 1912a:4).

With development of the automobile the Blue Grass Road's route began its evolution from a chancy dirt horse trail and stagecoach or wagon road to a modern transportation arterial. As an early automobile route it both predated the Registered Highway Era (1914–1925) and was conceived to economically compete with the Lincoln Highway. It became one of the three most important east–west registered highways in the state and improvements continued from beyond the end of the Registered Highway Era to the present. During the early federally funded eras its transformation from a trail to an early automobile transportation route, and latest transformation into a four lane freeway was set in motion. The road was continually improved, upgraded, and replaced in a process that is still ongoing. It is still the most direct and fastest route across southern Iowa.

Study Route 1: U.S. 34

(a.k.a. Blue Grass Road/Iowa 8/Harding Highway/Old U.S. 34)

HISTORY AND EVOLUTION OF THE EARLY ROUTE

Almost all highways are the result of generations of people following a pathway and U.S. 34 is the result of a pathway developed into a route. Pathways are frequently begun as Native American trails. As exploration, military control, trade, and settlement made inroads these general routes became trails for pioneer migrations. The introduction of federal mail routes in Iowa in the mid-nineteenth century formalized a number of the more heavily traveled cross county trails into roads.

It may be assumed that U.S. 34 follows a trail that had served explorers, trappers, and traders in Iowa's early years but no real evidence of its earliest existence or location is presently available. The General Land Office maps showing the routes are the first definitive evidence of the trail's location and these were often imperfectly located by the surveyors. These maps were drawn as county surveys were completed and showed many improvements such as roads. They do show that the road's path predates the area's recorded settlement and that by the 1830s its path had already become "fixed" on the landscape. That a road can be fixed to a landscape is a relative thing. Prior to the route's study period it took hundreds of years for the development of the general path, fifty or sixty years for the mail route's development, but only a few decades at the beginning of the last century to develop into the modern paved highway.

On proto-U.S. 34 in the late 1830s a stage line was running from Macomb, Illinois, to the new territorial capital at Burlington. The route from Burlington to Mount Pleasant was one of the first four government mail contracts awarded in Iowa (Colton 1960a:401–433, 1960b:168; Peterson 1970:inside back cover). By around 1837 a two-horse hack ran once a week from Burlington to West Mount Pleasant. The stage actually stopped at Richland (nonextant) about 12 miles west of Mount Pleasant, or somewhere along the road three to four miles west of Lockridge, in eastern Jefferson County. These hamlets were already defunct by 1875 (Andreas 1970:55).

In 1837 a government mail route was contracted for the Macomb, Illinois, to Burlington, Wisconsin Territory, route. This ran from Macomb, Illinois through Muddy Lane, Bedford, Honey Creek, and Shokoken, to the Mississippi River and across to Burlington. It was a twice-weekly two-horse line (Colton 1960b:168). The first definitive use of the route came when it was used by the United States military. The eastern portion of the route was established in 1839 to carry the Dragoon units from Burlington, the capitol of the Territory of Wisconsin at the time, to the Indian settlements at Agency, approximately 60 miles to the west (Ingalls 1990:18). This and other trails provided the capitol of territorial Iowa with connections from Galena, Chicago, Macomb, and St. Louis. In 1839 a bi-weekly cross-linking connection was established with Peoria, Illinois, for mail shipments (Colton 1960b:173). These routes had their origins in the needs of territorial officers at Burlington. It appears that the proto-U.S. 34's use was directed towards cities and towns in central, western, and southern Illinois during the 1830s and 1840s, and Burlington's eastern connection ended in Rushville, Illinois by 1842 (Colton 1960b:179). Presently U.S. 34 in Illinois continues northeasterly towards Chicago's western suburbs.

With the signing of an Indian treaty at Agency City in October of 1842 the expansion of the westward route through Iowa was assured (Colton 1960b:181). It is likely that some Mormons (The Church of Latter Day Saints) in their westward migrations from Illinois in the 1840s and 1850s used this former Dragoon Trail (U.S. 34), which had been formally surveyed and improved by the military to Agency, Iowa. Historically, in this context the road may be said to have had its starting point in western Illinois around Carthage, which is 24 miles east of Macomb on the route to Keokuk. The stage line on the old road had ended in Macomb, Illinois, not far from Carthage. When the Mormons left Illinois shortly after Joseph Smith was lynched at the jail in Carthage, beginning in the early 1840s they were probably one of the larger and better organized groups to use the route on a truly migratory scale. While for the Mormons the path of what would be the Blue Grass Road (U.S. 34) was an important trail, other trails associated with the Mormon's migration, such as that following Iowa 2 and the "handcart trail" westward from Iowa City, are often recognized as having played a more significant role.

As they went, from necessity the Mormons widened, bridged, and generally improved the routeway for those following. They often helped construct houses and barns for other settlers along the way and set up temporary camps and meeting points that often evolved into early crossroad hamlets. This was a major step in the evolution and development of this highway corridor as it changed from a foot and horse trail to a wagon road fit for migrants and settlers. This setting of a path or routeway was the road's first real start linking the Mississippi to the Missouri River.

Concurrently, in 1849 the Gold Rush in California captured the imagination of many and the progenitor route of U.S. 34 carried thousands of 49ers across Iowa. It became one of the main east–west routes across southern Iowa and carried wagon traffic from nearly every state to its east. It was during this time that much of the area along and around the route was settled. In a now familiar pattern many of those traveling west reported the good land and opportunities in southern Iowa to family and friends back east and the area along the route quickly infilled with pioneer settlers. This large influx of westward travelers and early settlers helped more firmly establish the road's path and established hamlets, villages, towns, and cities along the route. During the 1850s the area passed from the pioneer period of a scant and dispersed population focused along the rivers to a concentrated settlement pattern with growing towns and villages. The route helped connect most of the county seats along its east to west path through Iowa.

At some point after the Civil War the Burlington Road may have truly assumed the name Blue Grass Road (Nauman 2003:7), an appellation that would be used well into the 20th century and became the trademark name for the newly envisioned cross-state automobile highway. By the 1860s both the railroad and the Burlington to Mount Pleasant Road continued to carry heavy traffic to the west. Shortly after 1900 a new mode of transportation began to be seen on the road, the automobile. The importance and tradition of the Blue Grass Road, which also shared its route in places with the Harding Highway and Iowa Ayr Line at times, was shown in 1927 when the State Legislature called for its concrete paving from Burlington west to Council Bluffs, on a route that basically followed the original immigrant route from Burlington westward to the Missouri River bridge near Glenwood, south of Council Bluffs.

EARLY CONSTRUCTION TYPES AND EFFORTS

From around 1836 until 1853 the road west from Burlington was essentially a horse trail. In 1839 the section from Burlington to Agency was a military road called "The Dragoon Trail" or simply "Agency Road." (Brigs 1970; Hansen 1970; Parish 1970; Peterson 1970). In 1853 the Dragoon Trail from Burlington to Mount Pleasant became a plank road. This route was subsequently usurped by the nascent railroad expanding westward from Burlington to Mount Pleasant in 1856. When the railroad took over the plank road's route the wagon road was moved to just south of the railroad line. Hotels and stage routes were established along the way with the hotel at Jimtown, about halfway between Burlington and Mount Pleasant, being one of the most significant. The marker stone was removed for the construction of present U.S. 34. Another feature from that period was the Military Road spring or well located a mile east of Mount Pleasant. This was well known watering place for horses along the route during the same period that had evolved from a natural spring to a well known stopping point on the road. Like much of the earliest roadway between Burlington and Mount Pleasant it was covered in 1997 for the improvement of the interchange of current U.S. 34 and U.S. 218 (Ingalls 1990:433, 442; Hirst 1994).

By 1850, possibly already being known as the Blue Grass Trail, the road had been extended westward through the towns and later county seats of Albia and Chariton. The road in 1850 ended in Pisgah (IDNR 2000:23). Through the 1850s the road past Mount Pleasant was improved only slightly to Agency, just west of Ottumwa. From that point on the topography, thinning of the population (especially past

Chariton), and soil conditions kept the road's route and condition in a primitive state until the advent of the 20th century (Wilson 1935a–c).

Generally, the condition of U.S. 34 was no different than nearly all roads in Iowa during the mid 19th century. They were in poor condition and could be called "seasonal" at best. Rural isolation was common. The roads statewide were essentially static in that nearly nothing was done on them in the form of improvements. County road tax work kept some main roads in a minimal working condition and the better the economy of the county the better its roads, but the deplorable overall condition of the roads was partly the reason for inception of the Good Roads Movement. The movement led directly to a change of thinking in the counties along the route. They began seeing the economic benefit of good transportation beyond the farm-to-market road and the automobile both provided the impetus and helped end rural isolation in Iowa.

When the early route of present U.S. 34 entered the 20th century parts had been in place for well over 60 years (1840–1900) yet was still a dirt morass winding this way and that as either the topography or weather demanded. Within the study corridor this era is represented by the earliest and most primitive type of cut-off segment (see Jockey Hollow). Road elements from this period are one of the least common to find extant, especially with high integrity. Additionally, roads from this period are one of the most difficult to identify, date, and interpret (see National Register Evaluation below).

Preliminary Phase: pre 1900–1913. The route of what was to become U.S. 34 had slowly evolved over sixty some years from a horse trail to a farm-to-market road. For most of its existence it had been a route for westward movement of people and eastward movement of manufactured goods and agricultural produce from Iowa's interior. In 1900 at the start of the study period its condition was that of an ill-kept dirt road. It had every sort of iron and wooden bridge and culvert along its route, its sides were only occasionally ditched for drainage, and it drifted over the landscape changing course as needed. Its route remained consistent only at grades down steep valleys at the major river crossings where topography forced its route to a specific crossing point. These were often where the old bridges, fords, and ferry crossings of the previous era were located.

The most consistent features of this road's path were at the river crossings, which stayed in one place, and using the high divides between drainages. River crossings were the exceptions to the general rule of poor maintenance and poorer structures. The construction of large steel or wooden trestle bridges provided consistency of the route and a safer crossing than fording the current and more dependable that ferries. In their day these prefabricated bridges were the high point of late Victorian steel bridge engineering. A plethora of bridge types and designs were used. Cost was a major factor coupled with the distance to be spanned. The bow-string, Pratt and Warren trusses, and wooden trestle bridges, some of great length, were all built. Bridge manufacturing became local in 19th century Iowa with the Clinton, Burlington, Des Moines, Waterloo and other bridge companies providing such structures.

While the Good Roads Movement had been growing since the 1880s these efforts were concentrated on improving the farm-to-market roads and main roads around county seats and urban centers. The idea was to get the products to the railroad shipping point and little thought was given at that time to cross country travel. As the railroads had dominated travel in Iowa after the Civil War until well into the study period, the evolution of other forms of mechanized transportation such as the automobile and airplane radically changed the conception of travel. These new elements forced much needed changes and advances in road and bridge design and engineering, construction equipment, material production, acquisition, and transport. Also changing was labor and a host of economic affects related to the road's construction and location. As usual, technology advanced quickly beyond implementation.

While the Blue Grass Road was registered in 1917 its proponents and organizers had applied for such status as early as 1913. In the 1910s when the first automobile guides were published they show a route and landscape that appears much as it is today in many places, and also so different as to be unrecognizable in others. The 1912 guide to the Blue Grass Road was an invaluable help to following the road's pathway during the early auto era (Huebinger 1912).

The Blue Grass was the original early automobile era route, but in 1923 the route of the Blue Grass Road shared some of its alignment with other registered roads. The Auto Trails Map from that year notes that the path of the Blue Grass Road was shared with The Black Diamond Trail from Burlington to Fairfield. The South Diagonal section (1910–1925) of the Blue Grass route from Fort Madison was later called, or developed into, the Waterloo, Fort Madison Shoreline Route, which followed the route of the old Blue Grass Road along the Coleman Road through Houghton. This road went westward from Fort Madison through West Point, St. Paul, Pilot Grove, and Cottonwood, to Houghton. The North Diagonal section of the Blue Grass, which once ran from Davenport to Muscatine and Columbus Junction and jogged southwestwards to New London, was abandoned as a Registered Route in 1927 and reverted to the county road system still in use today as a series of rural county roads (see North Diagonal below: see also Figure 106) (Rand McNally 1923).

THE NEW ROAD: ONE TOWN'S EXPERIENCE

There is a town along the Blue Grass Road (a.k.a. The Harding Highway) whose experience in many ways typifies the experience of most towns along Iowa's new roads. The articles below relate the experience of New London, located between Burlington and Mount Pleasant, between 1923 when "road fever" hit and 1928 when concrete paving actually came to town. It is a tale that encompasses the frustration, progress, hope, and success of the town through the years as related to the reconstruction of the new concrete road through town. Its story is told from the New London Journal reprinted in 1975. It begins by relating that the:

> Blue Grass Road, later Harding Highway, and now Highway 34, was established across Iowa in 1917, and was supposed to be better cared for than most roads, yet it was impassable much of the time. New London's streets were no better. They were oiled in summer to cut down on the dust, but they were subject to the same weather influences as the most remote rural lane [New London Journal 1975:134].

On October 25, 1923, the New London Journal reported a "rumor" that the Blue Grass Road might be hard-surfaced from Mount Pleasant to Middletown; the road was already paved from Middletown east. The December 20, 1923, issue reported a group of Henry County citizens "was getting up a petition" against paving any roads in Henry County as "it would raise taxes and people couldn't afford it." The Henry County Farmers Union opposed the paving of Primary Roads before farm-to-market roads were surfaced (New London Journal 1975:134–135).

Meanwhile, the Blue Grass Road, or Primary 8 in 1923, was designated to be paved from Burlington to Chicago and in New London people began to have visions of being on a highway paved coast to coast. In 1924, the federal government announced that the new Harding Highway across the nation would follow Primary 8 through New London. Back in that day car counters appeared to be a common occurrence, even a sport, as people sat on their porches watching and counting the traffic going by. In such a match on Sunday, November 2, 1924, Charles Goody counted 768 cars passing through New London on the Harding-Blue Grass Road from ten a.m. to six p.m. and "The town felt the road was a coming thing" (New London Journal 1975:134–135).

In January of 1925, on behalf of the Harding Highway, J. M. Crawford, a local dignitary, made a trip to Washington, D.C. The highway was snarled in the usual red tape while Iowans were becoming impatient. Mr. Crawford appears to have been well feted. On the trip he met President Calvin Coolidge, Congressman W. F. Kopp, several cabinet members and the postmaster general, and saw Congress and the Supreme Court in action, but through the political smoke and mirrors appears to not have gotten any real action on the road (New London Journal 1975:134–135).

However, highway fever had struck the town and locals couldn't wait to begin the promised boom. The article relates that the:

> …New London Council leased four lots on the north side of Main Street, a block west of Pine, for a free tourist park. "No gypsies and no horses allowed," they announced (New London Journal, May 15, 1924). A total of 215 cars spent the night there during the summer of 1924 and the road wasn't even paved! But by 1930 the state requirements for tourist parks were impossible to meet with the free facilities the Chamber of Commerce was operating, the lots were sold to A. W. Honer of Michigan, who erected small cabins to rent to tourists. The cabins stayed for thirty years [New London Journal 1975:134–135].

In 1927, the Harding Highway (now U.S. 34) was being paved from Danville to Middletown, and as soon as they could decide whether to leave the highway as it was—crossing the railroad tracks at Danville and again at the Sater crossing east of New London—or run it entirely on the south side, the highway would be paved to the county line. They settled for eliminating the crossings, through some opponents cried about the expense of buying and grading the new right-of-way south of the tracks (New London Journal 1975:134–135).

By that time Henry County had voted to pass a bond issue to pay for its share of paving the Harding Highway. In August there were surveyors in town. At the Fall Festival in mid October, 1927, it rained, and the Mount Pleasant band was stuck in the mud west of town when the parade started. Citizens muttered, "wait until next year" and went home (New London Journal 1975:134–135).

By December, 1927, the hottest argument was whether to purchase land and run the highway straight east down Main Street past the light plant (the present route of old U.S. 34) or to continue the old route south on Elm, then southeast on Cleveland and following the general route the Plank Road took more than seventy years earlier. The New London Journal article says that "Thrift won, and the highway was plagued for years with two sharp corners where light poles and fire hydrants—and passengers in cars that struck them—suffered." In May 1928, the paving gang moved into New London, mixing concrete at the depot, which had become a "very busy place." By the Henry County Fair in August, the Harding Highway was open to traffic (New London Journal 1975:134–135). The new road had finally come to town.

The highway (U.S. 34) was finally re-routed and widened in 1953–1954 to go east past the light plant and along the railroad tracks to the county line. Except for a cut-off segment on the east side of town, and the now forgotten connection with the north diagonal route to Muscatine and Davenport, the road has remained in much the same location today as in 1923 when the movement started.

STUDY ROUTE SURVEY

A total of 336 miles of the many precursor routes of current U.S. 34 (Figures 116–126) (Tables 5, 6) were investigated, including the two diagonal sections. These routes were comprised of multiple in-place and cut-off segments dating from the study period (1900–1948). A total of 38 cut-off segments were located, identified, and evaluated. The main study route ran from Burlington to the Lucas County line. As many sections and cut-off segments of the early roadway's routes were out of the current corridor's area, and as several of these segments were not the focus of intensive survey or were beyond the scope of the study, it is possible that some less easily discernable segments may still survive but were not located or recorded. Cut-off segments adjacent to and directly related to the road's history were recorded when encountered.

In various publications it has been called a trail, road, and route somewhat interchangeably. The Blue Grass Road was first called the Blue Grass Trail from the 19th century until around 1910. For a while it was known as both a trail and as a road. It was called the Blue Grass Road on the 1912 auto-guide (Huebinger 1912a, 1924) and on the Rand McNally auto-guide map of 1924 (Rand McNally 1924). On December 1, 1917, it was registered as the Iowa Blue Grass Route with the Highway Commission (ISHC

1916c:11, 1917e). By the 1930s, after it was concrete paved, it was occasionally called the Blue Grass Highway, possibly due to being concrete paved and to sharing its route with the Harding Highway.

The Blue Grass Trail Phase: 1900–1909. The Blue Grass Trail was a 19th century appellation and the use of the word “trail” in its name suggests its early origins. Like the 19th century trails it was unpaved and unimproved. Other than the occasional dragging of some sections it saw little or no real improvement until the era of mechanized highway transportation and the formation of the ISHC in 1904. Except for specific instances the Blue Grass Road will be used to name this early Iowa automobile route.

The Blue Grass Road Phase: 1910–1927. The road’s change to a modern highway system and transportation arterial began during this period. The Blue Grass Road was one of the first Registered Highways in Iowa as well one of its first multi-state routes. The auto oriented Blue Grass Road was first proposed in 1909 and the preliminary route established by 1910. The Blue Grass Road was first mapped for an auto-guide in 1912 (Huebinger 1912a). It was this map and guide that allowed the present investigators to track the exact route of the road for that year. Subsequent maps and road guides show changes in the route over time (Huebinger 1904, 1910, 1912a, 1912b, 1913, 1915, 1924; TIB 1913; ISHC 1920–1948; Iowa Writer’s Program 1947). This research followed the general pattern of the route’s changes over time. As a new section was built or paved, a bridge constructed or improved, an early filling station opened, or even mudholes graded and filled, the route would be changed to utilize these improvements and incorporate them into their routes. Such route changes or improvements were often no longer than a mile and special “cut-off” sections or “trunk roads” would often run into a small town or village for service, food, and lodging along the way. Route changes were especially easy to make prior to the introduction of concrete paving and bridges. Once the travelway had become “fixed” in stone or concrete the time and cost involved made it impractical to change the route’s path until it required complete or nearly complete replacement.

In the early period the Blue Grass Road’s path was not yet immutably fixed to the landscape. It had numerous twists and turns, often ran through farm yards and pastures, forded streams with no bridges, and generally still followed paths set by three primary factors. The first was its previous route(s) and the general continuity of the route over time, second was the topography, and the third was the weather. All directions or signage (if any) were local as many individuals met along the route had seldom left the county or region and couldn’t direct a traveler past their own points of reference. Thus, the importance of the early auto-guides, which provided clear directions and established general uniformity for the route.

In one sense the auto-guides themselves determined or set the path of the road. Iowa had yet to issue a state road map so the auto-guides were the precedent for routeways. Through the late 1920s the auto routes essentially stuck to or followed the section lines wherever possible. The movement of roads to section line borders had been an ongoing process since the mid 19th century and this made the early automobile routes in general, and the Blue Grass Road in particular, a complex sequence of zigzag turns every mile along sections. Orienting on a rural stretch of the Blue Grass Road at night would have been a navigational challenge. Many early automobile routes must have followed telegraph lines simply so they could have poles to mark the route upon. Rural telephone and electrical lines were uncommon then.

THE DIAGONAL ROUTES (SECTIONS A & B; NORTHERN AND SOUTHERN)

The Blue Grass Road differed from other routes in Iowa in that it had two original diagonal sections called the Blazed Branches of the Blue Grass Road (Huebinger 1912a:117) (see Sections A and B below) (Figures 116–126). These branches had their own secondary routes and on occasion were rerouted on the landscape. The primary route ran westward from Burlington, following the route of the Dragoon Trail and later the Plank Road to Mount Pleasant and the early Agency Road westward. Most of this earliest route from Burlington to Agency has been obliterated by later construction (see below). However, two subsidiary sections called the North and South Diagonals were incorporated into the road’s design from the route’s inception in the earliest days of automobile transportation. These diagonal routes allowed travelers from around the river communities of Muscatine to the north, and Fort Madison to the south, along with those traveling from the East, to link to the most direct and improved highway route across southern Iowa at the time. These diagonal routes in themselves constitute cut-off arterial highway segments from Iowa's early automobile era.

The South Diagonal (Section A), started in Fort Madison and ran to Burlington before turning westward to join the main route west of Mount Pleasant. It also had seen a great deal of change in most sections affecting its overall integrity, but the National Register eligible Coleman Road and some other segments are extant and were reconnaissance surveyed and evaluated.

Figure 85. A. View of the end of the Half-Slab near Bonaparte, Van Buren County. B. Detail of ca. 1948 pavement of same with sorted river gravel in poor quality aggregate. 2003 survey photos.

The North Diagonal (Section B), which started in Davenport and ran southwards to Muscatine and thence through Columbus Junction and Columbus City, connected to the main route at New London (Figure 117). This diagonal from Davenport through Muscatine to Columbus Junction has been essentially obliterated and was not incorporated into the survey. However, just east of Columbus Junction at Fredonia, significant remnants of that early diagonal road still exist. The old route between Fredonia and New London, which contains the National Register eligible, convict-built, Fredonia to Columbus Junction Road (1914) is extant, and other segments running southward from Columbus City can be traced. These old cut-off segments were reconnaissance surveyed and evaluated.

The North and South diagonal routes, while not complete and often nonextant in sections, are considered important parts of how the entirety of the Blue Grass Road was originally conceptualized. It shows the efforts made to bring traffic from the north and south to the central routeway during the formative years of Iowa's automobile transportation growth. They both contain sections and segments that are critical to the understanding of the conception, construction, and evolution of the Blue Grass road and Iowa highways in general. These segments were cut-off prior to the organization of the federal highway systems in Iowa and were part of the state's official Primary Roads system for only a short time.

The South Diagonal: Section A (from Fort Madison to Mount Pleasant vicinity)

Route Description. The South Diagonal ran from Fort Madison to just west of Fairfield (Figures 116, 117). In the 1920s the South Diagonal of the Blue Grass Road ran along the Coleman Road through Houghton. In 1913 this road went northward from Fort Madison to Denmark on X32, then west on Iowa 16 between St. Paul and Pilot Grove, over U.S. 218 to Cottonwood and then to Houghton. In 1923 this route was also part of the Waterloo, Fort Madison Short Line (Rand McNally 1923).

The Half-Slab. In 1912 part of the Blue Grass Road's south diagonal section traveled over the route of the Coleman Road (Figure 85, also see Figure 73). The section through Houghton was still called the Blue Grass Road as late as 1927. The Coleman Road was one of the longest privately funded public concrete roads in the state. Only the last section, built in 1948–1949 and known as "The Half-Slab" survives as the rest has been visually obliterated by the resurfacing of Iowa 16. Like the Fredonia to Columbus Junction convict-built road, the Half-Slab exhibits characteristic construction methods, materials, thickness and width, and originally connected with the main section of the Coleman Road.

This route had its own subsidiary or secondary diagonal route running from Stockport through Libertyville and County Line to Agency, bypassing Mount Pleasant. Due to recent improvements that significantly affected its integrity this section was not thoroughly surveyed or evaluated. This early route was windshield surveyed and evaluated.

National Register Evaluation. One cut-off segment of the South Diagonal of the Blue Grass Road, the Half-Slab, is related to the Coleman Road and retains high integrity and significance. The evaluation of the road's construction elements and construction history suggest its importance for interpretive value and extant pavement and cross-section. The following outline its significance. They are:

1. The relationship of the Half-Slab to the Alexander Coleman and the Coleman Road is well Documented and significant.
2. The Half-Slab is unique in Iowa as the last known remaining section of original nine ft concrete pre-1950 highway paving.
3. The route, cross-section, pavement, and associated structures within the right-of-way are all original.
4. Length of three miles.
5. Unique nine ft width and 6″ thick pavement of either sorted river gravel or crushed dolomite.
6. Small intact cut-off segments may survive along Iowa 16 and Iowa 103.
7. No surviving intact segments from the South Diagonal Blue Grass Road, Iowa 8, or U.S. 34 appear to survive from Keokuk to Fort Dodge to Houghton although the route is original.
8. This section contained the Coleman Road. The only extant section is the Half-Slab in Lee County.
9. The Coleman Road relates to the early and middle ISHC era and the Half-Slab to the late era.
10. Relates to the privately funded roadway context.
11. Last surviving original road segment related to the Coleman Road.
12. Related to overall Blue Grass Road route and contexts.
13. Was conceived prior to 1948 but not built until 1949 due to legal battle of heirs over funding.

National Register Eligibility. One cut-off segment related to the South Diagonal, The Half-Slab, retains sufficient integrity to be eligible to the National Register. This cut-off segment is eligible under Criteria A, B, and C. Due to the covering of the original pavement the reworked segments of the Coleman Road (Iowa 16) related to the diagonal is ineligible under Criteria A, B, or C, or any Criteria Considerations.

The North Diagonal: Section B (from Fredonia/Columbus Junction to New London vicinity)

Route Description. The North Diagonal route of the Blue Grass, starting in Muscatine and then running southwards to Columbus Junction and intersecting the main route outside of New London, is considerably longer than the south diagonal, which started Ft. Madison. This route, with several cut-off segments, relates directly to the path of the Blue Grass Road in the 1910s and 1920s. It also was demonstrated as having extant elements of the pioneer trail. The segment to Fredonia that ran south out of Muscatine along Iowa 92/U.S. 61 to Grandview has been obliterated by current U.S. 61. From Grandview its route turned west along Iowa 92 to Fredonia and across the Iowa River bridge to Columbus Junction. There it turns south on Columbus Junction's main street to Columbus City. Through this area the modern route has nearly obliterated all of the route and cross-section of the old road except for the cut-off segment that once incorporated the Fredonia to Columbus Junction road, which is also known locally as the Convict Road, as it was built by convicts in 1914 (see above). It is possible to follow the old route.

Figure 86. A. The dated 1916 Blue Grass Road signature culvert using standard state design, New London vicinity, Henry County. B. Side view of same. C. County-built parapet top culvert (1929) on Blue Grass north of New London, Henry County. D. Viewshed photo showing segment unimproved since 1916. All located at corner of Oasis Avenue and 240th Street northwest of New London. 2005 photos.

Segment 1. This cut-off highway segment has been described previously as the Fredonia to Columbus Junction Road. To the author it is one of the earliest and most significant roads in the state. It provides the best extant example of a 1¼ mile, early ISHC period, concrete road constructed by convict labor, using hand construction methods and employing unique materials, early design elements, and technology. Its 16 ft width, less than 8" thickness, lack of curbs and drains, Baker metal expansion joints, right hand corners, use of convict labor, supervision by W. F. Beard, and ISHC experimental route with excellent documentation make this one of the state's premier interpretive cut-off highway segments.

It was such a novelty at the time of its construction that people came from miles around to drive on it. Along with the Blue Grass Road many of the state's Registered Highways such as the Great White Way, the I.O.A. Shortline, the St. Paul, Burlington, and St. Louis Route, and others moved their routes to use this improved section during this period. It was designed and the work overseen by the ISHC's master builder W. F. Beard. It was so important that an early movie was made of its construction in 1916 for the ISHC but this film's current location is unknown. It is noted in a list of films on road building in 1931 (Public Road Journal 1931:234–236).

Segment 2. This segment runs for 28¾ miles from the railroad bridge in Columbus Junction to the vicinity of New London through Louisa (10¾ mi) and Henry (18 mi) counties. It contains two sub-segments (A and B), which total 16¾ miles in length. These are: Sub-Segment A, a four mile gravel surfaced segment of the Blue Grass Road dating 1913 to ca. 1928, and Sub-Segment B, a 12¾ mile gravel surfaced segment of the Blue Grass Road dating from 1913 to 1925. This was the route of the North Diagonal of the Blue Grass. Two miles north of New London the North Diagonal joined the main route (Figure 86, see also Figure 116).

Segment 2–Sub-Segment A. From downtown Columbus Junction the route passed through Columbus City and then southwards out of town along X17 for slightly more than a mile, then turning westward along G52 for around two miles before turning due south on W Avenue. The approximately 2½ mile long section on W Avenue, until it reaches the corner at G82 east of Wyman, in Section 16 and 21 in Elm Grove Township (T74N-R5W) is the best preserved with original cross-section, bridges and culverts, and other period elements relating to the "brought to grade" period (1913–1930) of Iowa road construction. One county built concrete "signature" culvert (see Signature Culverts above) is marked "Louisa County 1917." A nearby steel pony truss bridge, moved to the location from old U.S. 218, is also still intact (Rebecca Lawry, personal communication April 18, 2005). While this segment has seen some alteration over the years it retains fair to high integrity and contains a signature culvert. Additionally, another signature culvert dating to 1922 is nearby. Culvert #29 was found suggesting that possibly 28 or more unevaluated early culverts may survive.

National Register Eligibility. This sub-segment of the North Diagonal is evaluated as eligible as a route and contains individually eligible structures.

Section B; Segment 2–Sub-Segment B. From the intersection of W Avenue and Iowa 249, the route travels southwards along Iowa 249 through Winfield and along a two mile section of Iowa 78 until resuming its country (gravel) track for 13 miles until about two miles north of New London where it connects with the old main route of the Blue Grass Road out of Burlington. Current U.S. 34 lies two miles to the south.

National Register Evaluation: Sub-Segments A and B.

1. This segment contains a total of nearly 17 miles of gravel road bed dating from 1912 to 1928
2. The two road segments are related to the Blue Grass Road's North Diagonal.
3. The road's path is exactly traceable to the 1912 Huebinger travel guide for the Blue Grass Road.
4. Both segments exhibit original cross-sections and road beds (1912–1928).
5. It has intact structures dating from its period of significance (1912–1928).
6. The road beds retain a very high feeling of time and place as most of the landmarks such as farms, houses, bridges, field patterns, and trees shown on the 1912 travel guide are still extant.
7. Road bed follows the stair-step pattern of early registered routes.
8. It was the primary route of the Blue Grass Road's North Diagonal until the late 1920s.
9. Contexts related to Good Road Movement, early Automobile Transportation Era, early Iowa Highway Commission, and the Blue Grass Road from the Registered Highway Era, and the State and Federal Aid Highway eras.
10. The route of the Blue Grass into Mount Pleasant (1910–1928) has been cut by current U.S. 218.
11. Contains significant county-built structures. The 1917 culvert is taken directly from the Highway Commission's 1913 design and may have been implemented under the new design review system.

National Register Eligibility. Two segments of the North Diagonal section of the Blue Grass Road retain sufficient integrity to be eligible to the National Register. The second segment consists of two sub-segments (A–B). These two cut-off arterial road segments (and sub-segments) are eligible to the National Register under Criterion A and C. They may contain individually eligible structures.

Segment 1–The 1¼ mile segment of the Fredonia to Columbus Junction cut-off segment (off Iowa 92) North Diagonal of the Blue Grass Road (1913–1925).

Segment 2–Sub-Segment A: the four mile long W Avenue segment (1912–1925).

Sub-Segment B: approximately 12¾ miles of 1916–1948 gravel road bed and cross-section terminating two miles north of New London.

THE MAIN ROUTE: THE ROAD FROM BURLINGTON TO ALBIA (SECTIONS C–H)

Route Description. Sequentially, the Dragoon Trail, pioneer wagon and stage road, Blue Grass Road, old Iowa 8 and old U.S. 34, and current U.S. 34 all have the same starting point in Iowa at Burlington, at the Mississippi River bridge's western end. During the pioneer period the route followed Mount Pleasant Street out of Burlington. The 1900 route was a dirt road leading westward from downtown Burlington. By 1912 this route was the main automobile road into and out of town and part of the Blue Grass Road. When the 1912 road reached the C. B. & Q. track and yards in West Burlington it paralleled the southern side of the tracks for approximately 14 miles to ½ mile before the Des Moines/Henry County line, about 2¼ miles east of New London (the Sater Crossing), where its route switched to the north side of the tracks. During reconnaissance survey the Sater Crossing was not positively identified although a north side route is visible on the aerial photograph. It is shown on the 1912 auto guide (Huebinger 1912a:109).

The railroad line is atop the original trail and plank road through this area while the automobile road paralleled it. Following the rail lines is a familiar pattern in early road's alignments. In 1915, a one mile section of the road through West Burlington was paved with brick. It was 16 ft wide and was cited as "one of the handsomest stretches of county road in Iowa" (ISHC 1915t:1). At this time many urban areas were using brick paving on main connector roads or highways, extending their main city streets into more rural areas. The cities of Clinton, Des Moines, Sioux City, and Davenport all did the same. The Burlington example paralleled the large train yards in West Burlington and connected these two adjoining communities. While the route of the brick paved segment is known it was not identified during survey due to heavy resurfacing, reconstruction, or replacement of the road in that area.

Over the next decade this brick paved section was extended to the west with concrete until it was one of the longer brick and concrete paved rural roads in the state. From New London in 1912 the main route joined the North Diagonal about three miles north of town before turning westwards towards Mount Pleasant. This section of the 1912 Blue Grass Road's original path is well preserved and retains high integrity. The route runs westward about two miles then jogs north about ¾ of a mile before turning westward approximately seven miles to Mount Pleasant. The route's approach to Mount Pleasant has been obliterated by the recent construction of the current U.S. 218's Mount Pleasant Bypass. It once entered Mount Pleasant along the north side of the railroad tracks near Wesleyan College and the train depot then continued downtown along the north side of the square before turning westward again and heading out Henry Street.

The 1900–1948 road's cross-section and pavement has been obliterated by current U.S. 34 in all but a few places. Remnant cut-off segments exist in West Burlington, New London, and a very short section of the former road bed at a place once called Jimtown. With the grading and paving of the route between 1916, when it was brought to grade, and 1928 when it was concrete paved, the alignment shifted to its present tract, as previously the route has been on the south side of the tracks to Mount Pleasant. This is the current path of U.S. 34. The 1928 paving was obliterated by both its first major rebuild in 1953–1954 and by the current 2000s reconstruction. Except for the small segment running through New London the current route from Burlington to Mount Pleasant has obliterated the 1928 concrete Harding Highway, dating to federal transportation era of the 1920s–1930s. This segment is still referred to as the Blue Grass.

As noted earlier, segments of the rural route of the Blue Grass Road from 1912–1925, up until the dissolution of the Registered Highway Era, exists with good to high integrity from New London to the eastern edge of Mount Pleasant (Figure 87). It has intact route location, cross-section, gravel surface, period county crew built culverts, and is much like the 1912 map. The integrity of the route for several miles is high with good viewsheds and original road bed.

Five cut-off segments were identified within this section. With a couple of exceptions little or no original culverts, bridges, drains, pavement, or even cross-sections of the roadway remains from the

Registered Highway or Federal Transportation eras (1922–1950). Of these cut-off segments only Segment 4 retains its integrity. These cut-off segments are:

Segment 1. Four miles of the West Burlington (Iowa 409) cut-off segment. Part of the 1920s route.
Segment 2. The Sader Crossing area along the north side of the railroad tracks to New London.
Segment 3. The 1½ mile, old U.S. 34, cut-off, concrete segment entering the SE side of New London.
Segment 4. The Jimtown triangle segment of the old Agency Road and Iowa Primary Road 8.
Segment 5. Seven miles of the 1912 New London to Mount Pleasant Blue Grass segment (Figure 88).

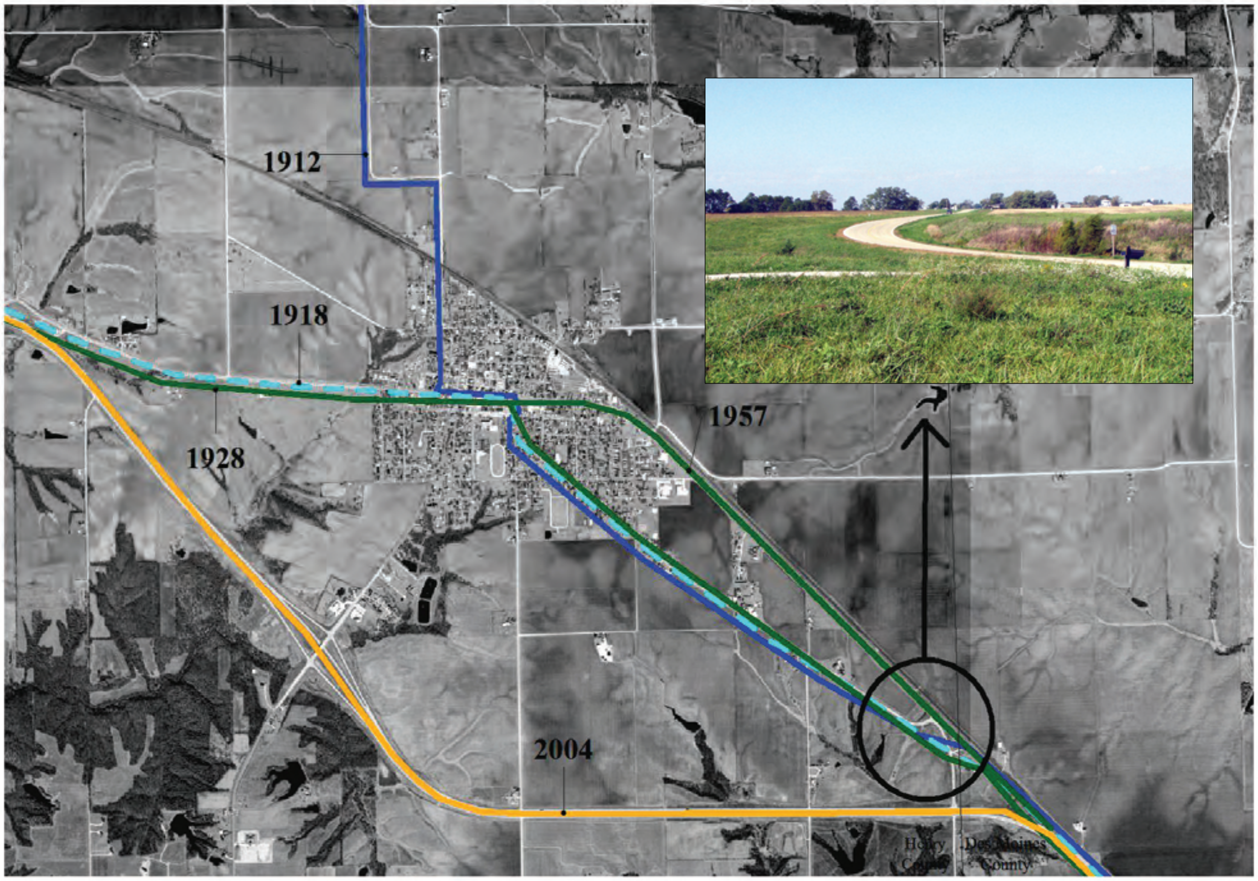


Figure 87. Aerial photo (2004) of New London (Segment 3) with intersection of old road in lower right corner. Inset. View of the modern replacement intersection east of the New London looking west at ca. 1928, in-use, through town, concrete paved cut-off segment related to The Blue Grass Road, Harding Highway, and old U.S. 34 (2005 photo).

National Register Evaluation. Section C: Segments 1 through 5 (Burlington to Mount Pleasant)

1. This segment of the Blue Grass Road contains seven miles of eligible dirt and gravel road dating from prior to 1910 to 1928 and running between New London and Mount Pleasant. It has been truncated by construction of the Mount Pleasant Bypass, about one mile east of Mount Pleasant.
2. This cut-off arterial highway segment is related to the Blue Grass Road's main path, which followed this route and that intersected with the North Diagonal Blazed Branch just north of town.
3. The road's path is exactly traceable to the 1912 Huebinger travel guide for the Blue Grass Road.
4. It exhibits a road bed and cross-section ca. 1916 with possibly earlier culverts and cross-section.
5. It has intact structures dating from 1910 to 1928.
6. Retains a very strong feeling of time and place as many of the landmarks (farms, houses, trees,

and) bridges that are shown on the 1912 travel guide are still extant (see Figure 88).
7. It follows the stair step pattern of a pre-1928 route.
8. It was the primary route until the concrete section of the New London to Mount Pleasant road was built as Iowa 8 and the Harding Highway (U.S. 34) in late 1928.
9. Regional and statewide contexts relate to Good Road Movement, the Blue Grass Road and Registered Highway Eras, and the early ISHC and Federal Highway eras.
10. No surviving original features were identified from the main Blue Grass Road, old Iowa 18, or old U.S. 34 between Burlington and New London.
11. A three mile surviving section cut-off segment of the old route that was repaved by 1954.
12. A possible surviving section, which may have for a time (ca. 1910 to 1924) run along the north side of the tracks, from the Sader Crossing, to where the route entered New London from the east.
13. The 1909–1928 Blue Grass's route into Mount Pleasant has been truncated by current U.S. 218.
14. An approximately 600 ft long section of gravel road running north and then west from the former location of the Jimtown Stage Hotel between two ca. 1910 farmsteads and intersection with county road at Nebraska/Oakberry Avenue is possibly connected to the Blue Grass Road's route.

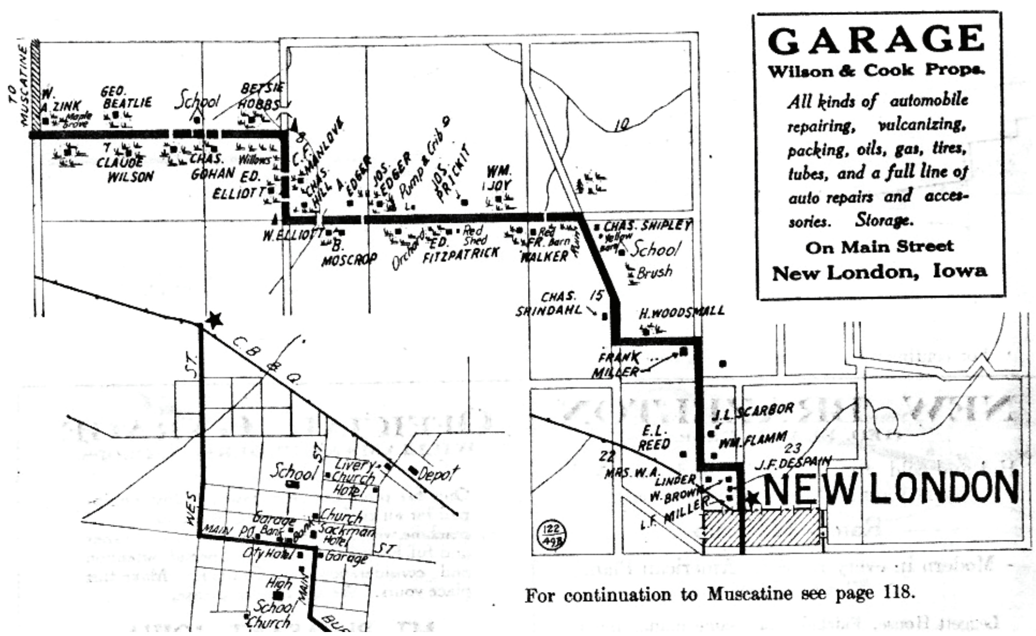


Figure 88. Map of New London showing route of the Blue Grass in 1912 (Huebinger 1912a:108).

One segment (Segment 3) from the original main Blue Grass Road, old Iowa 8, and old U.S. 34 appears to survive between Burlington and New London. This is a two mile long concrete section west of West Burlington. From New London to Mount Pleasant two cut-off segments with marginal integrity are extant. They relate to old Iowa 8 or pre-1954 U.S. 34. The first consists of a one mile long, ca. 1928, concrete section east of New London that extends to the center of town. The second is a 200 ft gravel segment located where the Jimtown Hotel once sat. These three segments were windshield surveyed only. The Jimtown marker boulder has been moved to the lawn of a farm ½ mile to the south.

Segment 1. This four mile long cut-off segment runs from current U.S. 34 east of Middletown to West Burlington along Iowa 406. It has retained some of its original route and cross-section but in most areas the pavement and drainages have been altered. This segment is evaluated as not eligible.

Segment 2. This cut-off segment relates to a change in route of the Blue Grass Road in the 1920s. At a point east of New London called the Sader Crossing the Blue Grass Road crossed from the north to the south side of the railroad tracks at an at grade crossing. The old route and crossing is shown on the 1912

Huebinger auto guide. The Sader farm is noted on the 1912 map (Huebinger 1912:117). As the route left West Burlington it was on the south side of the tracks. Along the western edge of Middletown the route crossed to the north side and ran along that side until reaching the Sader Crossing where it crossed once more to the southern side. From New London the Blue Grass diverted north through town and away from the tracks and the current or old alignment of U.S. 34, which as also the 1928 route of the Harding Highway.

Segment 3. The only surviving section of the Blue Grass Road (Harding Highway, old U.S. 34) is a ¼ mile long strip of curbed highway through the eastern side of New London. Dating from 1928 this roadway has been cut-off and preserved as an access road into downtown. It is of poured concrete and is 20 ft wide with some curbs remaining in town. While extant it is too short for interpretive value and the western section through the residential section and approaching the downtown area has been replaced.

Segment 4. A short, graveled, cut-off segment of the old Mount Pleasant Road, Blue Grass Road, and old Iowa 8 survives at an intersection at the point where the antebellum Jimtown Stage Hotel once stood between New London and Danville. This is the western end of 140 St., Danville Township, Des Moines County.

Figure 89. A. View of the Rome vicinity gravel segment of 1912 Blue Grass Road. B. Associated concrete railroad underpass that retains the painted Blue Grass Route sign illustrated in Figure67. Like most such structures the top has been replaced or rebuilt. 2003 survey photos.

Segment 5. This segment consists of the Blue Grass Road's route from New London to the eastern edge of Mount Pleasant and contains seven miles of gravel road that retains its 1909–1916 cross-section, surface, road bed, and drainage structures.

*National Register Eligibil*ity. One segment of Section C (The Main Route: Burlington to Mount Pleasant) retains sufficient integrity to be eligible to the National Register under Criteria A and C. Segment 5, the 1912–1928 route of the Blue Grass from New London to just east of Mount Pleasant, is eligible. This is the seven mile cut-off segment of the main Blue Grass Road west of New London dating from 1900 to 1913. It retains most of its original cross-section, county culverts, surface, and routeway. The route also relates to the Registered Highway Era that ended in 1927.

Section D (Mount Pleasant to Lockwood vicinity)

Evaluation. From Burlington to Mount Pleasant the route of old U.S. 34 has been obliterated. From New London to Mount Pleasant a graveled cut-off segment of the Blue Grass Road's route from 1900 to 1913 has survived with high integrity. Through that section the new route had remained identical to the old route. The old U.S. 34 route has been obliterated by the new route except for small segments noted (see Table 6). This condition changes on the western side of Mount Pleasant where the paths of the Blue Grass, old Iowa 8, and old U.S. 34 are widely separated from current U.S. 34.

Segment 1 (Mount Pleasant to Rome). While the Blue Grass Road had long entered Mount Pleasant on its northeastern side, towards Iowa Wesleyan College and the railroad depot, the route was altered to its present location by 1928 and rebuilt in 1954. The current alignment of U.S. 34, prior to the construction of the current Mount Pleasant Bypass and subsequent improvement on U.S. 218 and the U.S. 34 intersection, runs directly downtown and continues westward through the south edge of the city square. The Blue Grass Route differs in that it ran from where the route entered town from the east on Madison, just south of Iowa Wesleyan College, south down N. Main St. past the Harlan Hotel (NRHP), turned west along the north edge of the square and continued westward out Madison St. where there is a surviving section with some integrity of original cross-section and a 1915 culvert. Past the culvert the route turned north on N. Lafayette St., at the pre-1912 gas factory tanks, for two blocks, then turned west for three blocks on Henry Street, turned a block north again, then west over the railroad tracks on N. Carnahan Rd. before heading westward out of town on W. Courtland St. paralleling the railroad tracks. This ½ mile long segment through Mount Pleasant retains high integrity of cross-section and location.

Figure 90. A & B. Views of ca. 1928 concrete bridge over C. B. & Q. tracks on the western edge of Mount Pleasant. Note black centerline (photos #12,035 and #12,036 from Iowa DOT Library–Paving Folder).

Past this point at Hickory Road all structures except for the ca. 1928 Art Moderne-styled and curved highway bridge over the C, B, & Q. railroad tracks have been obliterated (Table 6). From Hickory Avenue to the Mount Pleasant Township line the original route has been completely obliterated by recent construction. Through Tippecanoe Township the roadway has been obliterated westward past the location of the old Skunk River bridge in the NW corner of Section 3 and beyond Rome.

Segment 2 (Rome Vicinity to Lockridge Vicinity). This cut-off segment was surveyed at the intensive level and consists of one mile of dirt road, approximately two miles of gravel road, and seven miles of concrete paving (10 miles total). These segments relate to three eras. First, the pre-1900 to 1913 Good Roads and early Blue Grass dirt surfaced eras (Sub-Segment 2A). Second, the 1912 to 1926 Blue Grass' brought-to-grade gravel era (Sub-Segment 2B). Third, the 1928 to 1948 gravel to concrete pavement era of the Blue Grass Road, Iowa 8/Harding Highway, and old U.S. 34 alignments (Sub-Segment 2C).

From two miles east of Rome westward to one mile west of Lockridge (seven miles total) the road segments from pre-1900 to 1928 survive in remarkably good condition and several sub-segments exhibit very high integrity. Long cut-off segments dating from prior to 1900 and post-1928 are extant. This seven mile segment, which contains the longest known surviving examples of multiple and parallel cut-off segment alignments with very high integrity, was the most intact section of such road located at the time by the author (see U.S. 34: Sections D–E). At the time of its survey in 2003 this section had one of the highest interpretive values of any highway segment found in the state. Since 2005 its integrity has been significantly compromised.

The multiple cut-off segments present, from two miles east of Rome to old U.S 34's junction with current U.S. 34, approximately 2½ miles past Lockridge, have contributing and interpretive elements dating from the entire length of the study period. One important element is the abandoned quarry bordering the old road's south side used for the road's first gravel paving, first concrete structures, and concrete paving. It relates to the ca. 1912 Blue Grass Road, ISHC, and early Federal Highway eras. While this resource is outside of the right-of-way it contributed the materials to construct the right-of-way and pavement.

The 1927 integral lip-curbed concrete pavement, related to old Iowa 8 and old U.S. 34 contexts, remains with intact cross-section, original ditches and drainages, culverts, and other elements. In the construction of this segment an earlier cut-off segment from the Blue Grass Road and Iowa 8 eras survives near the curve just west of Rome. The various routeways through and around Rome and Lockridge dating from pre-1900 to the 1930s, also have small intact cut-off segments of their own.

Figure 91. A. View of the now nonextant, curved, ca. 1930, Art Moderne-styled concrete railroad overpass. B. View of deteriorated bridge supports. 2003 survey photos. C. View of obliterated bridge's headwalls (2005 photo).

Sub-Segment A. The ca. 1900–1913 sinuous Blue Grass route with gravel surface, original cross-section, and railroad underpass with the last known Blue Grass signs, is one mile in length. The road (Dakota Road) paralleled current U.S. 34 on the south side of the river through the Elmer Scott Farm (Huebinger 1913:62) crossing the now nonextant bridge, the Skunk River Wagon Bridge, into Rome. This former through-farm road is now a dirt and gravel farm lane. The bridge's stone pilings were extant until 2005. This segment was abandoned as the Blue Grass route around 1918.

Sub-Segment B. Old U.S. 34 (1930s–1950s) consists of a ruinous concrete pavement east of the Skunk River with a length of 300 ft. Erosion of the Skunk River at this point had previously caused the replacement of the road into Rome three times. This segment was abandoned when the current road was built to its west in the 1960s or 1970s.

Sub-Segment C. This is a segment of the Blue Grass Road (ca. 1900–1913) running west and northwest out of Rome on 225th street. Most of the old route consists of graveled county roads with some changes to the ditches and travelway width. A short, dirt, brought-to-grade segment dating from pre-1900 to ca. 1918 remains along the north fence line of a yard before it rejoins the route of old Iowa 8/U.S 34. The segment of this road running diagonally across the field to the southeast is under cultivation and appears to be mostly obliterated. Construction of the new bridge has impacted this area.

Figure 92. Late 19th to early 20th century combination wooden and steel trestle railroad overpasses along old U.S. 34 near Lockridge. A. Bridge that was part of the Blue Grass Road by 1913. B. Former township road and livestock overpass now closed to traffic. Note jog in middle. 2003 survey photos.

Sub-Segment D. This segment consists of a 5½ to six mile long, 1924–1928, concrete highway with sinuosity of roadway, original pavement, cross-section, drainageways and culverts, and bridges (Figures 89–92, 118–119). It is related to the Blue Grass Road and the Registered Road Era, the Highway Commission Era for the Harding Highway (old Iowa 8) and U.S. 34. The highway has been given to county control by the Iowa DOT. The now nonextant concrete bridge over the railroad tracks was curved and displayed strong Art Moderne-styling in the handrails. During the start of the present study this road was original from one mile east of Rome to its intersection with current U.S. 34 west of Lockridge. During the study a one mile long segment was improved, obliterating the original cross-section and removing the original ca. 1930, curved, Art Moderne-styled railroad overpass.

Sub-Segment E. This one mile long cut-off segment of the Blue Grass Road (see also Figure 120) dates from pre-1900 to 1918 and consists of two sub-segments: Sub-Segment E1 (Jockey Hollow) and Sub-Segment E2. It starts at Henry-Jefferson Avenue, the Henry-Jefferson County line, and ends at the west end of 217th St. The Blue Grass Road followed 217th St. whose eastern end is cut off.

Sub-Segment E1. This sub-segment consists of an approximately ½ mile long abandoned stretch of the pre-1900 to 1913 Blue Grass Road (Figure 119). The sub-segment contains the original dirt roadway and ditches, two stone culverts and a stone bridge dating from ca. 1840 to around 1918, when it was abandoned. Known as Jockey Hollow for the nonextant tavern and racetrack there the road has been untouched since 1913 and has very high integrity. Also associated with this is an original wooden trestle overpass across which the Blue Grass Road ran until around 1913. It connects with Sub-Segment E2 at its western end. This segment began as a 1840s road and elements of this route are extant. As a significant and eligible section of roadway this sub-segment is eligible to the National Register.

Sub-Segment E2. The second sub-segment consists of an approximately ½ mile long segment of road brought to grade and graveled between 1913 and 1918 (Figure 119). This sub-segment connects with the abandoned sub-segment E1 at its eastern end and connects with old U.S. 34 after crossing the railroad tracks at grade. Currently a farm access road Sub-Segment E2 has seen maintenance but no improvement by the county. This segment has good integrity and contributes to both the Blue Grass Road's original route (consisting of Sub-Section E1) as well as the overall history and interpretation of old U.S. 34, Iowa 8. This segment also relates to antebellum roads in the region. It is eligible to the National Register as a contributing element to the main route.

Sub-Segment F. This segment consists of an approximately 300 ft section of pre-1922 road that was abandoned when the curve was rebuilt west of Rome (see also Figure 119). The road bed has been brought to grade and may have been gravel paved. It has large trees growing in the old alignment. At one time it continued over the hill to the west but this has been obliterated. This cut-off segment is evaluated as not eligible to the National Register due to its short length, lack of interpretive value, partial obliteration, and non-connection with the main route.

Sub-Segment G. This segment consists of a ¼ mile long piece of gravel road with an old automobile or livestock underpass beneath current U.S. 34 (Figure 119). The gravel road (213th St.) leads to a farm but no longer runs through it.

Segment H. A pre-1918 dirt road segment west of Lockridge that parallels current U.S. 34's northern side along the railroad tracks in Sections 31 and 32, T72N-R8W, Lockridge Township, Jefferson County, to two to three miles west of Rome (Figures 119–120).

National Register Evaluation. Section D: Segments A through H

Rome Vicinity:

1. Old U.S. 34 Segment east of Skunk River. Length 200 ft.
2. Seven miles of old U.S. 34 from Rome to Lockridge ca. 1928.
3. 1912 Blue Grass Segment east of Rome;
   a. current gravel section with underpass, Blue Grass sign, gravel surface (Dakota Ave.)
   b. abandoned and ruinous section of one mile long dirt surface roadway through a farm in Section
4. It once included the stone pilings from the old Skunk River bridge, which is now nonextant.
5. A one mile long abandoned and reused section west of Rome.
6. Gravel pit north east of Rome that was the material source for the road by 1910.
7. Concrete railroad underpass on trunk road into Rome. Possibly part of Blue Grass for a short time.
8. Art Deco styled ca. 1930 bridge over railroad west of Rome.
9. A one mile long gravel cut-off segment of the Blue Grass northwest of Rome.

Lockridge Vicinity:

1. Two mile length of old U.S. 34 built 1924 to 1926.
2. Stone railroad underpass.
3. Two ca. 1900 wooden trestle railroad overpasses.
4. Jockey Hollow segment one mile in length (pre-1900 to ca. 1912). It contains:
   a. abandoned dirt roadway.
   b. abandoned stone culvert(s).
   c. abandoned stone bridge.
5. Gravel section ½ mile in length west of Jockey Hollow.
6. Dirt section of the Blue Grass Road paralleling U.S. 34 west of Lockridge.
7. Cut-off segment ¼ mile in length and an underpass from the Blue Grass Road.
8. Abandoned 200 ft long segment on the curve west of Rome.

National Register Significance. Segments A through H contains:

1. Seven miles of cut-off, abandoned, or rerouted highway segments with high integrity.
2. Retains original cross-section.
3. Retains original culverts and drains.
4. Contains multiple parallel routes with intact cross-sections, structures, and surface.
5. Multiple routes over time that may have individual integrity, which varies between road sections.
6. Multiple route segments having very high interpretive value.
7. Two extant but abandoned railroad underpasses dating to the Blue Grass Road era.
8. Two extant wooden trestle overpasses over the C.B. & Q. tracks (ca. 1890 to 1910) of which one is directly related to the Blue Grass Road's 1912 route.
9. A one mile length of dirt pre-1900 to ca. 1912 roadway directly related to the Blue Grass Road (Huebinger 1912:107–109). Extant with two stone bridges, original cross-section and surface, which connects with a ca. 1920s section of the Blue Grass Road that is presently gravel paved.

10. Several graveled segments from Blue Grass Road era are extant but not evaluated as eligible.

Section E: U.S. 34–The Main Route (Lockridge vicinity to Fairfield)

Evaluation. From the end of Segment 4, west of Lockridge to the eastern side of Fairfield, current U.S. 34 has followed and obliterated the previous routes and roadways from the study period. Within the length of this section only a single possible intact segment survives (Figures 120–121).

Located on the eastern edge of Fairfield, just before the creek on the south side of the city park, it appears to consists of an approximately 150 ft long piece of extant, cut-off segment, road bed dating from 1900 to the first concrete paving of Iowa 8/U.S. 34 at that location (ca. 1925). The original route dating prior to and during the era of the Blue Grass Road may have ran along one of the park roads, and entering town where the park's current entrance is. Maps and aerials photos were not definitive for its location.

Figure 93. A. View of an in-use cut-off segment of old U.S. 34 used as access road on the eastern side of Batavia, Jefferson County. B. View of in-use cut-off segment of old U.S. 34 used as driveway in downtown Agency, Wapello County. 2003 survey photos.

National Register Significance. This section contains one possible extant cut-off segment. This cut-off and abandoned segment may date prior to 1930 but was rebuilt in the 1950s and possibly bypassed in the 1970s. It is evaluated as not eligible due to its short length, compromised condition, and lack of interpretive value.

Section F: U.S. 34–The Main Route (Fairfield to Agency)

Through Fairfield the Blue Grass Road (old Iowa 8/U.S. 34) followed the same course as current U.S. 34. With two exceptions current U.S. 34 obliterated the previous roadways through Batavia and westward to Agency. The extant cut-off segments of old Iowa 8 and old U.S. 34 are located within the town of Batavia (Section 3, Locust Grove Township, T72N-R11W, Jefferson County) and east of town, just west of the center of Section 25, Locust Grove Township, Jefferson County (Figures 120–122).

Section F: Segment 1. The first cut-off segment is within the town of Batavia and consists of two parts (sub-segments A and B) (Figure 122). Sub-segment A consists of a section of curving concrete pavement on the northeastern part of town. The sweep of the old road's concrete surface is still visible. This segment was left when the curve was straightened. It is approximately two blocks in length and still functions as an access road. Sub-segment B is a piece of cut-off segment approximately 100 ft long that is not contiguous with sub-segment A. It is located in the center of Batavia paralleling the south side of current U.S. 34 in front of what had once been a filling station. It is currently being used only for parking.

Segment 2. The second cut-off segment of old U.S. 34 is now a private road. It is isolated and not continuous with Segment 1. It is approximately ¼ mile in length and contains two contiguous sub-segments (C and D) (Figure 94).

Segment 2–Sub-Segment A. This curving sub-segment retains its original cross-section and a ca. 1928 Art Deco styled culvert over an unnamed branch of Cedar Creek. The paving has been removed leaving only the road bed, which has been further degraded by cultivation. This part is approximately 1/8 mile in length and its path can be seen curving up through the field to the north and east of the bridge. This segment was once concrete surfaced, like the segment to its west, and in the construction of old U.S. 34 in the 1950s its concrete paving and other elements were obliterated. The western half still retains its original 1928 cross-to section and concrete paving and is in use as a private driveway.

Figure 94. A. View of cut-off segment showing bridge/culvert. B. Detail of bridge footings showing spade marks. C. Detail of concrete pavement. D. View of obliterated segment through field. 2003 survey photos.

The ca. 1926 culvert has been abandoned for years and is not serviceable. Its footings have been seriously undermined and their bases exposed. The footings exhibited the spade marks that are the result of the footing's base being cut directly out of the clay subsoil. This hole was then filled with concrete and the spade marks were retained as a cast on its exposed exterior surface. The bridge has Art Deco styled siderails and a concrete slab deck. The intact and obliterated sub-segments are separated by the bridge.

Section F: Segment 2–Sub-Segment B. The old pavement currently functions as a lane and driveway. This sub-segment dead-ends just prior to the culvert over an unnamed branch of Cedar Creek, which is considered part of sub-segment C. It is located just west of the center of Section 25 (T72N-R11W). The total length of this cut-off segment is approximately ½ mile. The concrete paved western segment's length is 20 ft wide, integral lip-curbed, and the aggregate contains crushed rock from a state quarry. The plans and documentary evidence shows that it was being paved with concrete beginning in 1926 and was finished in 1927 (ISHC 1918a, 1926a, 1926d, 1926e, 1927d; Baird 1989:38).

National Register Evaluation: Section F: Segments 1 & 2 (Sub-Segments A–D). This section contains two cut-off segments (Segment 1: sub-segments A and B and Segment 2: Sub-Segments C and D). They are evaluated as ineligible due to the following reasons.

1. No longer are through routes.
2. Do not provide a sense of time or place.

3. Have had changes that seriously affect their integrity.
4. Contains no structures or other works of sufficient integrity to be evaluated as significant.
5. All are mostly in ruinous condition.
6. Lengths of less than one mile.

National Register Significance. Section F, Segments 1 & 2 (Sub-Segments A–D). These cut-off and abandoned segments date ca. 1928 and are evaluated as not eligible to the National Register. This conclusion was reached due to their short lengths, compromised to ruinous condition affecting their integrity, lack of interpretive value, and inability to be reconnected to through route.

Section G: U.S. 34–The Main Route (Agency to Ottumwa)

This section consists of two cut-off segments (Figures 95, 96, 123). These two segments are bisected by current U.S. 34 and are unique in the survey corridor and along the study routes as their having originally been a post-Civil War railroad grade. They retain original elements of this function in the cross-section and structures that were upgraded ca. 1918 when the grade was raised for the automobile road.

Segment 1 consists of a 1½ mile long segment that runs along 74th St. from the western side of Agency to the eastern side of Ottumwa atop an abandoned railroad grade and incorporated its earlier construction elements (Figure 95A). It has at various times been part of the Dragoon Trail, the Blue Grass, Iowa 8, old U.S. 34, and current U.S. 34. Presently, the cross-section dates to its ca. 1918 reconstruction period when the railroad grade was raised. The 1926 pavement is concrete with integral lipped curbs and integral drains. Some areas have been asphalt surfaced over the original concrete paving but the width is original.

Segment 2 consists of an abandoned ½ mile long segment that continues on the southern side of current U.S. 34 approximately ¼ mile west of its intersection with 74th St. It was also built atop the old railroad grade incorporating the earlier structures, has a potentially eligible deck truss bridge (Figures 95B–95D) incorporating an earlier railroad bridge's stone footings. It retains a sense of time and place.

Segment 1. This cut-off segment runs from Agency to current U.S. 34 on the eastern side of Ottumwa. This part is still in use as a local road and lies to the north of current U.S. 34. The unique aspect of this stretch of road is its being built atop the abandoned railroad grade and incorporates those original stone structures. This is somewhat comparable to the original plank road (precursor to U.S. 34) from Burlington to Mount Pleasant, whose route was also taken by the railroad (see Section C). Along that section the railroad was constructed upon the path of the original Dragoon Trail and Plank Road. The subsequent routes paralleled the railroad tracks. This section reversed this trend when the abandoned grade was rebuilt as the highway.

Dating to the late 1869 this railroad was a short line linking a now lost coal mine, with Ottumwa and Agency rail sidings. The rail line's grade appears to have been well built with substantial limestone culverts. The drainages leading to the culverts had their sidewalls lined with dry laid tabular limestone to stabilize the banks, preventing erosion. When the railroad grade was converted to an auto roadway some width was added to each side of the grade raising its elevation. The builders lengthened and lined some of the original stonework culverts with concrete. Thus, the roadway exhibits several periods of use and alteration. Its evolution went from an 1869 railroad grade, to a dirt road atop the grade, to a widened and graded road in the early Blue Grass Road era, to a graveled road in the mid-1910s, and finally to an elevated concrete paved highway in 1926 according to the plans (ISHC–Plans 1926a; Baird 1989:34–35). Areas of this cut-off segment have been asphalted, and some culverts possibly altered or replaced, but it appears to have kept its original cross-section and most culverts.

Segment 2. This cut-off segment consists of a ½ mile long abandoned cut-off segment that retains high integrity, but is in a deteriorated condition. This segment, along with Segment 1, was once the direct route into downtown Ottumwa from 1913 to 1945. It has presently been intersected and cut by current U.S. 34 but continues on the southern side (see also Figures 95, 123). The original cross-section, paving, deck truss bridge, which is related to the Jefferson Street Viaduct over the Des Moines River in Ottumwa, which was recorded by Historic American Engineering Record (HAER) and is National Register listed, and the long arcing curve of pavement into Ottumwa all remain. This segment appears to partly follow the old railroad grade and the Art Deco-styled, steel, deck truss bridge with concrete roadway appears to be built atop an older railroad bridge's cut limestone footings (Figure 95). Cut-off Segment 2 runs from its intersection with current U.S. 34 and curves southwestward to an intersection with Old E. Main. It could still possibly be reconnected as a through route.

Figure 95. A. View of in-use, asphalt surfaced Segment 1 atop old railroad grade looking southwest. B. View of abandoned Segment 2 looking southwest. C. View of abandoned deck-truss bridge on Segment 2 with 1869 stone footings. D. Detail of bridge handrail. 2003 survey photos, Ottumwa, Wapello County.

Segment 3 (Ottumwa Urban Section). Although not surveyed or evaluated due to the criteria set in the MOA the urban route with elements of the Blue Grass Road, Iowa 8, and old U.S. 34 through Ottumwa is briefly discussed below. The 1910s path of the Blue Grass Road was traced through town. Further study is recommended for evaluation of these routes within an urban context. The route of the Blue Grass Road continued southwestward out of Ottumwa and deviated from later U. S. 34 (Figure 123).

It should be noted that many cut-off segments that are now on the edge of a city or urban area were once in the country, and that as some cities expand some of these once rural cut-off segments should be evaluated within an advancing urban context. In general, cut-off highway segments in urban areas can be evaluated much as rural ones based on route, period of construction, sociopolitical contexts, period of significance, and occasionally the designer, engineer, or builder involved. The following discussion, taking up the route at the west end of Segment 2, briefly describes these connecting routes through this highly urbanized area of Ottumwa.

Eastern Ottumwa. The western end of cut-off Segment 1 once continued into Ottumwa along Main Street to the downtown area. This portion of the old road has been significantly altered but does follow the same route through downtown Ottumwa before turning south over the current and reconstructed U.S. 34 bridge, which is an eligible 1936 deck truss bridge similar to that in Segment 2 and built at the same time. The old route followed Main Street to Green, turned north one block, then west one block, before traveling over the Jefferson Street viaduct (Figure 123). This 1929, 1,722 ft long (993 ft steel truss), National Register eligible, Warren-Deck Truss bridge over the Des Moines River now follows Church Street on the southern side (Fraser 1993, Hippen 1986), but has had its concrete decking and siderails recently rebuilt (1980s) using the technique now known as "the Iowa Method" (HAER 1986).

Figure 96. A. Detail of interior of cut limestone culvert adapted from 1869 railroad spur (Section G; Segment 1) showing stonework, concrete and brick lining, and iron support bars. B. View of cut-off and abandoned segment (Section G: Segment 2) looking southwest. 2004 survey photos.

Southern and Western Ottumwa. The Blue Grass and old Iowa 8/U.S. 34's routes on the south side of the Des Moines River angled southwest. The Blue Grass Road's route separated from old U.S. 34, which followed along the south side of the river. The Blue Grass Road followed Church to Chester, down Rochester for two blocks, then turned due south on Milner for approximately nine blocks before turning westward on Mary and out of the city limits. Before it intersects U.S. 34 on the western side of Ottumwa a ca. 1925 concrete culvert is still in use but has been significantly altered affecting its integrity. West of Ottumwa the Blue Grass' route was mapped following county roads H41 and H47. This route coincided from Blakesburg to Ottumwa with The Southwest Trails route (1913) from Kansas City to Chicago (IDOT 1986). Still called the Blue Grass today it is gravel paved to Blakesburg. From there it runs north to northwest entering Albia from the southeast. Such urban sections link intact and locally recognized rural segments making a historic through-route.

National Register Evaluation. Segment 1. This segment contains or exhibits:

1. Two miles of concrete paving dating from 1928 following a mechanized transportation route dating from approximately ca. 1869 to 1940. Of this, several miles have been thinly asphalt surfaced.
2. Eligible context related to the 1910s–1930s Blue Grass Road during the Registered Highway Era, Iowa Primary Roads Era (Iowa 8) and Federal Highway Era (U.S. 34).
3. Was built atop a previously abandoned railroad grade (ca. 1869).
4. An important local context for the segments of the road using the railroad grade's existing structures (culverts, drains, berm, and limestone lined drainageways) and incorporating them into the roadway;
   a. stone culverts are extant but some were lengthened with concrete when grade was raised.
   b. this is a surviving example of a possible pattern of dual rail-auto transportation corridor evolution and abandonment in Iowa.
   c. examples of stone railroad structures being converted to highway use seems uncommon but not unknown at present. Another example has been observed near Centerville in Appanoose County.

Sections of road that may lie atop abandoned railroad grades in other parts of the study routes were not found. One was encountered during the statewide survey and others are present. Additional research needs to be done on the number and significance of these types of multi-use cut-off segments.

5. This cut-off segment is potentially eligible as the only surviving unaltered post-1928 segment of Iowa 8 and old U.S. 34 through Ottumwa (Figure 97). In addition it has one of the last surviving bridges of this type with the original deck and handrail. The similarly designed and built bridge over the Skunk River was removed in the early 1990s. The pavement through town appears to have been mostly obliterated but in-place segments probably survive. The Jefferson Street Viaduct over the Des Moines River is structurally similar to three original bridges of which only one survives.

Figure 97. A. View of ca. 1916 culvert on old Iowa 8/U.S. 34 in southwest Ottumwa, Wapello County. B. Detail of concrete showing both twisted and rectangular rebar. 2003 survey photos.

Segment 2. This segment contains or exhibits:

1. 2½ miles of eligible rural roadway related to the Registered Routes, ISHC, and Federal Highway eras.
2. The original paving, cross-section, and structures.
3. Sufficient length to retain sense of time and place.
4. Individually eligible deck truss bridge with Art Deco-styled handrails, which is related to and is a contributing element to the cut-off and abandoned 1910s–1930s corridor segment.
5. Dry-laid, rock-lined drainages related to the railroad era and used through the highway era.
6. Either connects to or is part of the original routes of the Blue Grass, Iowa 8, and old U.S. 34 through Ottumwa. Contributes to the similarly built and National Register eligible Jefferson Viaduct deck truss bridge over the Des Moines River (roadway and siderails modified).
7. Extant bridge reuses the stone footings of the earlier railroad bridge into the deck-truss design.

Section G: Segment 3. This urban segment retains the routes of the Blue Grass Road, Iowa 8, and old U.S. 34. This segment includes the significant Jefferson Viaduct, which has been HAER recorded and is eligible to the National Register. The north and south highway routes within Ottumwa are beyond the scope of this study but do connect eligible segments on each end.

Section H (Ottumwa vicinity to Albia vicinity).

Segment 1. As noted above, the original route through Ottumwa has been mostly obliterated by subsequent improvements, especially during the 1950s. On the southwestern side of Ottumwa the path of the Blue Grass Road and old U.S. 34 diverged as the Blue Grass headed southwestward (Figures 98–101, 124–125). On the western edge of Ottumwa at its junction with current U.S. 34, old U.S. 34 continues westward to Albia as County H35. This is one of the longest and most original sections of the study route. A discussion of the time periods and contexts involved in its evolution are outlined below.

The Blue Grass Road. With application in 1913 and registration in 1917, the Blue Grass Road was one of the earliest Registered Highways and was considered of military importance (Iowa DOT 1986). Prior to construction of U.S. 34 the Blue Grass Road's route out of Ottumwa ran southwestward along County H41 and H47, somewhat paralleling old and current U.S. 34 to its south through Blakesburg. It then curved northwards to rejoin old Iowa 8/U.S. 34 at Albia. The Blue Grass Road's route on H41 and H47 in Wapello and Monroe counties is still extant but the surface and cross-section has been significantly modified in many sections by the county. As this section of the route was out of the main U.S. 34 study section it was only windshield surveyed.

Registered Highway Era. During the Registered Highway Era the Blue Grass Road shared this route with three other registered highways. The first was the Air Line Road, which also ran to the north, recorded in 1912 (Huebinger 1912). This section was also the route of the Harding Highway registered in 1924 and covering 3,000 miles from Washington D.C. to Los Angeles, passing through Burlington and running on through to Nebraska City, Nebraska. This section was also the Southwest Trails route, which was registered in 1915, which ran from Kansas City, Missouri, and ended in Chicago, Illinois, covering a distance of 540 miles (Iowa DOT 1986). While the Blue Grass organizers appear to have been on good terms with the ISHC and a few telling documents survive (Bellamy 1916: ISHC–Letters 1916h), it is unlike the contentious Red Ball Route for which a great deal survives.

Iowa 8 and Old U.S. 34. County Road H35 in Wapello and Monroe counties was the 1920–1926 route of old Iowa 8, during Iowa's early Primary Roads Era, and old U.S. 34 after 1926 during the Federal Aid Era. It is the longest and most intact segments of such highway found in the state. Even without the Avery Creek bridge the roadway itself has high integrity, interpretive value, and historical significance (see Table 6).

This cut-off highway segment (H35) of the route of old Iowa 8 and old U.S. 34 (Figures 111–113), from the western edge of Ottumwa to the eastern side of Albia, is 28 miles long and retains very high integrity for most of its length. This lengthy cut-off section was formed when U.S. 34 was rebuilt in the early 1950s. This segment, which follows the 19th century route, was the main arterial from its being brought to grade ca. 1918 and concrete paving in 1928 until its replacement with a totally new route to the south in the late 1950s. At that time its ownership was given over to the counties along its length.

Figure 98. A. View in 2003 of the ca. 1928 Avery Creek bridge (nonextant 2005) in Wapello County. Note asphalt over-paving between original concrete curbs. B. View of same looking east. 2003 survey photos.

Route Description. The road follows the drainage of Bear Creek and follows the quarter section lines in Section 28 and the eastern part of Section 29 of Center Township. Curving north approximately ¾ mile it continues following the topography along Bear Creek and then turns westward again through Section 19, Center Township, and through Sections 23 and 24 of Polk Township. It turns southwards through the hills following the old stage route past the Christian Cemetery and Christianburg Church. It winds northwestward through the western half of Section 22 and the NE¼ of Section 21, crossing Avery Creek, where the original ca. 1928 steel truss bridge was still extant as of 2003, but removed in 2005 (Figure 98).

Near Smith Cemetery it runs northwestward through the SW¼ of Section 17. There it turns westward again through Munterville before turning southwestward once more, just before following the section line again at the Wapello and Monroe County line. From this point, through Wapello County it follows the section line between Sections 13 and 24, Polk Township, Wapello County before resuming its topographic route following Middle Avery Creek through Sections 19, 20, and 21 in Mantua Township. Briefly following the northern quarter section lines in Sections 20 and 21, in the NW¼ of Section 20, it curves northwards following the ridge top through Section 18. In Section 18 it reconnects with the section line between Sections 13 and 24, before turning southwestward, still following the ridge tops, through Section 24 for ¾ of a mile. In the NW¼ of Section 23 it heads due west into Albia. On the west side of Albia in Section 21, Troy Township, the route (Section H: Sub-Segment 2) runs along the side of St. Mary's Cemetery in the SW¼, NE¼ of Section 21 and crosses the creek and the railroad underpass reconnecting with current U.S. 34.

National Register Evaluation–Segments 1 and 2. The length of this 28 mile cut-off section (H) has two cut-off segments (1 and 2), 4 sub-segments (A–D), and an unevaluated urban segment through Albia. It contains or exhibits:

1. A 28 mile long, ca. 1904–1928, cut-off segment from west of Ottumwa to the eastern edge of Albia.
2. Is the longest original and intact cut-off segment within the study routes with very high integrity.
3. Original pavement's width is 18 ft with pavement mostly of river and bank gravel based aggregate.
4. It retains the original cross-section, lip-curbed pavement, and drop-inlet culverts.
5. Topographic route runs along the old stage coach route between Albia and Ottumwa and sticks to the ridge tops and runs through the mid-19th century communities of Munterville and Christenburg.
6. Some modifications have occurred but have not significantly affected its integrity.
7. At present this is considered the longest, intact, high integrity segment from the 1900–1948 study period in the state.
8. Contexts related to Good Roads Era, Blue Grass Road and Registered Highways eras, the formation of the ISHC and Iowa Primary Roads 8, along with old U.S. 34 and the Federal Highway Era.
9. Unevaluated in-place segments may survive within Albia.

Figure 99. A. View of route of 1900 to 1916 Blue Grass Road skirting Albia cemetery. B. Cut-off concrete highway segment west of Albia, Jefferson County at intersection of old U.S. 34 and current U.S. 34. Note curb, new turn before 100 ft cut-off segment, current U.S. 34 grade, then resumption of old U.S. 34.

Albia Urban Section. Through Albia the routes of the Blue Grass Road, old Iowa 8, and old U.S. 34 appear to be the same. The current road (H35) enters the eastern side of Albia. At the city limits it has been modified and becomes E. Benton Avenue. The old route runs along the north side of the downtown square, and continues westwards from downtown as W. Benton Avenue, until reaching the intersection with N. E. Street, where it changes to old U.S. 34. While the route and width of this urban segment is consistent with the 1928 construction, the pavement within town appears to have been mostly replaced or overlain. The curbs and culverts, along with the paving, have also possibly been replaced in this section. While the urban roadway itself may not be individually eligible it may be seen as a contributing element to the travelway and relate to the interpretation of the route. It acts as an important and drivable link between two cut-off rural segments with very high integrity and significance.

At the northwestern edge of the Albia Cemetery their courses diverge forming the second sub element. This is the Blue Grass Road's route that is shown on the 1912 auto-guide as skirting the southwest side of the Albia cemetery (Figure 99A) (Huebinger 1912:90). This cut-off segment is abandoned and nearly ruinous but still visible. Due to its early date (pre-1900–1916) it was dirt surfaced and probably never brought to grade. It is no longer even used as a cemetery road and its former use as a cross state arterial may have been forgotten. It is the only known segment from this period remaining along this section.

Segment 2–Sub-Segment A (Western Albia to Current U.S. 34). This cut-off segment of old U.S. 34 is 1½ miles long (Figures 99–100, 123–125). It runs from the western edge of Albia to the present intersection with current U.S. 34 and contains three sub-segments. The main alignment or section of old U.S. 34 is partly atop the old Blue Grass Road's route out of Albia's western edge.

Figure 100. A. View of dated 1927 railroad trestle over old U.S. 34. B. Detail of trestle. Note newer concrete top. C. View of cut-off segment of old U.S. 34 dead ending at Cedar Creek. 2003 survey photos.

Segment 2 (U.S. 34 to Cedar Creek to the Lucas County Line). Segment 2 consists of four concrete paved sub-segments (A–D) of old U.S. 34.

Sub-Segment A. This sub-segment extends from south of current U.S. 34 and proceeds uphill past St. Mary's Cemetery and then westerly along the ridge tops for approximately a 1½ miles before descending into the valley of Cedar Creek and meeting current U.S. 34. The new road between this intersection and a jog a short distance down current U.S. 34 brings the traveler back upon the old road's track. This segment is potentially significant in that it retains good integrity in its cross-section, paving, sinuosity of path, viewshed, and continuity with the segments east of Albia and thus retains interpretive value.

Sub-Segment B. This cut-off segment of old U.S. 34 is on the north side of current U.S. 34. Within it there is a ca. 1928, 400 ft long, sub-segment in the NE¼ of Section 26 that dead ends at Cedar Creek (Figure 100C). It is concrete paved, 18 ft wide, abandoned, nearly ruinous, and the bridge once over Cedar Creek has been removed. The old route of the Blue Grass Road has been obliterated where it crossed Cedar Creek and the railroad tracks north of current U.S. 34 and old Iowa 8/U.S. 34 through the NW¼ of Section 25. This segment relates to the middle period ISHC era where several routes were being paved across Iowa. At this same point the earlier route of the Blue Grass Road was not readily traceable at the time of survey. However, its path may be discerned on early U.S.D.A. aerial photographs. This segment is evaluated as not potentially significant as it has low interpretive value. Its construction can be seen in sections to its east that retain higher integrity. This segment no longer connects with the current or old route of U.S. 34.

Sub-Segment C. Ascending out of the Cedar Creek valley in Guilford Township is an approximately two mile long segment. It dates prior to 1913 but was graded and paved by 1926. On the northern side of current U.S. 34 the route of current county road (H35) is a cut-off segment of the Blue Grass. Its route once again follows the ridge tops through Sections 21, 22, and 23, crossing over 595th Avenue, before again intersecting current U.S. 34. This segment begins with a large bend to the northwest across Section 22, Guilford Township, before bending southwestwards, still following the ridge top, to reconnect with current U.S. 34 in the NW¼ of Section 28. Part of the 1920s Blue Grass route continued due east along the section line between Sections 21 and 28, and crossed the head of the Bee Branch of Cedar Creek in the NW¼ of Section 29, just east of Georgetown, which may once have been called Stacyville. The old dirt surfaced Blue Grass's route ran west from Stacyville (nonextant) then jogged southwestwards into Melrose. This route was driven but not surveyed.

Figure 101. A. View of early parapet topped culvert on old Iowa 8/U.S. 34 atop ridge. B. View of ridge top route of old Iowa 8/U.S. 34 with integral lip-curb drain (now county road H35). 2003 survey photos.

Sub-Segment D. At Georgetown an approximately 400 ft cut-off segment of concrete road dating to 1928 remains in front of St. Patrick's Catholic Church in Georgetown, and extends westward a short distance through the old rest area. This cut-off segment was left as an access road to St. Patrick's Catholic Church, a picnic/rest area, and several residences that make up the hamlet of Georgetown. The remainder of the now obliterated 1928 road through this area is 20 ft wide. The concrete aggregate is made of crushed rock from a state quarry and exhibits bitumen based expansion joints. Its path ran along the ridge before rejoining current U.S. 34 in Section 30. The concrete pavement on either side of the church and rest area has been obliterated and the road's path can just be discerned for a short distance through the fields to its east and west. This segment appears to have been made of state quarry dolomite while segments to its east were made of river gravels. The train tracks are nearby and may have brought in non-local materials to this upland location. It also was one of the later sections to be paved. A dirt segment of the Blue Grass and perhaps an early graded or graveled phase of the Blue Grass and Iowa Primary Road 8 parallels the north side of the current alignment of U.S. 34 past Georgetown.

This cut-off segment was the final cut-off segment within the limits of the intensive survey section of the study route and was near the county line terminus for the overall study route, as the route of current U.S. 34 has obliterated the routes of the Blue Grass, Iowa 8, and old U.S. 34 westward for many miles. The old roads ran directly under the current road for a considerable distance. The current U.S. 34 highway was driven but it became clear that as a historic study segment it had been compromised. To the far west cut-off segments of these old routes may survive but many have been replaced, repaved, or obliterated.

National Register Evaluations: Segments 1 and 2 (Wapello and Monroe Counties). This section contains three cut-off segments related to the 1918 to 1928 construction period and cut off in the 1950s to 1970s (Figure 126).

Segment 1 (Wapello and Monroe Counties).

1. An extant route approximately 28 miles in length.
2. It retains original lip-curbed concrete paving dating ca. 1928.

3. The cross-section is original along with all the culverts and drains.
4. The ca. 1928 steel, single span, steel truss bridge over Avery Creek (extant 2003) was an important contributing element to the route's interpretation until its removal in 2005.
5. This segment has drop culverts and drains that are integral to its original construction that differ from those built in Section D (Mount Pleasant to Lockridge vicinity).
6. 12 miles of aggregate from local quarry river gravels and 16 miles of state quarry dolomite.
7. Context of an arterial during Iowa Primary Roads and Federal Highway Era (1920s–1930s) with high integrity and interpretive value even with the loss of the Avery Creek bridge.
8. Eligible ¼ mi long ruinous cut-off segment dating from 1900–1916 with high integrity.
9. Old roadway follows route of pre-1900 stage road.
10. Two extant but abandoned and nearly ruinous dirt segments of Blue Grass Road exhibiting concrete culverts from early period (pre-1900–1916) paralleling and visible from old U.S. 34.
11. A nearly ruinous ca. 1928, through-farm, concrete paved segment abandoned by Wapello County.
12. Contexts include that of an arterial highway during the Registered Highway Era, the Iowa Primary Road and Federal Aid Highway eras (1920s–1930s) with high integrity and interpretive value.
13. Three extant sub-segments dating from 1900–1948.
14. The pavement within route through Albia's city limits may be present but replaced or resurfaced in most areas affecting its integrity but retains interpretive value and connects two eligible segments.
15. Strong sense of time and place along total length, paving width and cross-section, intact structures, topographic routeway, and viewshed–all with high interpretive value.

Segment 2 (Monroe County).

1. An extant, in-use, routeway approximately three miles in length dating to entire study period.
2. It retains original lip-curbed, ca. 1928, concrete paving dating from period of significance.
3. The cross-section is original.
4. Extant and contributing 1916–1928 railroad underpass.
5. This segment has original culverts and drains that are integral to its construction.
6. Two miles of river gravel based aggregate pavement from local quarries.
7. One mile of crushed rock pavement from local or state quarries.
8. Abandoned pre-1900–ca. 1916 dirt surfaced route along edge of Albia cemetery relating to early Blue Grass Road. Also may relate to pioneer era (similarities to the Floyd County Cemetery road).
9. Follows topographic route of pre-1900 stage route and wagon road.
10. Context of an arterial during Registered Highway Era, Iowa Primary Roads Era, and Federal Highway Era (1920s–1930s) with high integrity and interpretive value.
11. Two ineligible cut-off segments (Cedar Creek and Georgetown segments) due to limited interpretive value, ruinous conditions (Cedar Creek), or short length with obliterated ends (Georgetown).
12. Ineligible 400 ft long cut-off segment of abandoned and nearly ruinous 1928 concrete paved roadway that dead ends at Cedar Creek due to bridge obliteration.
13. Ineligible 400 ft long cut-off segment of 1928 concrete paved roadway reconfigured as an access road for St. Patrick's Catholic Church, houses, and roadside picnic/rest area in Georgetown.
14. These segments are not connectable to make a through route as the pre-1948 road has been nearly obliterated past the Lucas County line where the study's intensive survey section ended.

National Register Significance. Elements of these three cut-off highway segments date from pre-1900 to ca. 1955, by which time all segments had been cut-off. Of these Segments 1 and 2 are presently in use as county roads. They are considered eligible to the National Register under Criteria A and C. Segment 3 contains short, abandoned, or ruinous segments evaluated as not eligible due to significant changes affecting its integrity (Figure 102).

National Register Eligibility. The survey data shows that the route of old U.S. 34 and its precursors has several long and intact cut-off segments. The paved sections dating from the period of the 1918 Federal Transportation Act and it final concrete paving in 1930 are consistent in overall design elements such as cross-sections and pavement widths, but has wide variation over multiple counties in the use of materials and the design and construction of related structures, especially culverts and drains. The extant bridges are also consistent with the study period and contribute to the overall evaluation of the highway. While some of the longer and larger bridges, such as the one over the Skunk River west of Mount Pleasant have been replaced, past that point the road appears to retain higher integrity as it travels westward. This study section retains engineering elements and road beds for the full length of the study period (1900–1948). It has significant surviving segments relating to the late Iowa Good Roads Movement era (1880–1911), the Iowa Registered Highway era (1912–1927), the ISHC and State Primary Roads eras (1904–1930), and the National Transportation Funding and Federal Highway eras (1918–1948).

Figure 102. A. View from the eastern dead end of the Georgetown (Monroe County) cut-off segment of old U.S. 34 looking west. B. View of same looking at western dead end (2005 photos).

CONCLUSIONS: STUDY ROUTE 1–U.S. 34

The route of U.S. 34 through Henry, Jefferson, Wapello, and Monroe counties was recognized by the surveyors in 2003 as potentially having the longest and best preserved sections of intact 1920s integral lip-curbed concrete highway in the state. It also had the best concentration of previously cut-off segments of all lengths that were accessible, that represented the entire study period, and that had good historical documentation. At the time of the survey in 2003 it had the widest range of original structures along its length. There were two important eligible sections that ran from east of Rome to west of Lockridge and from west of Ottumwa to west of Albia. During the time it took to assemble and analyze the data much of these segments had been obliterated, which created new shorter cut-off segments. By 2005 much of the Rome to Lockridge section of the old route of the Blue Grass Road and old U.S. 34 from prior to 1940 was unrecognizable. At this writing the western segment from Ottumwa to Albia had seen a bridge replacement and some alterations but had remained essentially intact and original.

Following the 2004 evaluation 72 miles (Tables 4–6) was evaluated as eligible to the National Register. This eligible length was primarily composed of Segment B (13¾ mi), Segment D (10 mi), and Segment H (34 mi). Together these three segments composed 58 miles of eligible road way considered to be the best observed during the statewide survey. Due to alterations at present only the 34 mile long stretch of Segment H retains its historic fabric. While this is the still the longest stretch of unaltered early highway known to the author in Iowa it too is under pressure to be improved or removed altogether.

The route and its associated cut-off segments of U.S. 34 were the first to be surveyed for the study. Table 5 shows the large number of evaluated structures assessed. In addition, the route's history from a territorial era military road and its continued existence through Iowa's history has resulted in its providing an evolutionary background for the route and various roads along it over time. Additionally, it provided a wealth of data for comparison to U.S. 218.

Evaluated Structures

All structures and their remnants were evaluated during survey (Table 4). The survey evaluated a total of 382 structures within the intensively surveyed sections. Viewsheds and Miscellaneous totaled 137. These ranged from large bridges to culverts, abandoned road beds, remnant elements of abandoned or removed structures, and aggregate matrixes of pavements and structures. Cut-off segments found dated from as early as the 1840s to the 1950s. The earliest structures and roadways related to contexts involving territorial and early statehood roads prior to 1900. Later roads related primarily to the early years of the ISHC (1904–1912), to the period of ISHC review and the brought-to-grade era along with the Registered Routes era (1914–1926), to the inception of Iowa's Primary Road era. The process of making cut-off highway segments is still occurring. Culverts were the largest single category of structures found.

Culverts/Stock Crossings. U.S. 34 had a high number of original culverts with a total of 114 recorded. Of these some were on small drainages while others where a combination of both small drainage and stock-crossing culverts. Larger culverts with sidewalls or handrails totaled 40. Very early culverts with parapet tops from the brought-to-grade era totaled 28, while handrail culverts totaled 12. Often culverts exhibited one stylistic element on one side and a different finish on the other. While almost all culverts were water drainages a large number also served as livestock crossing. None were stock crossings only.

Abandoned Road Beds. A total of 39 abandoned cut-off road segments were recorded. These elements dated from prior to 1900 in one instance to the 1950s in another. Most of the abandoned segments dated from three time periods. The first related to the brought-to-grade construction of the road in the mid-1910s. The second period related to the further straightening and bridging of this road in the mid-to late-1920s. The third period relates to the cutting off of segments of the 1920s roadway in the 1950s.

Bridges. A total of nine bridges were evaluated. These consisted of three reinforced concrete bridges from the 1920s to 1940s, two deck truss bridges from Ottumwa, and one steel truss bridge near Albia. An abandoned stone mid-19th century bridge related to the Territorial and Early Statehood eras was in use into the early Blue Grass Road era. Of these two concrete bridges and one steel truss bridge have been removed since 2005. This underscores the speed with which these original structures are being removed.

Railroad Crossings. A total of nine railroad crossings were evaluated. They were built by the railroad. These consisted of six overpasses and three underpasses. All but two of these were of concrete. Those two consisted of wooden bridges that date to the time of the Blue Grass Road. One was noted as part of the route in 1912. Wooden railroad overpasses are a historic resource that has not been evaluated in Iowa.

Cement Drainage Gutter Chutes. This structure type totaled 108 along the survey corridor. Concrete drainage chutes relate directly to integral lip-curbs and their drains, which are usually open. They drain into small culverts and more frequently into drop culverts. Sometimes they drain into ceramic tile pipes that connect to the culvert. This type of drain structure was only found along old U.S. 34 and was built from 1924 to 1928. Their use relates directly to the 1924 to 1928 construction period and is drawn on the ISHC plans. They are a result of the topography and are commonly found along cut and filled segments with drops of usually more than 5 ft and up to 20 ft. The large ceramic tile pipes appear to have been made locally. Their use appears to relate to specific local contractors building ISHC contracted segments. Design, size, type, and distribution relate to county and township lines. Most are in poor condition.

Drains. A total of 16 curbed drain inlets were recorded along old U.S 34. These included dome topped, round cast drains, and rectangular iron inlet grates either factory or hand made. These drainage elements were usually along one side of the road and let to drainage tile systems that paralleled the road.

Signs and Marker Posts. A total of 12 signs and markers were recorded. Two of these were the original Blue Grass Road signs found on opposite walls of the same railroad underpass located east of Rome. The remainders were original wooden posts that marked culvert locations.

Retaining Walls. Two retaining walls/abutments were associated with a nonextant bridge east of Ottumwa on an abandoned segment of old US. 34.

Buildings. Twelve buildings related to specific eras, alignments, pavements, and structures of the study route were noted. During the course of the study it was clear that some transportation-related buildings in communities along their routes dated to specific time periods or eras. While buildings were not evaluated they were often helpful in tracking an old route's path through a town, city, or rural area.

Table 4. U.S. 34–Total Count of Structures/Objects/and Views Recorded

Element Type		Number Recorded
Culvert/Stock Crossings		114
Parapet Tops		28
Handrail Tops		12
Abandoned Road Beds		39
Bridges		9
Railroad Crossings—	Overpasses	6
	Underpasses	3
Cement Drainage Gutter Chutes		108
Iron Drains		16
Signs/Markers Posts		9
Retaining Walls		2
Buildings		14
Structural Matrix/Aggregate		22
Viewsheds/Secondary Views		137
Total Element Types		519

Summary of Sections and Surviving Segments along U.S. 34

The U.S 34 alignment consisted of eight sections (A–H) (Tables 5 and 6). There were a total of 19 cut-off segments that totaled 118.25 miles in length. These consisted of one in Section A (24½ mi), three in Section B (28¾ mi), five in Section C (25 mi), two in Section D (16 mi), one in Section E (11 mi), two in Section F (30 mi), three in Section G (10 mi), and two in Section H (34 mi). The sections follow the survey's fieldwork orientation and run from east to west, or from Burlington (Des Moines County) to west of Albia(Monroe County), and ending at Georgetown at the Monroe/Lucas county line.

Cut-off segments of all types totaled 181 miles in length and were as short as 200 ft to as long as 34 miles. The total of a particular segment's length may consist of a number of shorter segments added together. As a study route U.S. 34 had a higher total of section, segment, and eligible segment lengths than U.S. 218. While this was partly due to its longer total survey length the numbers are more directly related to the survival of cut-off segments. Their survival is a result of both topography and highway improvement over the years. While U.S. 34's old alignments were often paralleled, those of U.S. 218 frequently ran atop of the older alignments and obliterated them.

Table 5. U.S. 34 Section Lengths

Section	Section Length (mi)	Segment Lengths (mi)	Eligible Segment Lengths
A	24½	1¼	1¼
B	28¾	18	13¾
C	25	12½	7
D	16	16	10
E	11	200 ft	--
F	30	27¼	--
G	10	9	6
H	36	34	37
Totals	181.25	118	72

Eligible cut-off segments totaled 72 miles in length. A large proportion of this total was the 34 mile long eligible segments and sub-segments of Section H. In contrast, Section F was 30 miles in length with 27¼ miles of segments but had no eligible segments. Section E was 11 miles in length but also had only one 200 ft long surviving segment that was so short it was evaluated as ineligible. In general, the route from Burlington to New London more often ran atop the old alignments and obliterated them. From New London to Mount Pleasant the route of the Blue Grass Road survived while that of old U.S. 34 was obliterated by the 1950s U.S. 34, which was in turn obliterated by current U.S. 34.

National Register Eligibility

Section A. Located in Des Moines County only 1¼ miles of Section A's 24½ mile total length were evaluated as having very high integrity. This gravel and concrete surfaced alignment related to the Blue Grass Road and Iowa 8 with its period of significance dating from 1916 to 1948. It was evaluated as individually eligible under Criteria A, B, C, and D.

Section B. Located in Louisa and Henry counties Section B consisted of concrete and gravel surfaced alignments 13 3/4 miles in length. From that length three segments were surveyed and found to have high integrity.

Segment 1. Located in Louisa County Segment 1 is 1¼ mile in length with a concrete surface, high integrity and historically related primarily to the route of the Blue Grass Road but also had construction connections to subsequent Iowa 8 and old U.S. 34 from 1924 to 1949. It was evaluated as individually eligible and as a contributing element to a possible longer historic corridor under Criteria B, C, and D.

Segment 2. Located in Louisa County Segment 2 is 2½ miles in length with a gravel surface and high integrity. It relates to the Blue Grass Road from 1910 to 1928 and was evaluated as individually eligible and as a possible contributing element to a longer historic corridor under Criteria B and C.

Segment 3. Located in Henry County Segment 3 is 10 miles in length. It was a gravel surfaced road with high integrity and was related to the Blue Grass Road between 1910 and 1928. It was evaluated as individually eligible and as a possible contributing element to a historic corridor under Criteria B and C.

Section C. Located in Des Moines and Henry counties Section C is 25 miles in length. From that length five segments related to The Blue Grass Road, Iowa 8, and U.S. 34 were surveyed. Of those Segments 1–4 were evaluated as having low integrity.

Segment 5. Located in Henry County Segment 5 is seven miles in length. It was evaluated as having high integrity and was related to the Blue Grass Road from 1900 to 1926 making it individually eligible under Criteria A, B, and C.

Section D. Located in Henry and Jefferson counties Section D is 11 miles in length and contains two cut-off segments ½ and 10 miles in length respectively. It has nine dirt, gravel, and concrete surfaced cut-off sub-segments (A–I) related to the Blue Grass Road, Iowa 8, and old U.S. 34. Sub-Segment E has two sub-segments of its own.

Segment 1. Located in Henry County this ½ mile long segment is concrete surfaced and relates to the Blue Grass Road era. Its integrity is low and it is not evaluated as eligible under the present criteria.

Segment 2. Located in Henry and Jefferson counties this 10 mile long concrete paved segment is concrete surfaced and is made up of nine sub-segments. Each has its own assessment of integrity and eligibility. It integrity is high and it was evaluated as individually eligible under Criteria A, B, and C. Its context and significance relates to the Blue Grass Road and old U.S. 34 from 1910 to 1948.

Sub-Segment A. Located in Henry County this two mile long gravel surfaced cut-off segment's significance relates to the Blue Grass Road era. It has high integrity and was found to be both individually eligible as an intact example of the Blue Grass Road from 1919 to 1913 and also as a contributing element to a historic corridor under Criteria B.

Sub-Segment B. This cut-off segment is only 200 ft in length. It is located at the former location of the Jimtown Tavern. The tavern was removed in the late 1950s for the construction of old U.S. 34 but a small cut-off segment of the 1920s-built Harding Highway and U.S. 34 remains as a turning road. Once a historically significant site the removal of the tavern and original roadway has severely compromised its integrity and it was evaluated as not eligible.

Sub-Segment C. Located in Henry County this two mile long gravel surfaced sub-segment relates to the Blue Grass Road era. It integrity was low and it was evaluated as ineligible.

Sub-Segment D. Located in Jefferson County this six mile long concrete surfaced sub-segment of old U.S. 34 was evaluated as having high integrity. It is both individually eligible but as is a contributing element to a longer historic corridor. It period of significance dates from 1916 to 1948 and it is eligible under Criteria A, B, and C.

Sub-Segment E. Located in Jefferson County this one mile long dirt and gravel surfaced sub-segment predates 1900 but was used as part of the Blue Grass Road until around 1913. Located in an area known as Jockey Hollow the post-1900 alignment related to the Blue Grass Road and has elements of and follows the path of the antebellum Agency Road.

Sub-E1. Sub-Segment E1 retains its original pre-1900 to ca. 1910 road bed, stone culverts, and a dry laid stone bridge that was probably originally constructed in the 1840s along the Agency Road. This sub-segment is on private property and the road bed has been abandoned for many years. It is evaluated as individually eligible for its surviving section of the antebellum Agency Road with both intact masonry structures and the graded dirt surface of the early 20th century Blue Grass Road. It represents the period of the Blue Grass Road prior to this segment being brought-to-grade around 1916 when this alignment was abandoned and the road moved to the south side of the tracks. This segment was evaluated as very significant under Criteria A, C, and D.

Table 6. Summary of Sections and Surviving Segments along U.S. 34.

Section	Segment	Length	Material	Integrity	NRHP Eligible	Individual/ Contributing Resource	Route(s)	County	Dates	Era	NRB 16B Criteria
A		24½ mi	C/G		no		BG/IA 8	Van Buren			
	1	1¼ mi	C/G	high	yes	Individual	BG/IA 8		1916–1948	*C/D*	ABCD
B		28 3/4 mi	G/C								
	1	1¼ mi	C	high	yes	Ind./Cont.	BG	Louisa	1924–1949	*C/D*	ABCD
	2	2½ mi	G	high	yes	Ind./Cont.	BG	Louisa	1910–1928	*B/C/D*	ABC
	3	10 mi	G	high	yes	Ind./Cont.	BG	Henry	1910–1928	*B/C/D*	ABC
C		25 mi	C/G								
	1	4 mi	C	low	no		BG/US 34	Des Moines			
	2		D/G	unknown	no		BG/IA 8	Des Moines/Henry			
	3	1½ mi	C	low	no		US 34	Henry			
	4	400 ft	G	low	no		US 34	Henry			
	5	7 mi	G	high	yes	Individual	BG	Henry	1900–1926	*A/B/C/D*	ABC
D		11 mi	D/G/C								
	1	½ mi	C	medium	yes/no		BG	Henry			
	2	10 mi	C	high	yes	Individual	BG/US 34	Henry/Jefferson	1910–1948	*B/C/D*	ABD
	sub A	2 mi	G	high	yes	Ind./Cont.	BG	Henry	1910–1913	*B*	B
	sub B	200 ft	C	low	no		US 34	Henry			
	sub C	2 mi	G	low	no		BG	Henry			
	sub D	6 mi	C	high	yes	Ind./Cont.	US 34	Jefferson	1916–1948	*B/C/D*	ACD
	sub E	1 mi	D/G	medium	yes/no		BG	Jefferson			
	E1	½ mi	D	high	yes	Ind./Cont.	BG	Jefferson	1900–1913	*A/B*	AC
	E2	½ mi	D/G	fair	no	Contributing	BG	Jefferson			
	sub F							Jefferson			
	sub G	300 ft	G	low	no		BG/IA 8	Jefferson			
	sub H	¼ mi	G	low	no		BG/IA 8	Jefferson			
	sub I			low	no						

Table 6. Summary of Surviving Sections and Segments along U.S. 34, continued.

Section	Segment	Length	Material	Integrity	NRHP Eligible	Individual/ Contributing Resource	Route(s)	County	Dates	Era	NRB 16B Criteria
E		11 mi									
	1	200 ft	C	low	no		US 34	Jefferson			
F		30 mi	D/C								
	1	19 mi	C	low	no			Jefferson			
	sub A	2 blks.	C	low	no		US 34	Jefferson			
	sub B	150 ft	C	low	no		US 34	Jefferson			
	2	8 mi	C	low	no						
	sub C	660 ft	C	low	no		US 34	Jefferson			
	sub D	660 ft	D	low	no		US 34	Jefferson			
G		10 mi									
	1	5 mi	C	high	yes	Ind./Cont.	BG/IA	Wapello	1900–1948	*A/B/C/D*	ABCD
	2	1 mi		high	yes	Ind./Cont.	8/US 34	Wapello	1900–1948	*A/B/C/*	ABCD
	3	3 mi	G	low	no		BG/IA	Wapello	1900-1948	*D*	A
							8/US 34			*A/B/C/*	
										D	
H		36 mi									
	1	28 mi	C	high	yes	Ind./Cont.	BG/IA	Wapello/Monroe	1910–1948	*A/B/C/*	ACD
	2	8 mi	C	high	yes	Ind./Cont.	8/US 34	Monroe	1910–1948	*D*	ACD
	sub A	1½ mi	G/C	high	yes	Contributing	BG/IA	Monroe	1910–1948	*A/B/C/*	ACD
	sub B	400 ft	C	medium	yes		8/US 34	Monroe	1928–1948	*D*	ACD
	sub C	2 mi	G	high	no		BG/IA	Monroe	1910–1948	*A/B/C/*	
	sub D	400 ft	C	low	no		8/US 34	Monroe	1928–1948	*D*	
							US 34			*D*	
							BG/IA 8			*A/B/C/*	
							US 34			*D*	
										D	

Key to Surface Materials

C = Concrete
G = Gravel
D = Dirt

Key to Abbreviations

NRHP = National Register of Historic Places
NRB = National Register Bulletin
BG = Blue Grass Road

Key to Eras

A = Pre-1904: Time until formation of Iowa Highway Commission
B = 1904–1913: Early Mechanized Transportation Phase
C = 1914–1926: Registered Routes and Iowa Primary Road Systems
D = 1927–1948: Federal Control

Sub-E2. Sub-Segment E2 is a ½ mile long gravel surfaced continuation of the eastern portion of the Jockey Hollow Road. It is presently a township road that leads to a single farm. There it changes to a field access road at the eastern end of the property. While not individually eligible it is a contributing element to the earliest known alignment of the Blue Grass Road, as represented by Sub-Segment E1, and is thus evaluated as eligible under Criteria A and B.

Sub-Segment F. Located in Jefferson County this segment consists of an approximately 300 ft piece of pre-1922 road that was abandoned when the curve was rebuilt west of Rome. The road bed has been brought to grade and may have been gravel paved. This cut-off segment is evaluated as not eligible due to its short length, lack of interpretive value, and non-connection with the main route.

Sub-Segment G. Located in Jefferson County Sub-Segment G is only approximately 300 ft in length and has a dirt/gravel surface. It relates to the Blue Grass Road and Iowa 8. It was abandoned around 1928 when a new alignment (old U.S. 34) was built just to its south in order to eliminate a grade up a steep hill. It had been brought to grade and then abandoned and has large trees growing in it. Do to its low integrity and the way its cut off, which prohibits it from reconnecting into a longer route as a contributing element, it was evaluated as not eligible.

Sub-Segment H. Located in Jefferson County this ½ mile long segment is gravel surfaced. It is currently a township road that was formerly part of the Blue Grass Road. It has been brought-to-grade and graveled but currently dead ends at a farmstead. Due to its low integrity and inability to be connected to a historic routeway it was evaluated as ineligible.

Section E

Located in Jefferson County this 11 mile long section had one concrete surfaced cut-off segment 200 ft in length related to old U.S. 34. It was evaluated as to short to be eligible as current U.S. 34 has obliterated all of the earlier alignments.

Section F. Located in Jefferson County Section F is 30 miles in length. The first segment is located between the villages of Lockridge and Batavia. Nearly all of the old routes were obliterated by U.S. 34 when it was reconstructed in 1957. It retains two cut-off segments that have two very short cut-off sub-segments within each one. These segments are predominately concrete surfaced with only Segment 2, Sub-Segment D has a dirt surface where the ca. 1928 concrete paving was removed, exposing the road bed. In general this section exhibited low overall integrity with few extant pre-1948 cut-off segments.

Segment 1. Located in Jefferson County Segment 1 is 19 miles in length. It is concrete surfaced and relates to old U.S. 34. It was evaluated as having low integrity due to alteration in its cross-section and surface due to periodic upgrades.

Sub-Segment A. Located in the village of Batavia this cut-off segment is concrete surfaced and only two blocks in length. It relates to old U.S. 34 and consists of an access road paralleling old U.S. 34 along a curve in the east end of town. Due to its short length and inability to be connected to the historic old U.S. 34 routeway or possible historic corridor it is evaluated as not eligible.

Sub-Segment B. Located in the western end of Batavia this short concrete surfaced cut-off segment relates to old U.S. 34. It is currently used as access parking and driveways to a small commercial area. It lies parallel to U.S. 34 and is just a few feet to its south. Due to its short length, low integrity, and inability to be connected to a historic corridor or routeway it was evaluated as not eligible.

Segment 2. Located in Jefferson County west of Batavia this cut-off segment is eight miles in length with two cut-off sub-segments. All of the eight mile length of the Segment 2 consists of the post-1957 reworking of U.S. 34. During that reconstruction a segment that descended to and crossed an unnamed branch of Cedar Creek over a 1928 concrete handrail bridge was abandoned by the Iowa DOT in 1957.

Sub-Segment C. Part of Sub-Segment C’s western end was turned over to the township and is presently used as an access road to a small housing development. It is privately owned at its eastern end and used as a driveway. The concrete surface and bridge both date to 1928. The concrete paving still retains its integral lip-curbs. Due to its low integrity, short length, and inability to be connected to a historic corridor or routeway Sub-Segment C was evaluated as not eligible.

Sub-Segment D. At the time of the reconstruction of U.S. 34 in 1957, Sub-Segment D had its concrete paving stripped and the road bed was returned to agriculture. It is currently under cultivation but the remnants of its road bed are visible. Having been abandoned, obliterated, and returned to agriculture significantly affects its integrity. As a result Sub-Segment D is evaluated as not eligible.

Section G. Located in Wapello County this section totals 10 miles in length. It has three eligible sub-segments that relate to the Blue Grass Road, Iowa 8, and old U.S. 34. Its period of significance is from 1900 to 1948. Segments 1 and 2 are concrete surfaced while Segment 3 (3 mi) is gravel surfaced. The six continuous miles of Segments 1 and 2 constitute one of the longest original 1920s highways located in Iowa.

Segment 1. This five mile long concrete surfaced cut-off segment is located in Wapello County. Relating to the Blue Grass Road, Iowa 8 and U.S. 34 it has high integrity and retains its original cross-section and structures dating from its ca. 1928 construction. It was turned over to county maintenance in 1957 when the next alignment of U.S. 34 was constructed and has seen little change except for the removal of a large steel truss bridge over S. Avery Creek. Due to its high integrity, long length, and the possibility of its being reconnected to a historic corridor it was evaluated as individually eligible for its whole length and also as a possible contributing element to a historic corridor under Criteria A and C.

Segment 2. Located in Jefferson County this one mile long segment is concrete surfaced and relates to the Blue Grass Road, Iowa 8, and U.S. 34 from 1900 to 1948. It has high integrity and retains its original cross-section and structures relating to its ca. 1928 construction. It was turned over to county maintenance in 1957 when the next alignment of U.S. 34 was constructed. Like Segment 1 it has seen little changed since and constitutes one of the best examples of integral lip-curbed highways in the state. Due to its high integrity, long length, and possibility of reconnection to a historic corridor it was evaluated as both individually eligible for its whole length and also as a possible contributing element to a historic corridor or routeway under Criteria A and C.

Segment 3. Located in Jefferson County this three mile long gravel paved cut-off segment is currently a county or township road. It was once part of the Blue Grass Route until ca. 1928 when it was bypassed during the construction of a new alignment for old U.S. 34. Due to its low integrity and inability to be connected to a historic corridor or routeway it is evaluated as not eligible.

Section H. Located in Wapello and Monroe Counties this section totals 36 miles in length. It retains its original cross-section, integral lip-curbed paving, and structures. While the length of Section H has elements dating from 1910 to 1948 that relate to the Blue Grass Road, Iowa 8, and U.S. 34 its period of significance is from 1928 to 1948. Due to its high integrity, long length, and ability to be connected to a historic corridor or routeway it was evaluated as eligible for its whole length under Criteria A and C. Segments 1 and 2 constitute the longest stretches of original 1920s highways evaluated in the state.

Segment 1. Located in Wapello and Monroe Counties this segment is 28 miles in length. It runs from the western edge of Ottumwa, Wapello County, to the eastern edge of Albia in Monroe County. It retains its original cross-section, integral lip-curbed paving, and structures. While Segment 1 dates from 1910 to 1948 its period of significance is from 1928 to 1948. Due to its high integrity, long length, and ability to be connected to a historic corridor it was evaluated as eligible under Criteria A and C. Segment 2 constitutes one the longest stretches of original 1920s highways in the state at 36 continuous miles.

Segment 2. Located in Monroe County this segment is eight miles in length. Of that distance approximately 3½ miles consists of a cut-off segment. Segment 2 runs from the western edge of Albia to near the hamlet of Georgetown. It retains its original cross-section, integral lip-curbed paving, and structures. While the length of Segment 2 dates from 1910 to 1948 its period of significance is from 1928 to 1957. Due to its high integrity, long length, and ability to be connected to a historic corridor or routeway it was evaluated as eligible for its whole length under Criteria A and C.

Segment 2 has four sub-segments (A–D). These were cut-off during the 1957 improvement when the curvy, ridge top running 1928 road was returned to county maintenance. This segment is more discontinuous than Segment 1 due to its having had pieces obliterated by later road alignment. Each sub-segment has been cut-off at both ends. Individually eligible Sub-Segments A and B, part of County Road H35, have access to the current highway alignment. Contributing Sub-Segment C has access at one end but is terminated at Cedar Creek where the bridge has been removed. Ineligible Sub-Segment D has also been terminated at both ends. It has become the access road for the church at Georgetown and there are several houses and a picnic/rest area on its western end.

Sub-Segment A. Located in Monroe County on the western edge of Albia it is 1½ miles in length with gravel and concrete surfaced elements having high integrity. It is evaluated both as individually eligible and as a contributing element to a historic corridor or routeway under Criteria A, B, and D.

Sub-Segment B. Located in Monroe County and 400 ft in length this concrete surfaced segment relates to old U.S. 34. It terminates at Cedar Creek where the bridge has been removed and the pavement on the western side obliterated. Due to its short length and inability to reconnect with the original alignment it was evaluated as a contributing element to a historic corridor under Criteria A.

Sub-Segment C. Located in Monroe County and two miles in length this segment has high integrity although its pavement has been replaced where it accesses current U.S. 34. Part of it is maintained by the county (H35) while one part, which runs through a farm, has been abandoned. Relating to the Blue Grass Road, Iowa 8 and U.S. 34 it is evaluated as a contributing element to a historic corridor under Criterion A.

Sub-Segment D. Located in Monroe County this 400 ft long, concrete surfaced segment in Georgetown relating to old U.S. 34 was evaluated as not eligible due changes that affect its integrity such as its short length and inability to be reconnected with a historic corridor or routeway.

Study Route 2: U.S. 218/Iowa 923 and Iowa 965

(a.k.a. Red Ball Route/Iowa 40/U.S. 161/Old U.S. 218)

INTRODUCTION

The second study route consists of cut-off segments of the Red Ball Route, Iowa 40 (1919–1926). U.S. 161 (1926–1937) south from Cedar Rapids, old U.S. 218 (post-1938), and current Iowa 923 and 965. The roadway over time has incorporated each phase of development from territorial horse trail to modern four-lane highway. Sections of the route contain or are parallel with the Old Military Road (1839) which ran from Dubuque through Iowa City to the Missouri line (Briggs 1970:265–276; Hansen 1970:251–264; Parish 1970:249–250). Although there is some discussion that the travelway followed an earlier Indian and horse trail, unlike the route of U.S. 34 and the Blue Grass Road, this route did not precede the establishment of Iowa City as second Territorial and First State Capital (1847). The route of the Old Military Road is now incorporated by Iowa 151, Iowa 1, old U. S. 218, and rural roads sections such as Underwood Avenue in Washington County. These were used as the route from the territorial era, through the time of the Red Ball Route, until when the route was repaved as U.S. 218 (or U.S. 161) in the 1920s–1930s. It remained two-lane U.S. 218 until the 1980s when it was cut-off by the construction of current four-lane U.S. 218, when most of it was changed to U.S. 380.

The Iowa DOT Library holdings for the Red Ball Route consist of many photos and letters when compared to its holdings for the Blue Grass Road, which consists of a few letters, and other registered highways with nothing at all. One of the reasons for the differences between the content of the two road's archival folders is related to the large amount of personal correspondence generated by the head of this section of the Red Ball Route, Robert N. Carson. He was also the head or president of the River to River Road Association (Weber 1992:46, 48). Carson's correspondence with the ISHC, its head Fred White, and various other officials, gives a critically important view point of the interplay between the ISHC and important local businessmen representing the registered highways (Carson 1913a–1925d, Harrison 1925, ISHC 1913a–1916f, 1917c–1919d, 1919g–1925b, ISHC–Letters 1913–1925; Rawn 1920). The surviving Red Ball route maps, held in the Red Ball folder at the Iowa DOT in Ames, were submitted by Carson, show route changes that can be compared to the correspondence to flesh out the story of the road during this formative period and the roles played by individuals.

A 1912 advertisement for a Robert E. Carson is in Huebinger's Pocket Automobile Guide for Iowa (Huebinger 1912:70). Robert E. Carson was perhaps related to R. N. Carson. It relates in five lines: "R. E. CARSON, Automobile Supplies, and Expert Repairing, Dubuque and Burlington Streets, IOWA CITY, IOWA" (Huebinger 1912:57, 70). R. N. Carson's operation of an auto servicing business only a block from Robert E. Carson, the director/president of both the Red Ball Route and a section of the River to River Road, suggest a familial relationship. Additionally, the 1900 Atlas of Johnson County, Iowa, has an advertisement for his father, who was founder of the successful mid 19th century Carson's Implement Company (Weber 1985:151). His father, an early settler, owned the implement company, was president of the Johnson County Savings Bank (1912) and the Gas and Light Company. Robert N. Carson held the first automobile parade in Iowa City on October 12, 1910 (Weber 1990:133) and headed its auto club.

One segment between North Liberty, the Iowa River, and Shueyville in Johnson County received notoriety for a cultural event. The roadway up the north bluff from the river's edge to the ridge top was one famous point at which thousands of travelers on their way home from the November 22, 1922, University of Iowa football game against Wisconsin (Iowa 29–Wisconsin 14) was well known at the time as 500 cars and 1,500 people became stranded in the mud during a storm. This was a significant event at the time and perhaps one of the largest single pre-1948 strandings in Iowa transportation history. Several newspaper and historical accounts were written (Weber 1989:46).

This cut-off segment exhibits high integrity within its period of significance (1900–1930). The portion of the segment across the bottoms that once approached the old Curtis Bridge over the Iowa River at that point, while not suitable for driving, are extant and relate to the route's pathway during the period of significance, display period construction methods and materials, have a strong sense of time and place, and help to demonstrate the change in highway technology over time due to its vantage point from the new bridge at that point.

Proto-Red Ball Route (1900–1915). Prior to the Red Ball Route's registration in 1915 a direct or continuous antecedent route on which a later route could be directly based really did not exist during the first decade of the study period. The proto-Red Ball Route period relates to the earliest part of the Mechanized Transportation Era when automobiles were few and had not reached the numbers present by the late 1910s and 1920s (Bremer County History Book Association 1985:16).

In 1912, Huebinger's pocket guide shows no continuous route between Mount Pleasant and Cedar Rapids. At that time the nearest route to what would become the Red Ball was the Keokuk to Waterloo Belt Line Road. From Mount Pleasant northwards this route followed the route of the Old Military Road to about two miles south of Ainsworth. There it intersected The White Way (registered 1914) and the later IOA Shortline Road (registered 1924) before turning westward into Washington; thence north to Kalona along the Old Military Road, later renamed Iowa 1.

From Kalona the route of the Keokuk to Waterloo Belt Line route ran due south to Mount Pleasant. From downtown Mount Pleasant the original route differs from today in that it ran southwestward out of town along present H46 (Oakland Mills Road), to where it crossed the Skunk River at the old wagon bridge there (Huebinger 1912:62, 70, 110). This route (Franklin Avenue/W55) did not follow or coincide with the path of the Red Ball Road or old U.S. 218. The route through Oakland Mills eliminated the need for the road to pass through the Skunk River valley. This section had long been nearly impassable.

At the northern end of the study section, from Cedar Rapids southwards the Red Ball Route passed consecutively through the hamlets and cities of Fairfax, Western College, Shueyville, Cou Falls, Curtis, Mid River, Young, North Liberty, Iowa City, Riverside, Ainsworth, Crawfordsville, Wayne, Olds, Swedesburg, and Mount Pleasant. As noted above south of Mount Pleasant the current road's path deviated from the original route. This segment of the roadway was not put through until the 1930s.

The Registered Red Ball Route (1915–1927). The Red Ball Route was registered with the ISHC in 1915 but was perhaps known with that appellation as early as 1910. They had applied in 1913 (Carson 1913; ISHC 1916c:11). The Iowa DOT map of Registered Highway Routes in Iowa related that "This 600 mile route started in St. Paul, Minnesota and ended in St. Louis, Missouri and was of military importance" (Iowa DOT 1986). By the time the Red Ball Route had been established in 1915 the IOA Shortline's route had shifted to the north to Davenport and eastward along the path of the River to River Road. The Great White Way's route had also shifted northwards by the mid-1920s.

In 1935 the Red Ball Road's route from just south of Mount Pleasant to Iowa City followed the Old Military Road, and had become U.S. 161 (Gousha 1935). In 1935 the route was also noted as U.S. 218 and the missing section over the Skunk River, due south between Mount Pleasant and what was to become U.S. 161, had been completed. South of Mount Pleasant a cut-off segment of this route dating to this time and measuring approximately two miles in length was extant at the start of the survey. This segment had been completely obliterated by the end of the survey and its demolition was recorded (see below).

Federal and State Highway Era (1917–1948). The adoption of the National Transportation Act by the state in 1917 set in motion the improvement of most of the major transportation arterials in Iowa. The route from St. Louis to Minneapolis, under any name, was one of three early major north–south corridors in Iowa. The route was considered to be of military importance and was the most direct between the two cities on the western side of the Mississippi River. As a significant arterial in the state and under the federal purview its improvement began with the road being brought to a consistent grade and cross-section between 1917 and 1925. Many sections remained ungraded, graded but unpaved, or with gravel paving for many years. Much of it was still not concrete paved by the late 1920s.

Much of the first work was done between Iowa City and Cedar Rapids during Iowa's Primary Roads Era, which began in 1928 with the introduction of a statewide system that matched the Federal system. Even in 1948 the route of U.S. 218 between Cedar Rapids and Waterloo traveled westward on U.S. 30 to Vinton before going northwards. That route was west of the Cedar River while the current route is on the eastern side after crossing near the old Curtis Bridge. This western section was evaluated during the reconnaissance portion of the project and few or no significant cut-off segments useful for the study's purposes were noted. It was therefore not intensively surveyed. In general, the historical route of the Red Ball and U.S. 218 north and west of Cedar Rapids appears to have been obliterated in most areas. Areas that were extant as recently as ten years ago have since been obliterated during ongoing construction.

By 1931 the study route was paved with concrete from south of Mount Pleasant north to Ainsworth. From Ainsworth to Riverside the road was still of dirt (Figures 128–130) but from Riverside to Cedar Rapids the road was of concrete (Hunt 1926:181, Ohman 1931). By 1935 the route is shown as completely paved with concrete or other permanent hard paving (Gousha 1935) (Figures 130–136).

The New Road: Washington County's Experience

In many ways Washington County can exemplify all of the counties along the Red Ball Route and U.S. 218, and in Iowa in general, during the early 20th century. It was very rural with Washington as the major town and county seat. It was positioned between Henry County and Johnson County, with Iowa City dominating the region. The Old Military Road was the region's most important transportation arterial until the auto age prior to the route's eastward shift from Iowa 40, to U.S. 161, and U.S. 218.

Washington County's roads were as poor as any in the state and the usual 19th century transportation pattern had emerged. However, even in the 1890s forward looking individuals, many of whom had experience with improved roads in other places, began to take a lead in improving transportation. Maintaining the roads was still the responsibility of the township road supervisors, and all men in each neighborhood were required to annually spend a couple days working on the road. At first a "dump" scraper was used, then the King road drag and other improved scrapers became popular. These scraper types were the most technical development in road machinery technology at the time. So much so that one resident wrote a letter about a new grader on the market that said "I would consent to serve as Township Trustee just long enough to secure two of these machines…and nothing else in the world would induce me to accept the office." He had used the new scraper for a whole season, and felt that "this machine should be found in all communities where the self-binder, sulky plow, mowing machine, harpoon hay fork and other labor saving machinery are found," and that the old dump scrapers belonged "where farmers cradle their grain, tramp it out with horses, load corn with a single shovel, and go to mill on horseback." Road grader contests were held in various neighborhoods, where the relative merits of different grading machines were demonstrated (Fisher 1978:195).

Others had little faith in graders for county roads; they felt that their tendency was not to arch or round the road, but to gulley it in the center and make a canal. They felt that country roads were in much worse condition since the introduction of the scraper. Some believed in paying the road tax in cash, and having the roads worked scientifically by some officer who could be held to strict accountability for his work.

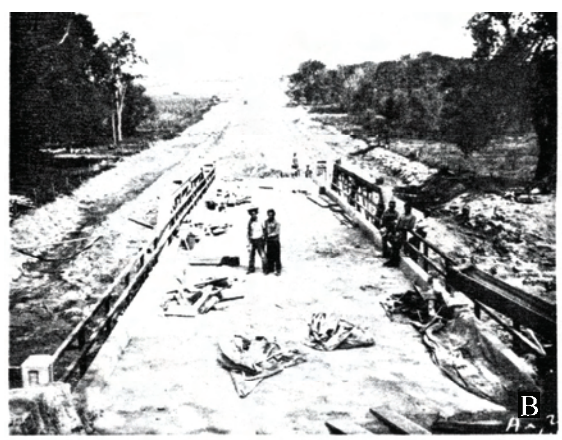
The first example in the county was plowing up the square in Washington for paving in 1903. This first step was heavy work that took a double team of horses. The plowing "turned up all kinds of artifacts—stone, bricks, bottles, iron, etc. were encountered—and stirred up a terrible smell" (Fisher 1978:196). The area was excavated then filled with 6" of "machine broken" limestone and 2" of sand were put down, followed by the heavy paving bricks. Cement curbs 18" high completed the work.

All other roads in the county were still dependent on the weather. In March 1913, the Journal reported "The roads in Washington and vicinity are…recovering from the…recent snows and freeze and more automobiles are to be seen than at any time since early last January." In May 1913 the county supervisors designated 159.5 miles of county roads, which would be taken care of by the county. One of these roads was from Washington to Haskins by way of Ainsworth. Another road was from Washington to Crawfordsville and south to the county line. Both of these projects became part of Iowa 40, U.S. 161, and old U.S. 218 within the survey route (Fisher 1978:196).

Around this time The White Way was marked through the county. On one side of the road every pole was marked for 20 miles. In most of the county only the second or fourth pole was painted. This was the county's first experience with a major roadway. All the bridges were marked white and it was regarded as the best marked road in the county. The construction was all done by hand with mules and elevating scrapers. This was also at a time when many Washington County people thought that hard surfaced roads would be worth the money spent on them. This feeling increased in 1915, thanks to the increasing number of automobiles, and in March 1916 the "Good Roads Special"—a special train sponsored by the federal government—came to Washington for an afternoon. The county supervisors and engineer were present and as a natural result there were some lively talks about roads and bridges. Talk was mostly the only thing that was accomplished (Fisher 1978:196).

All the road improvement done in the county was a product of the increase in automobiles. As traffic increased unofficial traffic signs began to go up in 1915. Auto touring had become a popular pastime. And automobiles on Sunday passed "…at an average of about one a minute and autos from twenty-one states were counted during the summer of 1915." A tourist tent camp was established west of Washington in 1921. The first cabins were built nearby. In 1925 the Camp Fire Girls built a brick Dutch-oven there for tourists to use and that same year the first stop signs were put up in Washington on a trial basis. The increasing number of cars led to new businesses in the county. Gasoline stations sprang up everywhere, tire stores opened, and blacksmiths found that they could make as much repairing cars as they had shoeing horses (Fisher 1978:202).

Finishing grade on 218 south of English River, 1930



Davis Creek bridge on 218; stream runs along side of hill, rather than at foot

Figure 103. A. Finishing grade on old U.S. 218, which was actually at the time U.S. 161, south of English River in 1930. B. The Davis Creek pony truss bridge under construction on old U.S. 218 (U.S. 161) (both images from Fisher 1978:197).

Even by 1920 most work was under supervisor control but the actual work was done by local farmers. In April they got together "…bringing teams, wagons, shovels, spades, axes and plow, tools necessary to repair some impassable places where wagons had mired in mud hub deep" (Fisher 1978:196). They had even offered the previous fall to provide free teams and men to run the road grader and to ditch and grade up the highways in their area so the road would be in good traveling condition in the spring. However, for some cause they were refused use of the road grader. As a result, they were shut down more than two weeks as the highway was impassable.

That same month the county supervisors announced that county roads were to be brought to permanent grade and drained that summer and the following summer. This included U.S. 161/U.S. 218. In Washington County 22 miles of road were improved that summer of 1920, with funds coming from the federal government and auto taxes (Figure 103) (Fisher 1978:196).

The road between Washington and Kalona seems to have been the first one made into an all weather road, as in the spring of 1923 it was graded and given a top coating of coarse sand and gravel. The county began using "big yellow caterpillar" graders about the same time. Long steep hills were special and expensive problems. Much of the work consisted of installing the baffle walls and aprons, smoothing the sides of the ditches, and fixing washed out areas and where dangerous gullies had formed.

In 1927 county voters approved a project for paving Primary Road 2, which was formerly The White Way across the county and an early Registered Highway, plus a mile of paving in each of four county towns, plus grading, draining, bridging, and graveling all other Primary Roads in the county (Figure 103). Marked by white poles and lights so airmail pilots could follow it at night from Chicago to Iowa City The White Way ran east–west. Projects included the Red Ball Route and U.S. 161, soon to become U.S. 218. The next road paved in the county was highway U.S. 218 in the summer of 1930. That year there were 250 men in two road gangs, with headquarters at Crawfordsville and Riverside. For the first time, all the work was done by machinery and there were little or no mules or horses.

Much of the construction of Iowa 40, U.S. 161, and old and new U.S. 218 avoided the dirt path of the Old Military Road. That avoided section of the old Red Ball is now current Underwood and Tulip avenues. The new road was built from 1 to 1½ miles to the east. Parts of the Old Military Road are now under cultivation.

SECTION A (OLD U.S. 218 FROM J20 NORTH TO MOUNT PLEASANT

This section of old U.S. 218 (a.k.a. U.S. 161/Red Ball Road) from J20 (Salem Road) north to Mount Pleasant was one of the last sections of the roadway to be constructed due to the difficulty in crossing the valley of the Skunk River. Prior to 1900 and up until the 1920s all through roads ran on the west side of the Skunk River. The wagon bridge crossing for the road was located southwest of Mount Pleasant at the Oakland Mills Bridge. This important bridge is recorded in the Historic American Engineering Record (HAER). During survey the Henry County section of U.S 218 from County Road J20 northwards to Mount Pleasant was being replaced. The two lane highway was being rebuilt as a four-lane highway and new construction included the newly completed Mount Pleasant Bypass. It contained one cut-off segment.

Segment 1 (Skunk River Bottoms). The current road (not the 1928 segment) road's pavement, cross-section, and structures date from the 1950s to 1970s reconstruction of the road. This section has been superseded by the completed four-lane route. During that reconstruction almost all of a parallel, one mile long, 1928, integral lip-curbed highway was obliterated except for a single remaining cut-off segment (Figure 104). This cut-off segment consisted of two parts and was extant on the north and south sides of the Skunk River at the time of the inception of the survey in 2003. The original Skunk River bridge had been removed many years ago. Most of the surviving 1928 pavement was on the south valley slope and was used as an access road to a few houses, river camps, and farmsteads on the river's south side. This cut-off segment ran for approximately ¾ miles paralleling the current road's path through the valley of the Skunk. An approximately ⅛ mile long cut-off segment was left as an access road on the northern side. These cut-off segments were no longer connected due to the removal of the bridge. The highway itself was 18 ft wide. Prior to removal the road bed's paving was of concrete whose aggregate was of crushed state quarry stone with round (post-1925) rebar. The section had integral lip-curbs, gutters and drains, culverts, grade, and an intact cross-section.

During the course of the survey both the construction of the new bridge over the Skunk River and extensive grading and paving of the steep approaches to the Skunk River's drainage were underway. In the construction the southernmost extant, 1928, cut-off segment was broken up, the rebar removed, and the concrete used for fill and rip-rap around the footings for the new bridge. It was clear that the new construction had recycled the old cut-off segment as a materials source. The road was viewed as a resource to be utilized in constructing the current alignment and not to be retained as a historic resource.

Figure 104. A. View of original cut-off 1928 segment at the Skunk River south of Mount Pleasant, Henry County. B. View of same old segment being broken for rip-rap. C. Detail of 1928 aggregate showing use of dolomite and finely sorted natural and crushed river gravels. 2003 survey photos with 6" ruler.

This cut-off road segment has now been obliterated. At the time of survey it was more interesting for the process of its destruction than its survival. Even prior to its destruction it was not evaluated within the survey context as significant.

National Register Evaluation of Significance

1. Length of less than one mile was too short for interpretive purpose.
2. Extant ca. 1928 lip-curbed concrete paving. Remnant remained on northern side as access.
3. Original curbs, cross-section, culverts and drains, and other features were of materials and a construction type that is still fairly common and relatively late.
4. No Criteria A or B significance for comparative or interpretive value.
5. Route was not related to any other parallel or nearby cut-off segments or road beds related to its evolutionary history or that in themselves had interpretive value to which the cut-off segment could have been a contributing element.
6. Recently functioned only as a short access road since it was cut-off and had been divided into two sub-segments that were discontinuous due to the removal of the original bridge.
7. Not a through route. Would be difficult to return to a through route even before obliteration.

Conclusions. This cut-off segment's removal was observed and photo-documented and its non-survival was a foregone conclusion. However, its removal does illustrate several points of comparison with all such cut-off segments. Its obliteration for the construction of the new pavement made clear a number of important aspects concerning the survival, evaluation, interpretation, comparison, and preservation of cut-off road segments on a statewide level (see Summary).

SECTION B (MOUNT PLEASANT VICINITY TO HENRY/WASHINGTON COUNTY LINE)

With the construction of the current U.S. 218 four-lane alignment most of the old roadway from Mount Pleasant to Swedesburg following the early route was obliterated, and the villages of Olds and Swedesburg bypassed. Archaeological and historic architectural surveys of the alignment were made prior to its construction and the cultural resources evaluated (Hirst 1990; Ingalls 1990). The bypassing of the two villages, which are only two miles apart, left a cut-off segment (possibly more than 50 years old) through these communities (Figure 127).

Route Description. This cut-off section of U.S. 218, known as Iowa 424 in 1991 (a.k.a. W60), was rebuilt on the old road bed in the 1950s. At that time the cross-section was reworked. It is 4¼ miles in length running from the southern edge of Swedesburg to 2½ miles north of Olds and is presently Iowa 78 (a.k.a. James Avenue). This segment ends at the Henry/Washington County line. This alignment appears to have followed the exact same path as every preceding road since the Old Military Road (1839) and its construction appears to have obliterated all of the previous alignment's structures and associated features within the right-of-way. It illustrates two elements of cut-off segments. The first is that such segments can go from a primary road to a secondary road is less than five years and have five names over that time.

This cut-off segment, while still functioning as an access road to Swedesburg and Olds, meets the same criteria for evaluation as any other cut-off segment. It's simply that this segment was cut-off more recently and is a little longer than most. Reconstructed in the 1950s, and later in parts, and following the path of the preceding highways it is nearing or at the National Register's 50 year cut-off date for potential significance. It also helps illustrate that cut-off segments are still being produced, necessitating reevaluation in the future for their changed uses, roles, and contexts (Figures 127–128).

National Register Evaluation. This segment contains or exhibits:

1. An extant route approximately 4¼ miles in length made up of a single cut-off segment retaining a partly original bed with ca. 1950–1970 paving and possibly over-paving.
2. Pavement segments that may predate present 1957 50 year National Register cut-off date.
3. A cross-section that is original to the 1950s reconstruction along with the culverts and drains. It has culverts and drains integral to construction period present but of common mass produced type.
4. Current route follows path/bed/routeway of earlier roads but appears to have obliterated same.
5. No aggregate from local quarries containing river gravels or exhibiting evidence of hand construction.
7. Context of an arterial during the later part of the Federal Highway Era (1940s–1950s) with high integrity but low to moderate interpretive value.
8. Cross-section and structures appear to date after the study period. May incorporate earlier roads.
9. Importance reduced from Primary Roads to secondary road status.
10. A drivable segment that connects overall route following the Old Military Road's path.

Conclusion and Recommendation. Not an individually eligible cut-off segment under Criteria A, B, or C. Exhibits potential overall consideration as being eligible as a contributing element to a historic roadway corridor due to its long history as a transportation route beginning in 1839.

SECTION C (WASHINGTON COUNTY LINE TO CRAWFORDSVILLE)

Segment 1 (Washington County Line to 282nd Street). From the center of Section 27, Crawford Township, south of Crawfordsville and extending northwards for 4¼ miles is a cut-off segment of old

U.S. 218. This is essentially the same 1930s–1970s road way, with the same characteristics noted above as W64/Vine Avenue (Figure 105). The town of Crawfordsville has been completely bypassed by current U.S. 218 to its east. Historically Crawfordsville sat astride the old routes dating from the Old Military Road (1839) until the 1990s when this segment was cut off (Figures 129–130).

The 1990s construction of the Crawfordsville Bypass resulted in the previous alignment's abandonment as a federal highway and this segment is now known as W68. The alignment of former U.S. 218 is still in use. It functions as the road to downtown Crawfordsville. It passes through Crawfordsville exactly along the path of the Old Military Road. This path is marked by a stone in front of the high school. From the marker, near the middle of Crawfordsville, it travels due north until rejoining current U.S. 218 at 282nd Street. Most of the paving appears to be from the 1950s in this area.

Its current engineering elements, such as cross-section, structures, and pavement are intact and date, like those in Sections A and B above, to the 1930s–1970s. It is consistent with or similar to Section D in its construction materials, cross-section, and structures. These appear to also be consistent with those same elements surveyed in the longer, surviving section of old State Highway 161 (old U.S. 218) that runs from Ainsworth to Iowa City (see below). They differ markedly from the earlier cut-off 1920s segments discussed in Section E and F (E: Iowa City to North Liberty; F: North Liberty to Shueyville).

Figure 105. A. Historic marker boulder along old U.S. 218 in Crawfordville, Washington County, which states that the 1839 Military Road ran past this point. B. View from the marker through Crawfordsville of the 1930s–1970s cut-off segment of old U.S. 218 atop the Old Military Road. 2005 photos.

Segment 2. There is a short segment of abandoned roadway dating from the time of the Old Military Road until the 1920s still extant in the NE¼ of the NW¼ of Section 34, Crawford Township, just southwest of the new bridge where the route traverses a branch of Crooked Creek (Figures 129–130). This segment is approximately ¼ mile in length. Due to its long use as a horse trail, wagon and stagecoach road, and during the early automobile era as a dirt-surfaced highway it has become deeply incised into the hill slope to a depth of 6 ft to 10 ft. It has never been modified, retains its dirt surface, and large trees now grow within its bed. It appears to have been used as a field access road until the 1930s–1960s, when it was totally abandoned. It also may relate to the failed 1850s Iowa Airline Railroad route.

Section C contains or exhibits:

1. An extant cut-off segment approximately 4¼ miles long constructed using a slip-form paver.
2. It has concrete paving, culverts and drains, and cross-section dating from 1950s–1970s.
3. Has drop culverts and drains integral to its construction that are of late mass produced manufacture.
4. Has aggregate from non-local state quarry. No aggregate materials from local quarries or containing river gravels.
5. A context of an arterial during the later part of the Federal Highway Era (1930s–1950s) but with

low interpretive value.

6. A cut-off dirt-surfaced segment ¼ mile long in original condition dating from pre-1900 to 1920s.
7. In sections it is built directly atop the Old Military Road noted by marker (Figure 105A).
8. No evidence of hand construction or labor.

National Register Evaluation. The Section C contains two cut-off segments. Segment 1 is not evaluated as eligible. Segment 2 may be the last surviving element of the pre-1900 roadway related to the Military Road, and the early automobile highway. The segment was probably cut off during the 1910s to 1920s when the curve was straightened. It is deeply incised and not brought to grade.

Segment 1. This modern cut-off segment lies atop several early roads. It is not eligible to the National Register under Criteria A, B, or C as it is not yet 50 years old and its significance at this time is evaluated as insufficient for listing.

Segment 2. This pre-1900 to ca. 1920s cut-off segment in Section 34 of Crawford Township is evaluated as potentially eligible as it:

1. Retains integrity of length of greater than ¼ mile with curving viewshed.
2. Exhibits a deeply incised original dirt road bed.
3. Is the only known extant segment remaining in area possibly dating from prior to 1900 to ca. 1920 and related to the Old Military Road, early ISHC, and the Registered Highway eras.
4. Context related to 19th century stage and wagon transportation as well as the early automobile era.
5. Has good interpretive value as it is the last such segment known from that era.

SECTION D (COUNTY HIGHWAY 652 TO AINSWORTH)

Overview. At the midpoint between Crawfordsville and Ainsworth current U.S. 218 cuts across the path of the east–west running The White Way (County Highway 652). Early in the Registered Highway Era it ran from the Mississippi River bridge at Muscatine, to the Fredonia to Columbus Junction Road (a.k.a. the Blue Grass Road and Convict Road), and westward to Washington (see Historic Overview above). Originally known as The White Way it was an important regional and transcontinental route. Although the road has been resurfaced some original elements, such as the route and a few structures, remain (Figures 129–130).

Route Description. At 282nd Street the old U.S. 218 (Red Ball, Iowa 40, U.S. 161) alignment rejoins current U.S. 218. From this point until two miles further north the earlier roadways have been obliterated. Total combined length is 3¼ miles.

Segment 1. Within the SE¼ of the NW¼ of Section 27, Oregon Township (T75N-R6W) a cut-off segment of the old highway (W64/Vine St.) diverges into the eastern side of Ainsworth. This section runs approximately 2¼ miles and intersects with east–west running Iowa 92 after one mile.

Segment 2. On the northern side of Iowa 92 it has been cut through leaving an approximately one mile long segment of Iowa 40, old U.S. 161, and old U.S 218 that continues north and intersects with current U.S. 218 at 240th Street. It is of concrete and has been asphalt surfaced. No original curbing remains and the cross section appears to be altered.

Segment 3. A very short cut-off segment (Iowa 92/W64) is located in Ainsworth. The southern part of this cut-off segment of old U.S. 218 is cut by the current U.S. 218 ramp. The cut-off segment on the north side of Iowa 92 is accessed by a newly rebuilt local road. It runs on 250th St. to Underwood Avenue.

Evaluation. This segment contains or exhibits:

1. An extant cut-off segment approximately 2¼ miles in length that contains three sub-segments. Two cut-off segments are sections of old U.S. 161/old U.S. 218, which is bisected by current Iowa 92. One short east–west segment (W64/Iowa 92) may relate to the path of old Iowa 92.
2. Concrete paving made with slip-form paver along with structures and cross-section probably dating from the 1950s–1970s.
3. Drop culverts and drains integral to construction are of a recent mass produced type.

4. Aggregate of crushed white dolomite from a non-local state quarry. No aggregates noted from local quarries or river gravels.
5. A context of an arterial highway during the later part of the Federal Highway Era during the study period (1940s–1970s).
6. Short lengths with limited interpretive value for the pre-1940 period.
7. No evidence of hand construction, local materials, or labor.
8. Road bed segments are on or near path of 1839 Old Military Road that has been nearly obliterated.
9. Segments do not comprise a connected or drivable length that connects eligible sections.
10. No significant views, structures, or connection with important individuals except marker boulder.

National Register Significance. The integrity of this roadway section has been significantly compromised. The current pavement of old U.S. 218 (a.k.a. Military Road, Red Ball, Iowa 40, U.S. 161) has been resurfaced and cut in half at Ainsworth. No eligible cut-off segments are present. These three cut-off segments are evaluated as not eligible to the National Register under Criteria A, B, or C, or Criteria Considerations A through G, nor do they contribute to a historic route or corridor evaluation.

SECTION E (IOWA 923 FROM AINSWORTH VICINITY TO IOWA CITY/JEFFERSON HOTEL)

Overview. This study section was especially important for its three parallel and often overlapping alignments dating from pre-1900 to post-1948. Long cut-off segments were identified and intensively surveyed (Figures 129–132). This was conducted in the same manner as the intensively surveyed sections within Study Route 1 (U.S. 34 above).

Throughout much of its history through this section the road's paths followed earlier roadways. The most important precursor road was the Old Military Road. Surveyed in 1839 this section of road, south of Iowa City to the Missouri line, was one of the first arterial north–south roads in Iowa and connected Eastern Iowa with Missouri (notably St. Louis) and Dubuque to the north. The cut-off segment of old U.S. 218 through Crawfordsville, Olds, and Swedesburg follows the Old Military Road's path almost exactly. North out of Ainsworth the current route of Underwood Avenue closely follows segments of the old road's path, which after 1900 began evolving into the route of the Red Ball through the mid-1920s. After that time the route was moved and its path formalized by paving.

Section E has a total length of 40½ miles and contains four cut-off sub-segments. They are:

Segment 1. 24 mile cut-off segment of old Iowa 40, U.S. 161, and old U.S. 218 (1923–post-1948) (currently Iowa 921/923).

Segment 2. 10 mile cut-off segment–Underwood Avenue segment of the Red Ball (pre-1900–1920s).

Segment 3. 3½ mile cut-off segment–Tupelo Boulevard/Rice Lane part of the Red Ball (1900–1918).

Segment 4. Three mile cut-off segment–Riverside Drive and Iowa City urban cut-off segments of the Red Ball and old U.S. 218 (1915–1948).

Segment 1 (Old U.S. 218). On the western side of current U.S. 218, one mile north of Ainsworth, the cut-off segment of old U.S. 218 (Red Ball Route) has itself been cut by current U.S. 218. The old route has been modified and linked into 240th Street, which is an east–west running gravel road. Presently, 1/8 mile to its north is the next junction between old U.S. 218 (Iowa 923) and current U.S. 218. From this point old U.S. 218 parallels the eastern side of current U.S. 218 approximately ½ mile to its east. This cut-off segment of old U.S. 218 is over 20 miles in length and although the pavement has been resurfaced and widened with asphalt for most of its length, the original 1920s–1930s road bed and paving may still be sealed underneath. In addition, the road's original cross-section and many drainage structures, are still extant (Figures 129–132; Table 9). The bridges were removed in 2005 (see below).

This cut-off segment is the longest section of the 1920s–1930s road left on this route in the study area. It has in-place route segments and elements that were probably updated from the 1950s–1980s, as the road was still in operation as U.S. 218 until that time. The road's pavement width was originally 20 ft but has been widened to 22 ft and resurfaced in most areas. The small culverts in this segment almost all appear to have been mass produced (precast) and are nearly identical. They are from a presently unknown manufacturer who may not have been local but who appears to have supplied these structures for this entire roadway segment. They post-date the period of county crew construction. The now nonextant steel bridges would have been manufactured and erected by a firm other than the road's contractors. The large culverts appear to have been poured in place.

Throughout its length the top-most concrete paving was laid with a slip-form paver and the aggregate is of crushed dolomite from a state quarry. This suggests that the top-most pavement dates after 1955 (Iowa DOT Tech Notes 2002). It appears that in 1955 the Iowa DOT began this construction method.

Old U.S. 218 has run along this course since the late 1920s (Figure 129). The Skunk River is the major drainage but numerous large and small creeks are present requiring bridging. The English River (south of Iowa 22) and Old Man's Creek (south of Hills) retained their ca. 1930, steel, Warren Truss type bridges (Fraser 1993:1–59) at the time of survey in 2003 (Figure 108, see also Figures 103, 120–121; Tables 7–9) but they were removed in 2005. The larger creeks such as Davis, Goose, and Whiskey Run creeks had steel pony truss bridges over them (ISHC 1915a:3–5). One of the pony truss bridges was marked as having been manufactured by the Illinois Bridge Company. Through this segment several large culverts also functioned as livestock crossings under the road (Table 7). More livestock crossing culverts were encountered in this study segment than any other. While extant at the time of survey the steel pony truss bridges, the large two-span steel Warren Truss bridge over the English River, single-span steel Warren Truss over Old Mans Creek, and several large early concrete culverts were replaced in 2005. Others on the route in Johnson County are being systematically replaced. One early culvert just north of Hills was replaced in 2003.

Segment 2 (Underwood Avenue). Paralleling current U.S. 218's western side from Ainsworth to the Johnson County line is the path of the Old Military Road and later the Red Ball Route (Figures 106, 129–130). This segment served as an important comparison for the road's evolution from Territorial Era military horse trail to an early automobile highway. This segment is especially interesting in that when concrete construction was planned this route was abandoned and a totally new road built nearly a mile to its east. It is just this type of route and roadway evolution in scale, materials, engineering, and route that has resulted in the many and varied cut-off segments identified and evaluated for this study.

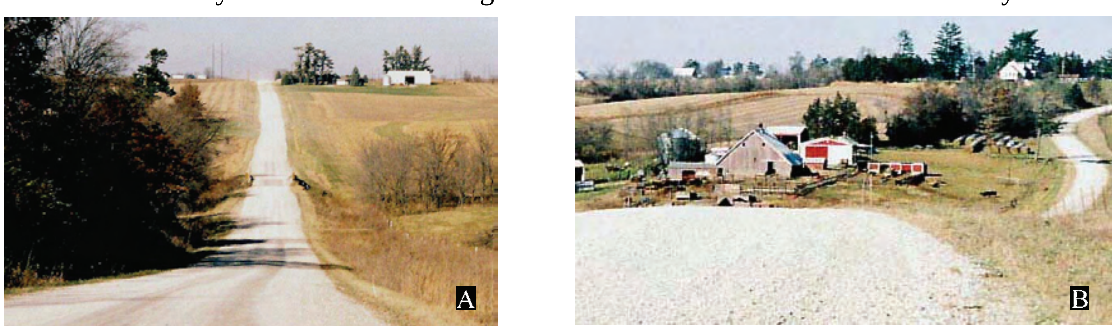


Figure 106. A. The route of the Old Military Road and Red Ball Route one mile north of Ainsworth on Underwood Avenue, Washington County. B. Two miles north. Note sinuosity of route. 2006 photos.

The selection for the route of the Red Ball Route logically followed this existing early route, which had been a well-traveled wagon road. It had been upgraded and improved from the early Mechanized Transportation Era, through the formation of the ISHC, and into the early Registered Highway Era. It was in the late 1920s when the new route went to its east, and it was abandoned as a highway. Until the 1920s the route had been improved with grading, ditches, concrete culverts, handrail culvert bridges. Near the end a gravel surface was added. It constitutes one of the few segments on this early cut-off arterial segment in which the older road's alignments have not been completely obliterated or altered.

Additionally, cut-off segments of the original Old Military Road and Red Ball Route parallels the western side of the current alignment of U.S. 218. From the late 1830s until 1930 the road's path differed both from the path of old U.S. 218 and current U.S. 218, in that it continued directly north from the western edge of Ainsworth along a gravel road (Underwood Avenue). This road segment was surveyed as it contained all of the pre-1925 structures and bridges related to the road's use as both the Red Ball Route, Iowa 40, and U.S. 161 during the Early Mechanized Transportation, Registered Highway, and early State and Federal Highway eras when it was brought to grade and the structures put in place.

Segment 3 (*Tupelo Boulevard and Rice Lane)*. Both the Old Military Road and the Red Ball Route followed current Underwood Avenue for seven miles, and then Tulip Avenue for four miles, until just south of Riverside (Figure 132). There the Old Military Road's and the Red Ball Route diverged for a couple miles. The Red Ball followed the path of current W61 (Riverside Road), crossing the English River at Riverside and continuing northwards on the diagonal running along Tupelo Boulevard, leaving the north side of town and dead ending at current U.S. 218. Rice Lane continues the road's path on the other side of current U.S. 218 to intersect with old U.S. 218.

It does not appear that Underwood Avenue at that point north of Riverside was the Old Military Road or the Red Ball Route. South of Riverside the Old Military Road ran closer to current U.S. 218 and through or along the now nonextant village of Yatton. This village was southeast of Riverside and the Old Military Road ran just to the east of the abandoned cemetery in the woods northeast of the end of Old Captain's Road. Underwood Avenue north of Riverside appears to have been completely reconstructed.

Tupelo Boulevard. In the northeastern corner of Washington County the Old Military Road followed a different path than the Red Ball going cross county to rejoin Underwood Avenue. The Red Ball Route swung northeasterly and followed Tupelo Boulevard. Tupelo Boulevard is a graded and graveled county road that currently dead ends on the western side of current U.S. 218, which has cut through its path north of Riverside (Figures 107, 130). This resulted in the abandonment of an original and undisturbed ½ mile long diagonal section of the Red Ball Route. The southwestern part of the road's bed has been returned to cultivation with the conversion of its northeastern half, once a "through-farm" road segment, to a farm lane and field access road call Rice Lane (Figure 107) after the farm family who has resided there for over three generations (Mrs. Larry Rice, personal communication 2003).

Rice Lane. This segment of abandoned road and farm lane appears to be the only section of original road surviving from the 1900 to 1915 time period. It retains its original cross-section, lack of paving, routeway, and possibly other features. The Red Ball Route's bed that now runs through a cultivated field at the western end of Rice Lane is best seen with infrared photography (Figure 107). Infrared and standard aerial photography can be invaluable tools for tracking old road beds across the landscape where cultivation, simple abandonment, or their conversion to field access roads or farm lanes has obscured their original purpose. Rice Lane joins the 1920s–1930s route of old U.S. 218 to the east.

Rice Lane diagonally crosses the border between Washington and Johnson counties. The cut-off segment in Johnson County is better preserved because it has been continuously used as a farm lane. The family related that their grandfather had told them of all the white markings with red balls along the road on the telephone poles, which are now gone. This cut-off segment contains the last original vestige of the pre-1915 Red Ball and previous routes. It has very high integrity and interpretive value but is compromised by its short length, which is ½ mile.

Conclusions. This segment of old U.S. 218 (Red Ball Route), especially along Underwood Avenue and Rice Lane, may be used as a comparative segment for other local and regional highway segments dating to the 1900 to 1915 period. U.S. 218 differed from the old U.S. 34 alignment in its lack of early or numerous cut-off segments. This appears to be due primarily to its linear north–south route with few curves to be cut off. These differences were a function of the topography of the Southern Iowa Drift Plain through which both routes run, although in opposite directions. Straight sections of old roads tend not to have as many cut-off segments.

Due to the topography U.S. 218 differed from U.S. 34 in several ways. There are the number of stock underpass culverts, in the use of iron and steel bridges rather than concrete, the absence of overpasses and underpasses, its elevated road bed section in the English River flood plain, and in other design and construction methods and features designed to the landscape.

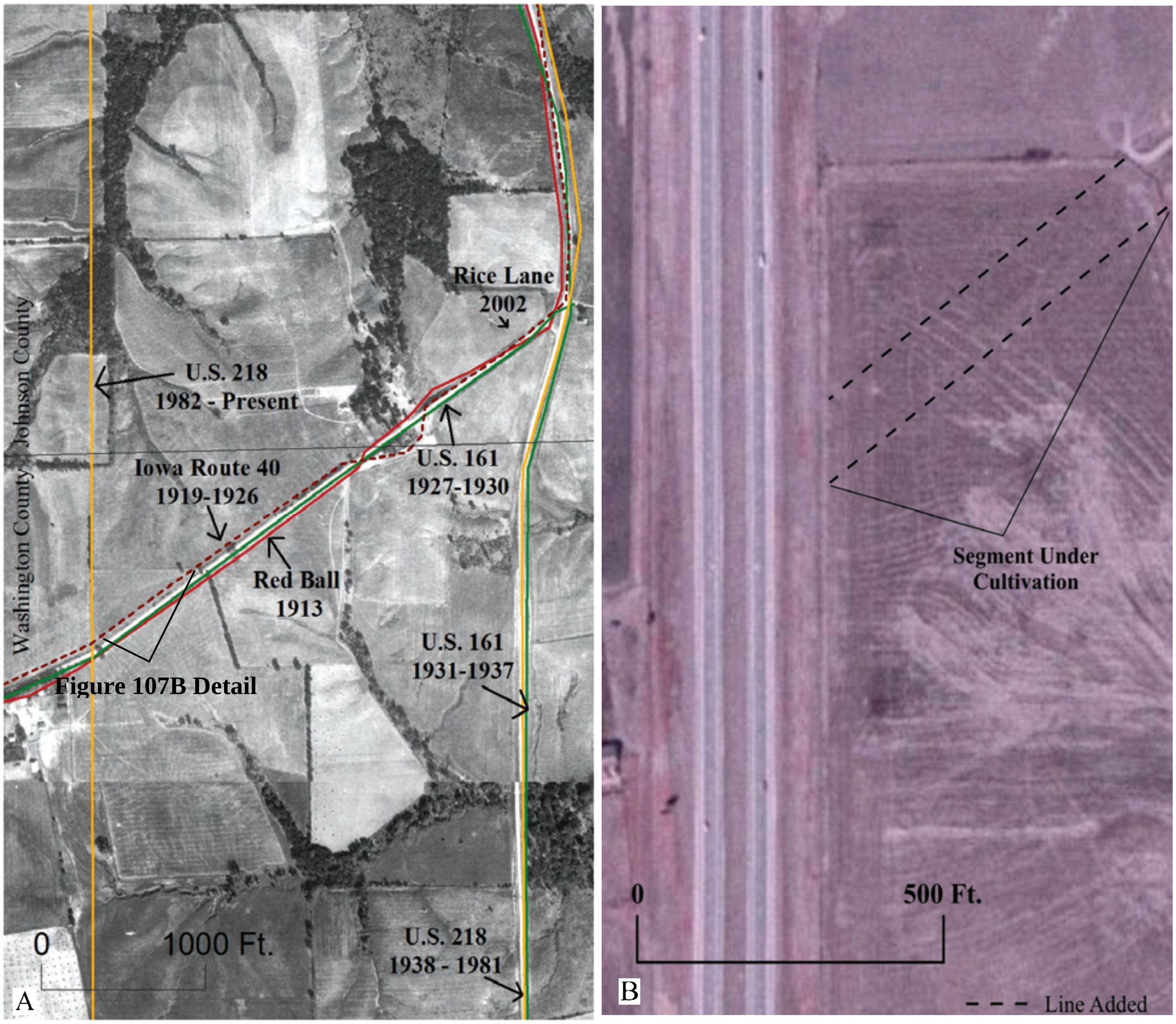


Figure 107. Two views of the same landscape over time. A. 1936 aerial photograph of Red Ball and old U.S. 218 (Iowa DNR, Johnson County, Georectified 2006). B. Detail of 2002 infrared aerial photo of nonextant diagonal segment lost under cultivation, showing photographic trace of the route (Iowa State University, Iowa Geographic Map Server, Cairo, GIS 2006).

Segment 4 (Johnson County Line to Indian Lookout). During the period prior to 1915 the proto-route of the Red Ball had wandered and zigzagged between Washington and Riverside in Iowa Township (T77N-R6W), Washington County (Figures 131–132). On reaching Riverside, and having crossed the English River there, the route turned eastward along the north side of the Rock Island and Pacific (R.I.&.P.) (1910) railroad tracks to the now nonextant town of Iowa Junction in Section 10 (T77N-R6W). There, after crossing and recrossing the tracks at grade several times in less than a mile, it turned northwards paralleling the R.I.&P. railroad tracks across the Johnson County line into Liberty Township (T78N-R6W). This part was cut through and eliminated decades ago.

After the diagonal segment of Rice Lane (see above) the path turned due north and has stayed within the same route on old U.S. 218 (Iowa 923/921) until the present. From the Washington/Johnson county line this segment runs for three miles northwards to Hills (Figures 108–110, 131). The base of the road in this segment dates from the late 1920s to the 1930s, while the current paving appears to date from after the 1950s as it uses crushed state quarry dolomite in the aggregate and may have been widened. These are the same construction materials and structures as noted in Section E–Segment 4. In three miles its path ran south to north from the Johnson County line (Rice Lane) to Hills, then crossed, in order, Davis Creek, an unnamed creek, and the English River, over which there were respectively a steel pony truss bridge, a steel Warren Truss bridge, and a concrete Art Deco-styled handrail bridge (Figure 108). Only the Art Deco-styled culvert is still extant. Near that bridge, at the northwest corner of the intersection of 565th Street and W64 (Iowa 936) is a very early looking concrete culvert abandoned in a farm yard. This culvert may relate to the 1906 to 1913 path of the road, which may have run through the farmstead at that time, and been built by a county crew. It may have functioned as a livestock culvert similar to the one located north of North Liberty, and possibly not a drainage culvert, but this is unknown at this time.

Figure 108. A. The Davis Creek pony truss bridge (nonextant 2005) on old U.S. 218 south of Iowa City. B. Art Moderne style bridge over secondary drainage into Old Man's Creek (2003 survey photo). C. Old Man's Creek bridge (nonextant 2005). D. English River bridge (nonextant 2005). 2003 survey photos.

The section of old U.S. 218 between Sections 21 and 28, Liberty Township (T78N-R6W), and the town of Hills is elevated well above the nearby English and Iowa Rivers. It possibly has elements of earlier railroad-derived construction method (Gubbels 1938:22) where the materials were borrowed or scooped from either side to elevate the road bed above a low spot or flood plain rather than bringing fill in from borrow pits. This resulted in a cross-section profile that differs somewhat from the usual ditching and filling methods used in other parts of the road. This section stands in contrast to both the southern sections of the road that were built later which appear to follow a more standard cut-and-fill approach.

By the time this section of road was constructed a large degree of standardization had occurred in the concrete industry. This standardization of both materials and precast structures differs from the greater variation shown in the materials, scale, and design used on the earlier U.S. 34 alignments. Between North Liberty and Shueyville a cut-off segment survives that utilized predominately local materials and local manufacturers and builders resulting in greater variability in the roadway construction materials and structures through that section. The culverts impressed with landowner names impart a sense of individuality and community not seen in other portions of the study routes.

Sub-Segments A and B (Harry's Road and Walnut Road). Two cut-off segments, which are possibly related to the early Red Ball Route, are present at the Johnson/Washington county line (Figures 130–131). The first is called Harry's Road (A), in Johnson County (Liberty and Fremont Townships) and the second Walnut Road (B), which is in Washington County. Harry's Road appears to be the mid-19th century wagon road and runs for approximately two miles along the base of the Iowa River's western bluff towards Indian Lookout. Although it was never noted as part of the Red Ball or other Registered Routes on available maps it may have functioned as part of the ca. 1900–1917 precursor system. It parallels an abandoned railroad spur with similar concrete culverts remaining. It was an important early to mid 19th century settlement road along the western side of the Iowa River valley in southern Johnson County.

Sub-Segment C (Indian Lookout to Iowa City and the Jefferson Hotel). For the three miles northwards beyond Hills the road stays in the low area bordering the floodplain along the Iowa River valley until ascending to the bluff crest at a high point overlooking the Iowa River locally known as Indian Lookout, approximately 1¼ miles south of Iowa City (Figure 132). The remnants of several pre-1900 roads or trails are visible along the bluff's crest on the eastern side of current W64 but could not be definitively related to the 1900–1948 routeway at that time.

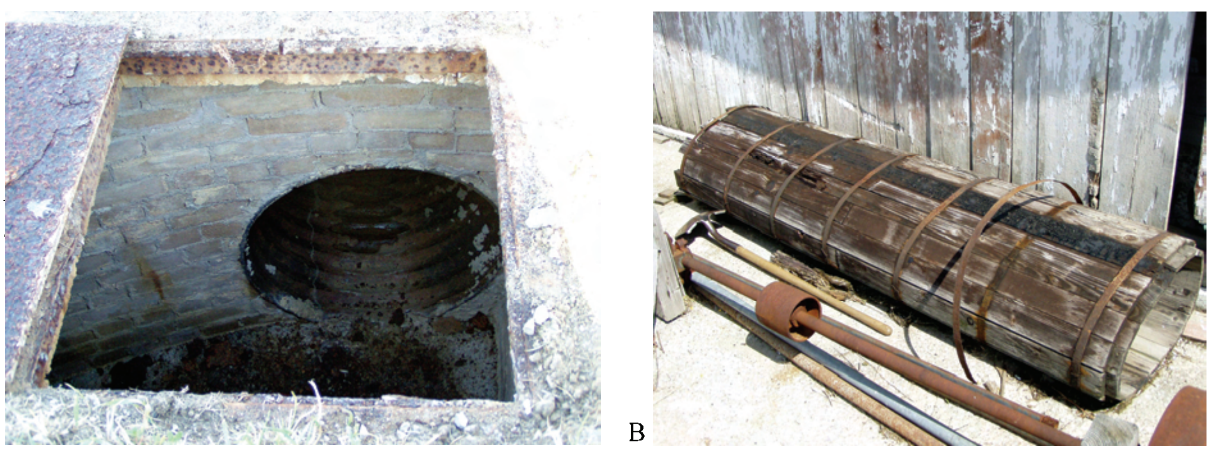
A B


Figure 109. A. Circa 1930 brick box culvert and corrugated metal pipe drain atop Indian Lookout segment of old U.S. 218. B. Redwood stave culvert (1890–1920) stored outdoors at the Johnson County Poor Farm by the Secondary Roads Department. Note ends for joining into lengths. 2003 survey photos.

During survey, at the crest of the hill (Indian Lookout) a brick, box-like, drop inlet drain and tile culvert were uncovered (Figure 109A) along the road's eastern side by a Johnson County road crew. This drainage structure related to the 1900–1948 study period. This brick-built, drop-culvert drain had 6" ceramic tile running out of two sides. This structure would not have been visible to the surveyors and this drainage structure type would have been missed if construction was not ongoing. It was covered with a small cast iron grill. As culvert types often run only as far as the original road construction project, which often stopped at county lines, it is unknown if this type is common or uncommon in Johnson County along the Red Ball's route, or other routes from the same period. Culverts did vary within the county. The fact that it is not of all concrete construction is of note and it may represent a local or transitional type.

One member of the county road crew related that they had uncovered an unusual wooden culvert (redwood stave) not far way. It had been located on an abandoned segment of what had been the Iowa City-Williamsburg-Victor Road west of Iowa City (Rand McNally 1923). This was an east–west road that intersected the Red Ball in downtown Iowa City. It had been saved and stored behind the barn at the Johnson County Poor Farm (Figure 109B). On examination it was approximately 10 ft long, 20" in diameter and constructed of two overlapping layers of redwood staves held by thin iron straps. In many ways it was constructed similarly to the upright wooden stave silos being built in the area at the same time. It was in near perfect condition when excavated but has deteriorated over the intervening years. Wooden stave culverts appear to have been used from the 1890s to around 1920 but their exact period of use and place of their manufacture is unknown at present. Such culverts were not noted in any of the printed advertisements of the period, of which most dated after 1912. Both the brick drop-inlets and wooden stave culverts may have been quite common at one time along main roads in rural Johnson County, or Iowa generally, but appear to be very uncommon survivors at present.

Figure 110. Road marker pole on Dubuque Street in front of the Jefferson Hotel in Iowa City. It marked a significant intersection of local and regional routes in 1916 (ISHC 1916g:9, Photo #4119).

Most of the road's path from the crest of Indian Lookout to Iowa City followed the current alignment of W64 paralleling the railroad tracks. However, a cut-off segment remains within an industrial area on the eastern side of the current road, marked old U.S. 218 (a.k.a. old Riverside Drive). This cut-off segment is in use and is located between the Johnson County fairgrounds and the airport. During the period between 1920 and 1948 it was a common pattern throughout Iowa for an arterial road's route to go past the airport. Iowa City was on one of the earliest air mail routes in Iowa. Near the airport the path continued along the old route into Iowa City's southern edge where it is now under Riverside Drive. The old route crossed the Iowa River at the Benton Street Bridge. This cut-off segment, including a possible 1950s segment along the river, has limited integrity or interpretive value but the route is well known. Sub-Segment D (Iowa City/Dubuque St.). Although the Red Ball Route through Iowa City was not intensively surveyed it was reconnaissance surveyed along its old path and surviving structures noted. While during the 1920s to 1930s Iowa City was an important crossroads, little survives from that era due to subsequent improvements. However, it must be noted that potentially significant cut-off segments and through routes due occur within urban environments (Figures 110, 132).

Approaching Iowa City in 1912 the route through southern Johnson County, from the Johnson/Washington county line northwards to Iowa City, had not yet been built. Instead, the arterial route ran northwards from Kalona to Iowa City along current Highway 1 and was shared by the Keokuk Belt Line and the St. Paul, Burlington, and St. Louis Road. These two roads at times would share the path with various other routes and eventually shifted eastward and become the route of the Red Ball by 1916.

By 1920 the path of the Red Ball as it approached southern Iowa City became fixed along the path of old U.S. 218 (a.k.a. Iowa 923). It paralleled the railroad tracks running north along the western side of the river beneath what is now Riverside Drive and past the airport. It crossed the Iowa River eastward at the Benton Street Bridge then turned northwards on Capital Street, passing under the old railroad viaduct (ca. 1910–1930) until it reached Court Street, turning eastwards one block to Clinton Street It ran on Clinton Street northwards to Washington Street, turned west for one block to the Jefferson Hotel, and then headed northwards out of town on Dubuque Street from the northern side of the Jefferson Hotel.

Eleven Registered Highway routes went through Iowa City in 1923. All of these routes either shared part of or crossed the Red Ball's route. On the 1923 Rand McNally Auto Trails Map they are noted as The White Way, The Diamond Trail, Chicago-Kansas City-Gulf-Omaha, St. Louis Short Line, Detroit-Lincoln-Denver Highway, Diagonal Trail, Mississippi Valley Highway, River to River Road, Red Ball Route, and the local University Trail and Iowa City-Williamsburg-Victor Road (Rand McNally 1923).

At that time the route of the Red Ball coincided with State Route 40. From Coralville to Oxford the River to River Road and the Red Ball shared their routes. They later became U.S. 6 and current U.S. 964 (formerly U.S. 218) respectively. The 1923 Rand McNally map notes that there were 99 registered auto trails in Iowa. Iowa may have had up to 103 registered auto trails at their peak.

Evaluation. Segment 4–Sub-Segment D. This road segment contains or exhibits:

1. An extant cut-off segment approximately 24 miles in length.
2. The pavement has been resurfaced with asphalt for most of its length. The original 1920s–1930s road bed is paved over and survives as an in-place cut-off segment.
3. The road's cross-section is still original.
4. This segment contained three pony truss bridges and two large steel Warren Truss spans that bridge Old Man's Creek (single span) and the English River (double span), and several larger concrete culverts, which while extant in 2003 were replaced in 2005.
5. Numerous drop culverts and drains integral to original period of construction (1928–1932).
6. A 20 ft wide roadway made of an aggregate of crushed dolomite possibly from a local quarry (River Products). No aggregate contained river gravels.
7. A context of an arterial highway paved and repaved during the middle and later part of the Federal Highway Era (1930s–1970s).
8. Moderate interpretive value but a long route that is still drivable.
9. No evidence of hand construction, local materials, or labor.
10. Period of 1916–1927 for road bed and for "brought to grade" period, 1928 for first concrete paving.

11. Viewshed gives feeling of time and place.
12. High integrity of associated structures integral to construction period and design.
13. Materials and structures typical for period of construction.
14. Period of significance dates to pre-World War II transportation period.
15. Largest number of livestock crossing culverts.
16. Road follows natural contours.

Evaluation. Section E (Ainsworth to downtown Iowa City). Segment E consists of one main cut-off segment and four sub-segments. The sub-segments are: 1) the Ainsworth to Iowa City route on old U.S. 218. Its period of significance dates from 1917 to 1948, 2) Underwood Avenue, Tupelo Boulevard, and Rice Lane. This segment's significance dates from 1900 to 1916, 3) Rice Lane northward to south Riverside Drive past Indian Lookout, 4) through southern Iowa City on Riverside Drive past the airport and across the Iowa River northwards to the Jefferson Hotel.

Segment 1–Current Iowa 923/921 (old U.S. 218). This 24 mile section was built in the 1920s–1930s. Its contexts relate to the Red Ball Route during the Registered Highway Era and old U.S. 218 in the ISHC Era (post-1913), and the post-1918 Federal Highway Aid Era. The Red Ball Route through Johnson County to the Linn County line was paved in 1927 (Weber 1990:175). It contains the following elements:

Segment 2–Underwood Ave. (a.k.a. Red Ball Route: pre-1900–1920s, Military Road: 1839):

1. Roadway's path evolved from historic Old Military Road (1839).
2. Context of pre-1900 to 1905 roadway predating formation of ISHC (1904).
3. Road surface, culverts, bridges, and cross-section generally dating from ca. 1900 to 1926.
4. Segment dates to the early part of Registered Highway Era and State Primary Roads Era.
5. Segment may date to the very early part of Federal Transportation Era.
6. Example of a cut-off arterial segment reverted to local road use.
7. Extant period structures exhibiting use of local materials, early construction methods and design, built by local contractors or county crews.
8. Retains gravel surface and much of original cross section and ditching.
9. Short but early period of significance for use as arterial during study period (1900–1916).
10. Little or no subsequent significant alterations over much of route.
11. Possibly high interpretive value as route of Old Military Road, Good Roads Movement, early Mechanized Transportation Era, early Registered Highway Era, and early ISHC contexts.
12. Unidentified additional cut-off segments dating from first three above eras possibly to likely present.
13. Of sufficient length for feeling of time and place; integrity of route and materials high with intact cross-section, period structures, and road bed.
14. A cut-off segment of a 1900 to 1916 arterial highway over seven miles in length.
15. Routeway exhibits handmade construction using small scale early machinery (drags, graders, etc.) and containing structures possibly built by county crews.
16. Road follows natural contours.

Sub-Segment A. Tupelo Boulevard and Rice Lane (Red Ball Route: 1910s–1920s):

1. Context/period of significance includes original route of Red Ball Route (1913), Registered Highway Era (1915–1925).
2. Road (Rice Lane segment 1900–1915) predates ISHC and Federal Transportation Act.
3. Retains original pre-1915 cross-section (Rice Lane).
4. Retains original dirt surface for part of length (Rice Lane).
5. Last known surviving driveable section of unpaved pre-1915 Red Ball Route.
6. Cut-off arterial segment of ½ mile in length and not a through route.
7. Limited interpretive value due to short length.
8. Short length and viewshed/sighting distance may affect historic integrity.

9. Part of length currently under cultivation (Rice Lane).
10. High study value for surviving ¼ mile remnant at southern end of Rice Lane.
11. Moderate study value for Tupelo Boulevard segment.

Sub-Segment B. Old U.S. 218 (Rice Lane to South Riverside Drive)

1. Has been resurfaced in areas.
2. Some changes to cross-section in places.
3. Relatively late construction date.
4. Reconstructed during 1950s–1970s.
5. Materials, design, and construction methods common for era.
6. Roadsides under high developmental pressures.
7. Lack of early or innovative design, materials, or structures.
8. Lack of local materials.
9. Lack of handwork.
10. Limited interpretive value.
11. Limited viewshed related to time and place but has scenic qualities.
12. Old 218 (Iowa 923) built with large equipment, pavers, and non local materials.
13. No extant period fencing or signage.
14. Intact cut-off segment of Red Ball Route in industrial/commercial area along railroad tracks located on the east side of Riverside Dr. across from airport and fairgrounds.
15. Is an through route with sense of time and place that is drivable and connects to rural segments.

Segment 4. Old U.S. 218 (Riverside Drive to Iowa City's Jefferson Hotel)

1. Urban segment with some surviving original structures.
2. Resurfaced.
3. Route still accessible.
4. Zigzag route following early pattern.
5. Leads to important historic crossroads at Jefferson Hotel.
6. Connects eligible segments and may relate to overall historic routeway.

National Register Eligibility. Section E contains four cut-off segments. Of these Segments 1 and 2 are evaluated as eligible. Segment 3 contains three sub-segments (A–C). Segment 4 has two potentially contributing sub-segments (A and B). Section E is evaluated as having the possibility of being a contributing element to the overall potential interpretation of the Red Ball through this area.

Section F (Jefferson Hotel in Iowa City to North Liberty).

The crossroads junction in front of the Jefferson Hotel was marked by a pole that showed the various routes that intersected there in 1916 (see Figure 110) (ISHC 1916g:9). In 1912 the Red Ball's route intersected with approximately three other routes. These were local and regional in nature and included the River to River Road, the Waterloo and Keokuk Beltline Route, and the St. Paul, Burlington and St. Louis Route (Huebinger 1912:70). From 1912 to 1922 the Red Ball's path intersected with up to eight other routes at the same location, some of which were not marked. At this spot in 1924 the Red Ball Route intersected only with the River to River Road (U.S. 6) and the White Way. In 1916 the telephone pole at the corner of Washington and Dubuque Streets, Iowa City, bore the unique distinction of displaying:

> …the most important tourist road marks of any similar pole in the world. The markings from top to bottom are American Automobile Association emblem, the Kansas City and Gulf, the Red Ball, the Black Diamond, the River to River Road, the M. & M., the Red Cross, and The Burlington Way or Orange and White (ISHC 1916g:9).

From the Jefferson Hotel in downtown Iowa City the Red Ball's route ran northwards along Dubuque Street. Just south of the present Mayflower Residence Hall, the present eastern lane still runs over part of an extant 1911 concrete culvert (Figure 111D). The Mayflower sits on the location of the early (1842) Terrell Mansion, which became the Red Ball Inn in the 1910s and 1920s and later the Mayflower Tea Room (Weber 1989:46). It was removed in the 1960s for construction of the new building.

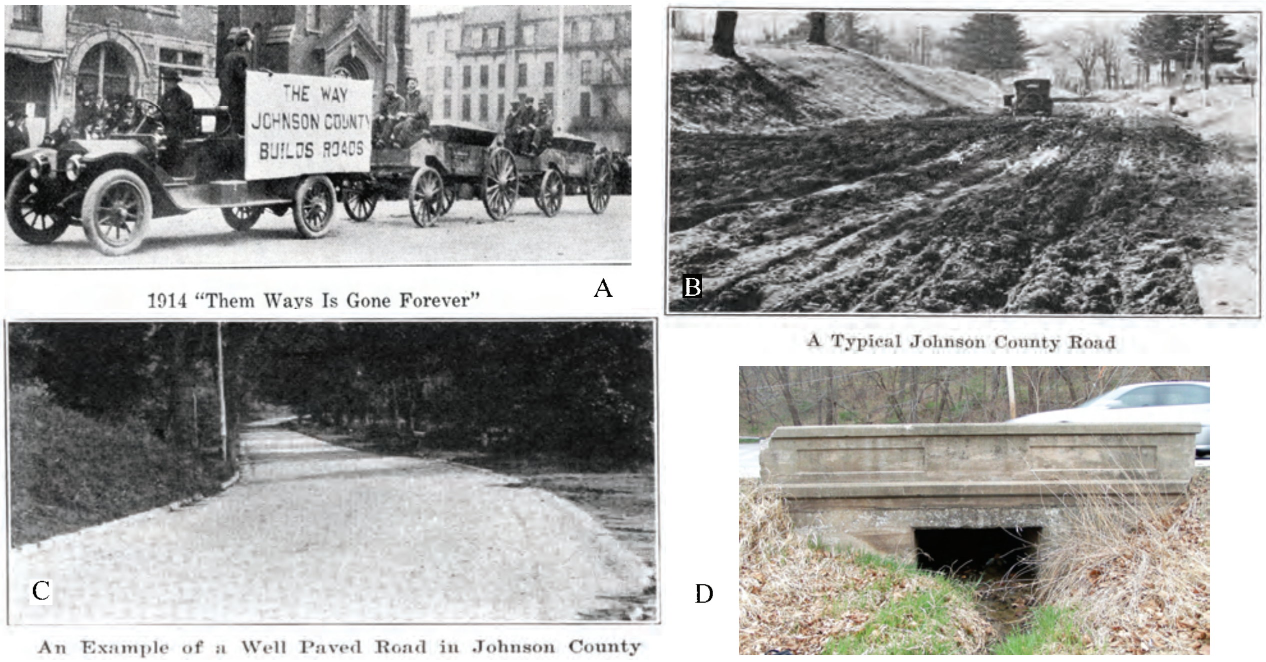


Figure 111. A. Transportation float from 1914 University of Iowa parade (Transit 1914:36). B. Typical Johnson County road (Hunt 1926:171). Possibly Park Road. C. Well paved Johnson County road (Hunt 1926:172). Possibly North Riverside Drive. Note both curb and integral lip-curb used. D. The 1911 Dubuque Street culvert from the Red Ball Road (west handrail removed 2000) (2003 survey photo).

It appears that the eastern lane of current Dubuque Street is atop the original road bed and its cross-section is partly intact but 2005 improvements have removed original pavement segments. The western lane of Dubuque Street is modern and has a different cross-section and elevation. While not completely intact the culvert retains enough original material integrity to be of interest for comparison study as it is dated and exhibits the design, materials, and workmanship as they existed at the time. This culvert was in battered but original condition until 2000 when improvements along the current Dubuque Street right-of-way removed the culvert's western sidewall. The eastern sidewall is still present but the alteration has severely impacted the structure's integrity as it was also widened at that time. It serves as a good example of an early structure on an arterial road segment that is still in place but which has suffered enough change over the years to make it individually ineligible.

To the north of the Mayflower dormitory a small stretch of the original Red Ball Road's route may still exist along the western side of present Dubuque Street. This old routeway, now Laura Drive/Knollwood Lane Road, is presently not a through street as it passes along the side of a few houses and a trailer court. The construction of the intersection of Dubuque Street for I-80 may have eliminated most of the route in that area. The Red Balls Road's route on North Dubuque Street over the I-80 overpass has been further impacted by the ca. 1991 removal of the old steel truss bridge (Butler Bridge) over the Iowa River.

Through Iowa City the route had left the path of the Old Military Road (Dodge St.) which followed Iowa 1 (Dodge St.) through town. The Red Ball instead followed Dubuque Street out of the city's north side. The route exited Iowa City northwards on Dubuque Street, an antebellum route, where only the remnant of the 1911 concrete culvert noted above marks the original route.

Due to recent improvements the old pavement of this section of the Red Ball's roadway (Dubuque Street) has essentially been obliterated up to North Liberty. North of North Liberty the pavement was impacted by the construction of Iowa 965. Both of these roads are presently heavily trafficked local corridors and have been significantly altered. However, they generally follow along the historic route's pathways. In some areas the route retains the original profile and drainage structures although all of the large bridges and major culverts, especially the steel truss bridge over the Iowa River, have been replaced. The late Red Ball briefly shared its route with the River to River Road (U.S. 6) through Coralville (5th Street) before turning northwards along Iowa 965. This segment appears to also have been obliterated.

The early Red Ball route passed through North Liberty on a basically diagonal path, but which zigzagged both through and around town at various times between 1900 and 1940. At the railroad tracks on the western side of North Liberty it jogged due west to connect with current Iowa 965, which has mostly obliterated its route northwards through this section (see Figure 133).

Evaluation. Segment F. This road segment contains or exhibits:

1. Limited eligible intact surface, pavement, or cross-sections visible. Some original structures.
2. Follows original routeway but lacks interpretive value.
3. Viewshed not related to the period of significance although sinuous current viewshed is scenic.
4. Current right-of-way, cross-section, and pavement appear to date after 50 year cut-off.
5. No clear relationship to any previously outlined significant contexts, periods, or eras.
6. One-half mile of 1900s wagon road and 1910–1917 route of the Red Ball.
7. Paths of early (Dubuque St. to North Liberty) and late Red Ball/U.S. 6 diverge (Coralville and U.S. 6 up Iowa 964 to North Liberty).
8. Does connect rural segments. Retains some semblance of early route past Coralville Reservoir.

National Register Eligibility. This section's road bed is evaluated as not eligible to National Register under Criteria A, B, or C, and/or Criteria Considerations A through G, due to changes that have significantly affected its integrity. The 1920s–1930s path of the Red Ball was shared with the River to River road but continued northwards. The other routes continued westwards through Coralville until turning northwards at the location of current Iowa 965.

Section G (North Liberty to Shueyville)

This section in total is six miles in length. Between the northwestern corporate edge of North Liberty (240th St.) and the Iowa River three cut-off arterial highway segments related to the Red Ball Road and U.S. 218, dating from ca. 1900–1930, were located during survey (Figures 132–135; Tables 9, 10). These include a ¼ mile segment of the dirt paved Red Ball Route just outside of North Liberty along Iowa 965 (Segment 1), the ¾ mile long concrete paved segment of old U.S. 218 (Curtis Bridge Road) ending at the south side of the Iowa River (Segment 2), and the 2½ mile long concrete paved section on the north side of the Iowa River that once led to Shueyville (Segment 3).

Highway 965 from North Liberty (Penn St.) northwards closely follows an early trail that is shown on the General Land Office survey maps, which evolved into stage and wagon roads and in the 20th century the automobile route. Like many early auto highway routes for much of its length it followed the railroad tracks, frequently crossing and re-crossing the grade, and zigzagging from section line to corner. It had numerous at grade crossings. Its 1900 to 1916 path ran along the railroad grade, through farms, and along ridge tops. By 1916 the rural route was formalized and concrete and steel bridges along with concrete culverts and stock underpasses were built (Figures 132–133). The road's corners were cut off when the concrete pavement was laid around 1926.

Segment 1. The oldest cut-off segment remaining of the old Red Ball roadway north of Iowa City was identified just northwest of North Liberty near 230th Street (Section 2, T80N–R7W) (Figure 112B). This dirt surfaced route is still visible where it cut over the railroad tracks, now an entry lane, then it ran along the edge of a farmstead (Figure 112). The road through this short stretch had been graded and the bed is clearly visible running through a shallow cut along the margin of the property. From that point it crossed a cultivated field where it is no longer visible and over an extant 1915 concrete stock crossing culvert adjacent to the Anderson Farm. The owner related that it then passed through the farmstead itself, between the house and the barn, and then reconnected with the present alignment out their entry lane (Mrs. Anderson, personal communication 2003). She related that the concrete culvert in the side yard or pasture was not a drainage way but had been built solely as a hog crossing (Figure 112A). The informant also related that the road between North Liberty and a mile or so beyond her place had been a real problem as it crossed and recrossed the railroad tracks at grade multiple times.

Figure 112. A. Hog crossing culvert (1915) abandoned next to farmstead. Note lack of siderail. Approaches are gone. B. View of 1915 road bed cut along edge of farmstead. 2003 survey photos.

At one time, to the north the route crossed the Iowa River at the Mid River/Cou Falls vicinity. This pre-1900–1913 road segment with earthen surface was over-paved by Segment 2 (Figures 113, see Figure 134). This was the only cut-off segment dating from 1900–1916 retaining the original surface (dirt) and cross-section between Iowa City and Cedar Rapids. The only comparable segment on the Red Ball Route is the short length that remains along Rice Lane at the Johnson/Washington county line. While the cut-off segment on Rice Lane retains the old roadway with its original cross-section that segment had no additional structures. Both segments have limited interpretive value.

Evaluation. Segment 1 contains or exhibits:

1. Intact pre-1900 to ca. 1920 road bed.
2. Lack of significant interpretive value.
3. Short overall segment length.
4. Intact 1915 concrete hog culvert missing approaches.
5. Through-farm cut-off segment type.
6. Much of surviving old road bed converted to farm access lane.
7. The center of this segment has been obliterated due to cultivation leaving the ends intact.
8. Follows or built atop route of 1840s to 1870s wagon road and stagecoach route.
9. Follows early auto era road pattern of paralleling railroad grade with multiple at-grade crossings.
10. Only identified intact segment of Red Ball road north of Iowa City along study route.
11. Original road predates the ISHC and Federal Highway eras.
12. Relates to Good Roads Movement and early ISHC Era.
13. Only known example of totally non-drainage related stock culvert.

14. No significant viewsheds.
15. Does not connect to a longer or potentially eligible section of the Red Ball or old U.S. 218 routeway nor does it relate directly to interpreting their contexts.

Segment 2. This 3½ mile long segment is located parallel to current Iowa 965, 2½ miles north of North Liberty, on the south side of the Iowa River (see Figure 134). A turn onto old Curtis Bridge Road puts one back onto the old, curbed, concrete highway dating ca. 1927. This southern cut-off segment is slightly over ½ mile in length and is being still used as an access road. The old road's pavement ends at the edge of the pool margin for the Coralville Reservoir and is used as a boat ramp. This segment is scheduled for replacement by Johnson County.

The pavement itself is 18 ft wide, has integral lip-curbs, and was made of local and state quarried crushed dolomite. The road's bed and concrete culverts and drains probably predate the road's paving by ten years or more. There is a signature culvert along this cut-off segment that is unusual in that it has the names of both the farmer and his farmstead, in front of which it was built, set into the tops on each side. This appears to be the work of a presently unknown local contractor and has not been observed on other culverts or structures. The culvert is marked "Longview Farm" on one side and has the name "Hrdlicka" on the other (see also Signature Culverts, p. 112 and Figures 56A, 56B). The letters were impressed into the top of the sidewalls with a template then filled with crushed marble fragments. The structure clearly functioned primarily as a stock crossing although it did provide some drainage. The landowner may have paid extra for this type of non-standard stock culvert treatment. The culvert dates ca. 1916 and predates the 1927 paving.

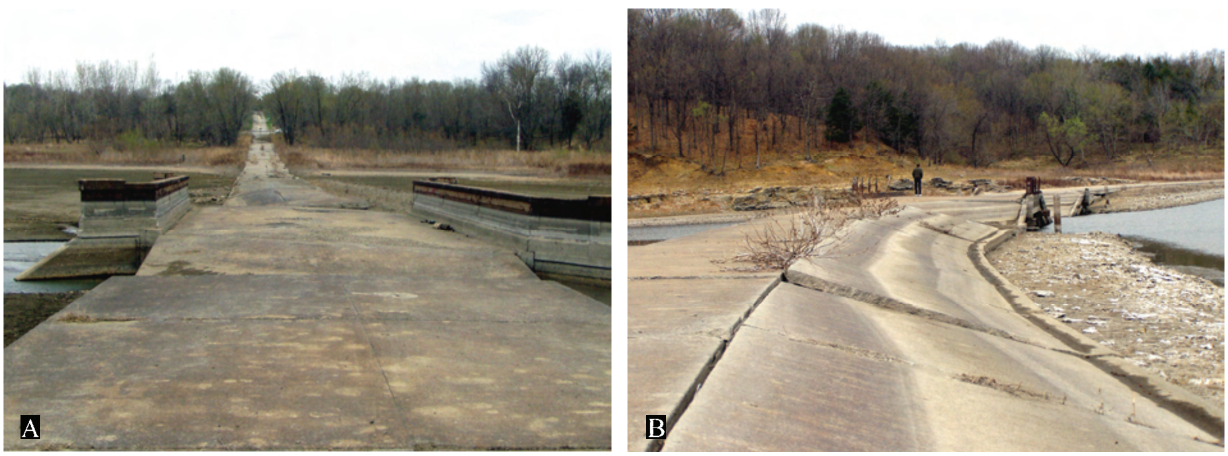


Figure 113. A. View of late 1920's integral lip-curbed concrete roadway of old U.S. 218 across Iowa River valley south of Shueyville, Johnson County. B. Detail of same showing curve. 2003 survey photos.

The names on the top of its side walls matches that of the landowner who lived there and the name of their farm. The name "Hrdlicka" suggests a possible ethnic relationship to the large Czechoslovakian community in Cedar Rapids, Iowa City, Cou Falls, and Ely. The structure is in good condition at present. This signature culvert may be unique along the Red Ball Route (see Figure 56). Additionally, its like has not been observed elsewhere in the state by the author. Thus, it is evaluated as potentially eligible to the National Register as an unique example, with possible connection to the Czechoslovakian communities in Cedar Rapids and Iowa City, and relate to the Registered Highway Era. The pavement over it is not evaluated as individually eligible but may contribute to the surviving routeway as a whole.

From the southern bank the concrete pavement of old U.S. 218 is visible extending across the Iowa River but all the bridges and culverts appear to have been dynamited in-place. Although it cannot be driven it can be walked. During high water levels of the Coralville Reservoir they are frequently submerged. The connecting bridge over the river has been removed. Along the banks of the Iowa River the road passed through or near the former river villages of Cou Falls, Curtis, and Mid River.

Evaluation. Segment 2 contains or exhibits:

1. Context related to Registered Highway Era, mid ISHC Era, and Federal Aid Era.
2. Length of 2½ miles of 18 ft wide concrete pavement with integral lip-curbs.
3. Culverts, road bed, and general cross-section probably predate the concrete paving.
4. Unique eligible signature culvert stock crossing.
5. On the route of ante-bellum stagecoach and wagon road.
6. Paving has not been overlain with asphalt.
7. Segment is a dead end and does not presently connect to eligible segment on north side although the roadway is still visible but is impassable.
8. Segment is under heavy development pressure.
9. Segment exhibits elements of ca. 1910 to 1930 construction methods and materials.
10. Presence of handwork on structures.
11. Lack of handwork on pavement.
12. Interpretive value of segment only fair due to short length and a segment with higher integrity to the north. It does serve as a contributing element.
13. Construction elements, features, and materials of pavement fairly typical of similar period roads.

National Register Eligibility. This cut-off segment is evaluated as eligible to the National Register under Criteria A and C. It is eligible under Criterion C for its importance as a type section of 1920s construction methods and materials. It has interpretive value as erosion has exposed long sections of the pavement and road bed for close examination. It is also eligible under Criterion A for its 1922 association with the largest auto stranding in Iowa up to that time, and for its interpretive value in containing an important signature culvert stock crossing possibly representing the area's Czech heritage.

Segment 3. On the northern side of the Iowa River the extant 18 ft wide concrete pavement continues (Figures 114, 115, 134–135). The original late 1920s paving still extends 2¼ miles northwards to the intersection of east–west running county road F12 at Shueyville. It retains its original route (ridge crest to valley), cross-section, concrete paving (patched, obscured, and overlain by asphalt in places), curbs, gutters and drains, culverts, and other structures including marker posts. It appears that most of the culverts predate the concrete paving and relate to the route's 1910–1925 period of its having been "brought to grade." Because the abandoned river bottom portion cannot be driven, and is only a walkway, the pavement's and the route's visual interpretive value has risen. One can easily see the road's path, where it came from, and where it went. This is possible even though the road bed and pavement is ruinous due to the purposeful destruction of the bridges and culverts and the undermining of sections of the roadway and pavement from seasonal inundation and submergence by the Iowa River. The deterioration of the road's bed allows for close observation of the construction elements and materials.

Evaluation. Segment 3 contains or exhibits:

1. Follows original horse mail route, stage route, wagon road, Red Ball Route, and old U.S. 218.
2. Original road bed and cross-section.
3. Culverts and drainage features are original, show variation in type, predate the surface paving.
4. A 2½ mile long, sinuous ridge top route with integral lip-curb paving.
5. Roadway taken as a whole has integrity of cross-section, route, width, structures, and ends at an area with high interpretive value.
6. The asphalting of pavement has not seriously affected its integrity as the width, route, and cross-section have all remained the same. The original paving is under the thin layer of asphalt.
7. Roadway relates to pre-1900 route, the Registered Highway Era, early and middle Highway Commission Era, Federal Aid Era, and its eventual abandonment to county road system.
8. Culverts exhibit stylistic elements from early highway era, local materials used in construction, and

exhibits a large degree of handwork and variety of construction methods and materials.

9. Provides a strong sense of time and place.

National Register Eligibility. This section contains three cut-off arterial highway segments. They are:

Segment 1. Ineligible due to its short length, lack of interpretive value, and reworking of structures, pavement, and/or right-of-way elements.

Segment 2. Ineligible due to its short length, lack of interpretive values, and reworking of structures, structures, pavement, and/or right-of-way elements.

Segment 3. Evaluated as eligible to the National Register under Criterion A and C (see above). It retains original elements, and multi-mile length, scenic viewshed, and good interpretive value. It is not under as high developmental pressure as Segment 2.

Figure 114. A. View of ca. 1913, cast in place, concrete culvert with low parapet and imbedded, turned-out, wooden wagon wheel hub used as survey point, North Liberty, Johnson County. Note shouldered and stepped base of outlet with chamfered top corners. Cracking and spalling is due to water running under culvert causing cavitation and resultant cracking. B. Detail of axel hub in culvert (6" ruler). C. View of 1913 ceramic tile pipe culvert along Red Ball segment between Iowa River and Shueyville now on old U.S. 218. D. Detail of small, ca. 1930, cast in place concrete, wing type headwall outlet with ceramic tile pipe culvert on old 218 south of Iowa City. 2003 survey photos.

Section H (Shueyville to Cedar Rapids Corporate Limits). From Shueyville at the intersection of county road F12 northwards on current W54, past Western College to Cedar Rapids, the Red Ball Road's and old U.S. 218's route ran to the northern edge of Section 27, College Township (T82N-R7W), Linn County, before turning eastward for ½ mile on current Wright Brothers Boulevard (Figure 135). Its path then turned northwards again onto C Street Road SW, now located to the west of the entry to Kirkwood

Community College, before entering the current Cedar Rapids' corporate limits near its intersection with Ely Road. From Shueyville northwards this road's cross-section and paving have been completely replaced.

Evaluation. Section H contains or exhibits:

1. Current road lies atop old route obliterating it.
2. Altered or completely replaced cross-section, structures, pavement, and other original elements.
3. Has no historical interpretive value.
4. Lack of association with any above mentioned significant contexts.
5. It post dates the present National Register 50 year cut-off date.
6. Strong developmental pressure a factor for its improvement.

National Register Eligibility. Section H is evaluated as not eligible to the National Register as the pavement and cross-sections have been completely replaced and altered.

Figure 115. A. View of in-use cut-off segment from old U.S. 218 (South Curtis Bridge Road) north to the Iowa River showing original 1920s cross-section, pavement with integral lip-curbs, and structures. B. View of original parapet top wing wall culvert south of Shueyville, Johnson County (North Curtis Bridge Road) that pre-dates concrete paving. Note color. Culvert is covered with debris from curb removal.

CONCLUSIONS: STUDY ROUTE 2–U.S. 218

The route of U.S. 218 was chosen as the study's north–south route. It is comparable to U.S. 34 in that they both started as territorial era roads, had a multi-county length, were arterial roads through many periods and eras, and exhibited elements that dated from the beginning in 1900 to the end of the study period in 1948 (see also Figure 116). It differs from U.S. 34 in that from its inception the Red Ball Route specifically linked St. Louis to St. Paul. It has been both historically and presently referred to as The Avenue of the Saints. Table 7 gives an overview of the numbers of each type of resource evaluated. A total of 154 resources were recorded during the intensive survey. Taken with viewshed and secondary views the total is 239.

Evaluated Structures

Culverts. The most common structures recorded were culverts. Of a total of 83 culverts recorded most were simple drainage culverts. Those with parapet tops numbered 12 while those with handrails numbered 14. Cement drains numbered only five which is much lower than those found along U.S. 34.

This total is markedly lower than the number recorded along U.S. 34 for four reasons. This was due to 1) U.S. 218 has had much of its 1910s to 1930s roadway structures and pavement replaced, 2) the difference in topography with the route situated atop lengthy north–south running ridge tops requiring fewer drainage devices. U.S. 34's route had to cut across numerous drainages with divides oriented in a north–south direction that is opposite to the direction of travel, 3) the total length of the intensively surveyed segments was shorter than those along U.S. 34 and, 4) it was built later with more consistent design and materials. As with U.S. 34, urban elements were noted where relevant but not evaluated.

Much of the surviving lengths of road such as the Underwood Avenue segments dated to the 1910s brought-to-grade period of development that had no concrete surface to drain. Concrete paved segments did not have the topographic relief requiring high cut-and-fill drainage crossings. Lastly, the topography also played a factor in the number of railroad crossings. Historical maps, travel guides, and oral history had related that the 1900s to early 1920s route paralleled the railroad tracks and crossed them numerous times in a mile. By the mid-1920s when the road was being concrete paved these crossings were eliminated and the road ran on only one side of the tracks.

Table 7. U.S. 218–Total Count of Structures/Objects/and Views Recorded

Element Type	Number Recorded
Culvert/Stock Crossings	83
Parapet Tops	12
Handrails	14
Abandoned Road Beds	7
Bridges	10
Railroad Crossings	
Overpasses	0
Underpasses	0
Cement Drainage Gutter Chutes	5
Iron Drains	2
Signs/Markers	3
Retaining Walls	1
Buildings	1
Structural Matrix/Aggregates	16
Viewsheds/Secondary Views	81
Total Elements Recorded	239

Abandoned Road Beds. The number of abandoned road bed segments was only seven. Compared to the 39 on U.S. 34 this is a significant difference. Again the factors most responsible for the survivability of cut-off alignments have to do with topography and reuse of the routeway over time. As the routeway traveled over the same path through the years the previous roadway was obliterated and not abandoned. Only cut-off segments from the 1910s gravel surface era and the routeway through very hilly terrain such as that along the Iowa River valley between North Liberty and Shueyville or south of Iowa City survived.

Bridges. The number of bridges evaluated was 10. At the time of survey U.S. 218 had a large number of surviving bridges from the 1920s to 1930s located between Ainsworth and Iowa City. Large steel Warren-truss structures still spanned the English River and Old Man's Creek. Other combinations of steel pony trusses were found on Davis Creek and numerous other smaller drainages. By 2005 all of these had been replaced. This dramatically altered not only the original context and materials of the route but also the viewsheds associated with these period structures. It is such structures along with the original cross-sections and pavement that give the route its historic fabric, integrity, and significance.

Signs and Markers. Only three signs related to the old roads were found. One was a modern marking of the Red Ball Route from Ainsworth northwards to Riverside. This was a privately funded endeavor to promote the historic route where its path followed that of the Old Military Road. The second was a 1950s stop sign along Rice Lane. Third was a painted marker off the main route in Ainsworth. In general early signs, markers, guardrails, or posts were not found along the U.S. 218 alignment.

Section Lengths and Eligibility

Section Lengths. Lengths of the eight sections of the U.S. 218 study route intensively surveyed totaled 114¾ miles (Table 8). The longest was Section E, which was 54½ miles long. It had 54½ miles of evaluated cut-off segments. In this instance the total is not composed of one continuous length but rather of a series of segments whose lengths total up to the section's length. While four section lengths corresponded directly to segment lengths four others did not. Sections A and H had the least correlation between section and segment lengths while sections D, E, and F had direct correlation to length. While Section A was 12 miles long it had only 1¼ miles of cut-off segments. Section H at four miles in length had no cut-off segments. Section B at 7¾ miles in length had 4½ miles of cut-off segments evaluated.

The sections were sub-divided into segments. In total 99¾ miles of cut-off segments of all types were recorded. While this seems like a large part of the 114¾ mile long total study section length it actually consists of many parallel segments from multiple time periods. This was especially noticeable from Ainsworth to Iowa City where three lengthy and parallel cut-off segments were evaluated.

Table 8. U.S. 218 Section Lengths

Section	Length (mi)	Segment Lengths (mi)	Eligible Segment Lengths (mi)
A	12	1¼	1¼
B	7¾	4½	4½
C	5¾	5	0
D	12¼	12¼	12¼
E	54½	54½	49
F	15	15	15
G	7½	7½	7½
H	4	0	0
Totals	114¾	99¾	89¼

Summary of Surviving Sections and Segments

The summary of surviving section and segments for U.S. 218 is contained in Table 9. A total of eight sections were surveyed and evaluated. Segments run from south to north along the alignment.

NATIONAL REGISTER ELIGIBILITY

Section A

Located in Henry County Section A contains one cut-off segment of 1¼ miles in length dating from 1928 to the 1950s. This segment consisted of two parts along the Skunk River. It related to old U.S. 161

and old U.S. 218 during the state's Primary Road Era. Its integrity at the time of survey was low due to its short length and discontinuity with any route. It was cut-off in the 1950s. The southern part was obliterated in except for a few feet in 2005. The remainder on the northern side still serves as an access to a few houses along the river. It was evaluated as not eligible due to its low overall integrity.

Section B

Located in Henry County Section B is 7¾ miles in length and contained one eligible segment of 4½ miles of concrete highway dating from 1928 to the 1950s that relates to old U.S. 161 and U.S. 218 during the state's Primary Road Era. Although its integrity is only fair it may be a contributing element to a longer routeway under Criterion A.

Section C

Located in Washington County Segment C is 5¾ miles in length and had one ineligible and one individually eligible cut-off and abandoned segment.

Segment 1. Segment 1 is a concrete surfaced road related to old U.S. 161 and U.S. 218 during the Primary Road Era. It was evaluated as ineligible due to integrity issues.

Segment 2. Segment 2 is a dirt surface road that dated from the 1850s to the early 1920s. It was originally a stage and wagon road, perhaps part of the Old Military Road, then subsequently part of the Red Ball Route. It may also relate to the 1850s Iowa Air Line railroad. It is abandoned, deeply incised, and has a dirt surface. It was evaluated as eligible under Criteria A, B, and D.

Section D

Located in Washington County Section D is 12 miles in length and has three segments. It contains two segments of 2¼ and 10 miles respectively and a third segment 300 ft in length. These segments dated from the 1910s to the 1950s and were all concrete surfaced. The three segments were evaluated as ineligible due to their low integrity.

Section E

Located in Washington and Johnson counties Section E is 54½ miles in total length. It had the greatest number of parallel cut-off segments found during the study with concrete, gravel, and dirt surfaces relating to the state's Primary Road Era (old U.S 218 and old U.S. 161) (Segments 1, 3, and 4). It has four cut-off highway segments (Segments 1–4) that are 25, 18, three, and three miles long respectively for a total of 49 miles. This section has three parallel highway alignments dating from 1839 to the present.

All four segments were found to be potentially contributing elements of a longer route while Segments 1 and 2 were specifically evaluated as also being individually eligible. Segment 4 has three sub-segments. None of the three sub-segments (Sub A–Sub C) were found to be individually eligible.

Segment 1. Located in Washington County and concrete surfaced Segment 1 is 25 miles in length. It relates to old U.S. 218 during the state's Primary Road Era. While having undergone some alterations the basic cross-section, roadway, and right-of-way is consistent with a 1920s to 1950s highway.

Segment 2. Located in Washington County Segment 2 is 18 miles of gravel surfaced road made up of three sub-segments. It relates to the Red Ball Route, Iowa 40, and U.S. 161 during the Registered Route and Primary Road eras. It also follows the path of the Old Military Road. It was evaluated as both individually eligible and as a contributing element of a heritage corridor or historic routeway under Criteria A. It consists of Underwood Avenue, Tupelo Boulevard and Observatory Road. The Red Ball Route followed these roads from around 1913 to 1927. It is evaluated as both individually eligible and as a potentially contributing elements of a longer route under Criterion A.

Segment 3. Located in Johnson County Segment 3 relates to old U.S. 161 and old U.S. 218 and is three miles in length. It was evaluated under Criterion A as containing potentially contributing elements of a longer historic route.

Segment 4. Located in Johnson County Segment 4 relates to Iowa 40, old U.S. 161, and old U.S. 218 and is three miles in length. It was evaluated under Criterion A as containing potentially contributing elements of a longer historic route. Its context relates to and runs through the whole study period from 1900 to 1948.

Sub-Segment A. This sub-segment consists of Harry's Road and Walnut Road. Sub-A is two miles of gravel surfaced roadways related to the Red Ball Route during the Registered Road Era from 1900 to 1916. Harry's Road is also a 19th century wagon road and possibly a stage road. It was evaluated under Criterion A as a potentially contributing elements of a longer historic route.

Sub-Segment B. This sub-segment consists of Rice Lane. It is gravel and dirt surface and ½ mile in length. It is related to the Red Ball Route during the Registered Road Era from 1900 to 1916. It was evaluated under Criterion A as a potentially contributing elements of a longer historic route.

Sub-Segment C. This sub-segment is a concrete surfaced roadway dating from 1938 to 1950. It runs three miles from Indian Lookout to the Jefferson Hotel. It is related to the Red Ball Route and old U.S. 218 and was evaluated under Criterion A as a contributing element of a longer historic route.

Section F

Located in Johnson County Section F is 15 miles in length. While its integrity was evaluated as low the route into, through, and out of Iowa City was evaluated as possibly contributing to the overall historic alignment and travel way dating from 1918 to the 1950s. The urban part of the route was not evaluated although a couple of extant structures marking the route and relating to the Red Ball Road were noted.

Section G

Located in Johnson County Section G is 7½ miles in length and contains three cut-off segments. Its surfaces were both dirt and concrete. All three cut-off segments were found to be eligible as contributing elements to a longer historic routeway consisting of North and South Curtis Bridge roads. Both Segment 2 and Segment 3 retain their original cross-sections, structures, and integral lip-curbed pavement. Some of the structures are unique while the whole gives a good idea of the roadway dating from the 1910s to the 1930s. The South Curtis Bridge Road is currently under heavy development pressure.

Segment 1. Located in Johnson County Segment 1 is a ¼ mile long dirt surfaced alignment related to the Red Ball Route and Iowa 40 from 1910 to 1927. A through-farm road Segment 1 retains in the eastern part its original cross-section and structures. Its original paving was dirt. Some of the structures are unique while the whole gives a good idea of a roadway with multiple at-grade crossings dating from the 1900s to the 1920s. Segment 1 is evaluated as eligible as a contributing element to a longer historic route.

Segment 2. Located in Johnson County, and known as the South Curtis Bridge Road, Segment 2 is 2¾ miles in length, concrete surfaced, and related to the both the Red Ball Route's pathway, Iowa 40, and old U.S. 218. Segment 2 retains its original cross-section, structures, and integral lip-curbed pavement. Some of the structures are unique while the whole gives a good idea of the roadway dating from the 1910s to the 1930s. It is evaluated as both individually eligible due to its high integrity and eligible as contributing elements to a longer historic route.

Segment 3. Located in Johnson County and known as the North Curtis Bridge Road, Segment 3 is 4½ miles in length, concrete surfaced, and related to the Red Ball Road and old U.S. 218. Segment 3 retains its original cross-section, structures, and integral lip-curbed pavement. Some of the structures are unique while the whole gives a good idea of the roadway dating from the 1910s to the 1930s. Part of the North Curtis Bridge road has been abandoned since the 1950s and is in ruinous condition but its exposure provides a study section of 1920s highway construction. Early dirt or gravel surfaced alignments predating the 1920s may have existed east of the current paved alignment running from the river to the hill crest but they were not surveyed. Segment 3 is evaluated as individually eligible under Criterion A due to its high integrity and as contributing elements to a longer historic routeway.

Table 9. U.S. 218–Summary of Surviving Sections and Segments.

Sect.	Seg.	Length	Surface Material	Integrity	NRHP Eligible	Ind./ Ctrb.	Route(s)	County	Dates	Era	NRB 16B Criteria
A		12 mi	C								
	1	1¼ mi	C	low	no		US161/US218	Henry	1928-50's	D	
B		7¾ mi	C								
	1	4¼ mi	C	fair	yes		US161/US218	Henry	1928-50's	D	A
C		5¾ mi	C/D								
	1	4½ mi	C	low	no		US161/US218	Washington	1928-50's	D	
	2	¼ mi	D	high	yes	I	US161/US218	Washington	Pre-1900-20	A/C/	ABD
D		12 mi	C								
	1	2¼ mi	C	low	no		RB/US161/ US218	Washington	1920's-50's	C/D	
	2	10 mi	C	low	no	I	RB/US218	Washington	1910's-48	B/C/D	
	3	300 ft	C	low	no		US218	Washington	1928-50's	D	
E		55½ mi	C/G								
	1	25 mi	C	fair	yes	I/C	US218	Washington	1920's-50's	C/D	A
	2	18 mi	G	high	yes	I/C	RB	Wash./John.	1900's-20's	A/B/C	A
	(Underwood Ave./Tupelo Blvd./Observatory Rd.)										
	3	3 mi	G	low	yes	C	US161/US218	Johnson	1915-48	C/D	A
	4	3 mi	C	low	yes	C	US218	Johnson	1915-48	C/D	A
	sub A	2 mi	G	low	no		RB	Wash./John.	1900-16	A/B/C	
	(Harry's Rd. (pre-1900) and Walnut Rd.)										
	sub B	½ mi	D/G	medium	no		RB	Wash./John.	1900-16	A/B/C	
	(Rice Lane)										
	sub C	3 mi	C	low	no	C	RB/US218	Johnson	1928-50's	D	
	(Indian Lookout to Jefferson Hotel)										
F		15 mi	C	low	yes	C	RB/US218	Johnson	1927-48	D	A
G		7½mi	D/C								
	1	¼ mi	D	medium	yes	C	RB	Johnson	1910-48	B/C/D	A
	2	2¾ mi	C	high	yes	I/C	RB	Johnson	1910-48	B/C/D	A
	(South Curtis Bridge Rd.)										
	3	4½ mi	C	high	yes	I/C	RB	Johnson	1910-48	B/C/D	A
	(North Curtis Bridge Rd.)										
H		4 mi	C	low	no		RB	John./Linn	1910-50's	B/C/D	

Key to Surface Materials
C=Concrete
G=Gravel
D=Dirt

Key to Abbreviations
NRHP=National Register of Historic Places
NRB=National Register Bulletin
RB=Red Ball Route
Ind.=Individual Resource
Ctrb.=Contributing Resource
Seg.=Segment

Key to Eras
A= Pre-1904: Time until formation of Iowa Highway Commission
B= 1904–1913: Early Mechanized Transportation Phase
C= 1914–1926: Registered Routes and Iowa Primary Roads Systems
D= 1927–1948: Federal Control

Section H

Located in Johnson and Linn counties Section H is four miles long, concrete surfaced, and relates to the Red Ball Route, Iowa 40, U.S. 161, and old U.S. 218 from 1910 to the 1950s. Running north for Shueyville to Cedar Rapids past Western College it has seen complete alteration in its cross-section and pavement thus significantly affecting its integrity. It was evaluated as ineligible. The Cedar Rapids urban segment was not evaluated.

CONCLUSIONS AND RECOMMENDATIONS.

Much of the U.S. 218 corridor has seen considerable change that has affected its integrity. Few long stretches of original roadway exist and several have been obliterated over the last few years. Along the concrete sections all of the major culverts and bridges are in jeopardy and most have already been removed. Segments in good original condition exist such as the multi-mile segment of the Red Ball Route atop the path of the Old Military Road along Underwood Avenue between Ainsworth and Riverside. This segment has high integrity and is not under as much developmental pressure. Also the North and South Curtis Bridge Roads have good integrity although the South Curtis Bridge Road segment has come under developmental pressure recently. The segment of old U.S. 218 from south of Iowa City has much of its original cross-section and it retain much of the look and feel of the 1930s road. This section has shorter and earlier segments that can be contributing elements.

There is often some continuity between certain segments that, when looked at in total, can be evaluated as contributing to a potential historic routeway or heritage corridor. While segments of unusually long lengths and high integrity are easy to evaluate as individually significant many segments of lesser lengths or integrity may be contributing elements to reestablish a longer segment of the original routeway. If such segments can be reconnected or are already connected by altered elements they may still retain a sense of time and place over a considerable distance. As the integrity of the segments is important for some lengths of a highway alignment often a series of such segments can provide an overall feeling of a vital driving experience along a historic road.

For example, the Segment E involving Underwood Avenue and old U.S. 218 can add up to nearly 50 miles of driving experience related to both 19th century roads and early to mid-20th century roads. Other than a single example, these potential historic roads or heritage corridors such as these within the state have not been evaluated. Tracking out the routes of the Red Ball and Blue Grass roads, along with the Old Military Road, can provide a unique driving experience that can visual relay the historical and scenic aspects of Iowa and its countryside. However, as in the case of Scenic Byways, when the original cross-section and paving surface is modified or covered the alteration significantly affects the historic integrity and the significance of the road in its original condition. Many roads in Iowa have been altered for their scenic aspects with no regard to their historicity. It needs to be considered that once the original features and conditions of the road are altered the road itself is greatly compromised in its historical significance and that of a historic corridor as a whole. As many roads are altered a little bit at a time over a lengthy period this change in integrity is incremental and difficult to recognize but this process can be devastating to the integrity of a significant historic road.

Lastly, cut-off segment of less than a mile can be individually eligible for a number of reasons. For one they can be the last surviving segment of an earlier historically significant road. Also they can function as interpretive devices for understanding early road construction materials and methods. Such is the case with the north and south segments of the Curtis Bridge Road. These cut-off segments contain interpretive elements on the Czechoslovakian farming community in the area, significant historical events such as the stranding of thousands after a rainy 1920s Iowa football game, and even the abandoned segments that have had their cross-sections undercut by the Iowa River exposing the pavement’s and bridge’s sides and bottoms for examination.

Final Conclusions: Study Routes U.S. 34 and U.S. 218

The multi-county lengths of the two study routes provided a great deal of information on the types of structures present, their association with specific time periods and contexts, and how to differentiate between individual examples. They provided as wide a variety of cut-off segment types and length along with their associated structures as any in the state. The results of this study provide a means for a statewide application of the results and findings. This can be interpreted as a very good sample.

The totals in Table 10 show the total number of element types encountered and recorded during the survey. A total of 694 elements of all types were identified and evaluated. These included large structures such as abandoned road beds, culverts, bridges, and railroad crossings to smaller components such as curbs, drains, signs and markers, and even individually recognizable concrete pours termed structural matrix or aggregate. Culverts were the largest group. The numerous viewsheds and secondary views of evaluated structures totaled 154. Viewsheds are necessary to show how the road relates to the landscapes it traverses. Such views were taken from the right-of-way to help record the road alignment, to relate to what a driver or builder would see during a specific time period, and to show what the roadway contains at present. Lastly, the statewide survey phase of the project was not included in this total.

EVALUATED STRUCTURES

Culverts. On the two study routes the total number of culverts including plain, stock crossing, handrails, and parapet tops evaluated for the project was 197. All of these structures were located only along the intensively surveyed segments of the study routes. These structures were not broken down further as the study’s purpose was to learn about the structures and not to categorize them minutely.

This total included combination stock crossing/drainage culverts. Stock crossings appear most frequently from 1902 to 1933. Combination culvert/stock crossings were highest after 1948 and lasted into the 1950s and beyond. Many of these were found on the U.S. 218 segment from Hills to Iowa City. Those recorded along the study routes dating between 1902 and 1948 are considerable and attests to the major use of this type of structure over a long period. In general there was a steady increase in this type of structure over the study period. The evaluation of roads built between 1900 and 1916 showed that they often lacked associated culverts of any type. As an observation, most culverts encountered dated between 1916 and 1940, except on long stretches of replaced road surface such as those between Riverside and North Liberty on U.S. 218.

Culverts with handrails, parapets, or curbing were noted. Parapet tops numbered 28 on U.S. 34 and 12 on U.S. 218. Handrail tops, which included some with low sides, numbered 12 on U.S. 34 and 14 on U.S. 34. Across the state culvert construction was probably most intense from 1914 to 1928. Larger culverts (major culverts) and bridges over 12 ft in length were most commonly found with handrails. These culverts related to the road passing over a creek or stream. Smaller culverts (minor culverts) were usually only associated with draining the right-of-way itself. These types most frequently had the parapet tops extending up only a few inches. Handrail culverts had fully developed sides that were around 3 ft tall. Some were originally built low in height while others were a result of later raising of the road bed.

Railroad Crossings. During the 1910s to early 1920s railroad crossings were the primary concern of road safety and highway construction in the state. An intensive statewide movement for their upgrade or elimination occurred. A total of nine underpasses or overpasses were encountered. All were on U.S. 34. Most early crossings were most often “at-grade” crossings.

Bridges. Surveyed bridges were either of concrete or steel, or some combination of the two, but differed from culverts in that they were generally over 12 ft in length and had no poured concrete bottom. Two major highway overpass bridges on old U.S. 34 were obliterated in 2005. They were both curved Art

Deco or Art Modern in style and dated to the 1920s and 1940s. This is an early and significant structure type that is in great jeopardy of removal all over the state due to their narrow widths, poor conditions, and weight embargoes. These structures were generally obliterated along the study routes and are in peril statewide. Railroad over and underpasses of all types may be a major unevaluated historic resource.

During the project 19 bridges were evaluated. While most of these dated after 1948 a significant number of surviving bridges from 1900 to 1940 were encountered. The period between 1933 and 1948 had the highest number of original bridges. Those from 1917 to 1933 were second in number and those from 1900 to 1917 were the least found. Only three dated prior to 1902. As of 2006 all major concrete or steel rural bridges evaluated on the study routes in 2003 were either obliterated or replaced.

Table 10. Totals of Surveyed Structures.

Element Type	Number Recorded
Culverts/Stock Crossings	197
Parapet Topped	40
Handrails	26
Abandoned Road Beds	46
Bridges	19
Railroad Overpasses	6
Railroad Underpasses	3
Cement Drainage Gutter Chutes	113
Iron Drains	18
Signs/Markers/Posts	16
Retaining Walls	3
Buildings	15
Structural Matrix/Aggregate	38
Viewsheds and Secondary Views	154
Total Elements Recorded	694

Abandoned Road Beds. During the course of survey work or the recordation of structures it would be noticed that a segment or a series of cut-off segments had distinctive element of construction, design, and conformed to the pattern of a recognizably distinct historic alignment. Abandoned road beds evaluated and recorded totaled 46. Of these the majority (40) dated from 1917 to 1948 although two relate to a pre-1900 through 1948 study period and six were indeterminate or prior to 1920. All abandoned road beds were under a mile in length and the majority less than 1/8th mile. A number were less than 400 ft long. A few abandoned road beds along the study routes predated the 1900 cut-off date for the study period but their use continued until the early 1910s and were used as auto routes.

When evaluating arterial highways one should be aware that there is nearly always a surviving segment of these roads left that may not be visible with standard survey methods. Early maps and travel guides, aerial photographs, oral histories, and a good eye for detail and topography are extra important when identifying these earliest roads. Dirt roads easily revert to the landscape. The lack of very early abandoned cut-off roads segments appears to primarily be the result of later routes going directly over the original road's route. Lastly, early roads tended to meander and over time shortcuts or the avoidance of natural obstacles played a big role in route changes on the landscape. As a result a road segment may run for only a few years and may not be shown on the available maps. However, early roads tended to converge on specific points such as fords, bridges, or towns and can often be traced back from these points and their paths located across more open or even cultivated landscapes.

Drains. A total of 131 roadway drains, chutes, and drainage systems exclusive of culverts were evaluated. Integral curb drains associated with 1917 to 1938 roads were the most numerous with 113 examples. These were especially evaluated for design, materials, manufacturers, location, and time period. Early examples are very vulnerable to removal due to upgrading. Simple iron drainage grates or caps numbered 18 with only two found along U.S. 218. This included 13 wooden drain marker posts.

Buildings. During the course of the study it was clear that some transportation related buildings along the study routes dated to specific time periods or eras. While buildings were not evaluated they were often helpful in tracking an old route's path through both urban and rural areas. While not evaluated 15 buildings were recognized as directly related to the context and construction of the two study routes.

Structural Matrix/Aggregates. The consistency, content, and context of concrete pours was observed. It was possible to differentiate different types of concrete by the amounts and types of aggregates, color, and associated structures such as drains. Segments with similar aggregates could be tied to contract letting, available quarries and borrow pits, contractors and equipment, and other elements including brick and tile. As culverts were usually poured prior to the concrete paving they generally had different pours than the roadway. Pours within culverts that were consistent along a segment's length often illustrated those culverts that had been replaced or which were the earliest built. In general, pours that exhibited river or bank gravels that were uncrushed but size sorted were the earliest. Those with crushed and uncrushed river and bank gravels were a little later. Those with a mixture of sorted gravels with crushed dolomite were later still and those with only dolomite or quartzite the most recent. Concrete pours could also help identify whether it was built by a township or county crew, was a state project, and occasionally if it may have been built by a designer/builder such as Marsh or Stark. Some of Iowa's earliest concrete roads were built by farmers. These are largely unrecorded and are an important element of further investigation.

Signs and Markers. Only signs and markers within a right-of-way were recorded. They directly related to the roadway and not advertisements. Segments with extant original culvert marker posts, remnants of fencing or safety rails, or some other such element were also noted. Three historic signs were found.

Viewsheds and Secondary Views. Viewsheds documented the appearance of a roadway within topographical and sociological settings and contexts. They illustrated the level of technology within an area and documented surviving examples within various contexts. A road cannot be divorced from its setting and the integrity of design, view, originality, and significance needed to be documented. This was both helpful as a working marker for location in the field and also for later analysis during research.

Documentation including secondary views. These were photographs of a structure or structural element from a different view or direction. As structures such as a culvert, bridge, or road bed usually has two sides and two ends it was important to document such features from multiple angles and for specific details. Photos of the approaches, undersides, supports, retaining walls, grades, rebar, bolts, and rails were taken. Of the hundreds of photos only a very few were included in the report as illustrations. It was not always apparent at the time of survey which photos would turn out to be important or used as an illustration. In general, in order to cut down on the potentially huge number of photos as few as possible were taken for organizational purposes. However, with so few shots the most illustrative shots were taken.

Curbs. The presence of curbs on rural highways were the best way to recognize pre-1940s concrete highways. Unlike culverts or bridges which have a specific location, integral lip curbs are long linear elements of a larger construction design or pavement. Cut-off segments within a given alignment that retained their original curbs were recorded generally in regards as to which segment of the road had curbs and which segments did not. While these elements were noted they were not tabulated as some segments had curbs for their whole length, some had curbs present in some areas but not in other areas and some segments had no curbs at all. This could occur all on the same road from the same period. The change from totally curbed to partially curbed or uncurbed highways often occurred at township or county lines and sometimes was a result of a switch in design, contractors, or later construction. They also related to the ISHC's or Iowa DOT's designs implemented in the letting of the construction contract for that section. Neither of the study route pavements showed evidence of curb removal except the western urban section of old U.S. 34. Scars present under a later overlay could not be directly observed.

Summary and Recommendations

Historic roads and cut-off highway segments are present on the Iowa cultural landscape in many types and forms. From abandoned dirt segments under cultivation to segments hidden from view by foliage or converted to other uses they are frequently difficult to identify and evaluate. This study of roads and cut-off highway segments dating from 1900 to 1948 used the examples within the two study routes (U.S. 34 and U.S. 218) to identify, track, and record the relevant data and salient points of how and why road segments are cut-off. These roads can be recognized and evaluated using a combination of documentary and oral research and physical survey. The numerous applicable contexts developed have been related to large and small historical trends and events. The engineering of highways is part of a social, political, and economic environment that results in the construction, use, and eventual abandonment of roads. While seeming permanent and fixed on the physical and cultural landscape, over the long term roads and highways are ephemeral objects with finite life spans. During research, survey, and analysis it was found that certain evaluation and preservation issues reappeared. These issues are that:

1. All roads and cut-off segments are vulnerable to further truncation, removal, and/or often obliteration no matter how substantial they appear.
2. The materials of which the old road bed is composed are now essentially a modern material source and are being reused and recycled.
3. The large scale of modern highway improvement projects on arterial roads often precludes the survival of nearby extant historic cut-off segments.
4. Cut-off segments are difficult to recognize, poorly understood, and their historical significance under appreciated in many ways and this contributes to their eventual removal.
5. Old road sections are being removed or obliterated at an ever increasing rate and as such the surviving eligible resources and structures are both in peril and have an elevated need for identification, evaluation, and preservation.
6. The most easily recognizable cut-off road segments are those that date from 1917 to 1930. During this period most Iowa arterial highways were graded and paved first with gravel and then with concrete. The construction of these roads obliterated most of the earlier trails and roadways that they followed.
7. The construction elements such as cross-sections, materials, location, and the state of engineering technologies are expressed on the cultural landscape in the surviving pavements, structures, and cross sections.
8. Surviving roads and road segments, including associated structures, can be viewed as a type of highway technological marker from whose elements it can be determined when the segment or structures was built, during what political and engineering design time period or era they evolved from, the integration of local materials and builders in early segments, their history of use, and their eventual abandonment.
9. On major arterials the oldest surviving cut-off road segments (pre-1900–1915) are the hardest to identify and evaluate, retain the highest information value, and are the most at risk for destruction.
10. The majority of the current surviving cut-off road segments date from the 1917–1933 time period and relate to the Federal Transportation Aid Era. Future cut-off segments may become increasing large.

11. Cut-off road segments of any significant length are very uncommon and any pre-1900–1917 arterial road segments with even minimal integrity, consisting of original cross-section and some original structures, and having a length exceeding one mile are uncommon to rare.

12. The location in the state greatly influenced when types of roads were constructed or when and where innovative materials or designs were first used.

13. The conversion of an old road segment to a Scenic Byway seriously impacts any historic integrity or historical accuracy of the road bed itself, because improving the roads for increased safety, speed, access, and tourism sometimes destroys both the road itself and often alters the aesthetic environment. The change of grade involved in bank cutting, road bed lowering, and changes in pavement width and surface may significantly alter the visibility of the scenic landscape in regards to the rise and fall of the natural topography.

14. Roads are presently seen as economically important resources that could be used for access to sites, parks, scenic vistas, and other recreational areas but not as historic sites in themselves that could be used to attract or draw revenues from various sources.

15. County engineers may see these historic resources as impediments or problems to be eliminated. As such the oldest and most historically significant structural elements are in highest jeopardy.

16. Little or no effective education concerning or including the survival and preservation of these resources is present in the state concerning the preservation of roads that are not main routes. Most multi-county routes show little consistency in recognition or preservation across the state.

17. Cut-off segments can provide a sense of linkage and continuity between the current and past cultural landscapes and between communities.

18. Many potentially significant cultural, historic, or heritage corridors are unidentified in Iowa and may contain numerous and potentially significant cut-off highway segments and associated structures.

19. Historic routes may be reconnected through the reuse of cut-off highway segments for automobile, bike, and pedestrian use and thus enhance the functionality and continuation of historic routes and heritage corridors in Iowa.

20. Highest priority for preservation is on routes from 1900 to 1916. These should include dirt, gravel, and concrete surfaces with priority given to original grade, cross-section, and structures such as culverts and bridges. Many of the structures beneath a road bed, especially culverts, date much earlier than the surface paving. Those culvert and bridges that can be identified to contractor, builders, or county crews and especially those which are "signature" structures are the most significant.

21. More work is recommended for defining cut-off segment's relationships to heritage corridors. Many roads in Iowa have been altered for their scenic aspects or driveability with no regard to their historicity. It would help to note that once the original features and conditions of the road are altered the road is greatly compromised in its historical significance and that of a historic corridor as a whole. As many roads are altered a little bit at a time over a lengthy period this change in integrity is incremental and difficult to recognize but this process can be devastating to the integrity of a significant historic road.

22. Signage is a critical part of historic roads. Didactic and illustrative signs can identify old routeways, scenic and historic locations, and other information. On segments used as bike or walking paths this could be especially important. On segments that can be driven AASHTO and others have encouraged reducing the speed limit to replicated the speeds being driven at the time of use or construction to give the drivers a sense of early motoring, to point out narrow or poorly maintained segments, to ban certain types of vehicles, and to give directions to the driver.

23. When evaluating arterial highways one should be aware that there may be a surviving segment of these roads left that may not be visible with standard survey methods. Early maps and travel guides, aerial photographs, oral histories, and a good eye for detail are extra important when identifying these earliest roads. Dirt roads easily revert to the landscape. The lack of very early abandoned cut-off roads segments appears to primarily be the result of later routes going directly over the original road's route. Another

reason is that they are under cultivation. Lastly, early roads tended to meander and over time shortcuts or the avoidance of natural obstacles played a big role in route changes on the landscape. As a result a road segment may run for only a few years and may not be shown on the available maps. However, early roads tended to converge on specific points such as fords, bridges, or towns and can often be traced back from these points and located across more open landscapes.

24. The study clearly showed that old bridges and culverts of all types are being replaced at a rapid rate. This is especially true on rural roads or sections with high farm, truck, or commercial traffic. During the period of the study nearly all the surviving bridges along the study routes were removed. Although the concrete bridges would be harder to replace other steel bridges may be brought in at a later date to help return the road to its more original setting. Some designated early travel routes can be reconnected with such structures in the future. This would both reuse the bridges and reconnect a historic routeway for modified automobile use or another suitable uses such as trails or tourism.

25. Brick pavers underlie many highway segments, rural roads, and urban streets in Iowa. They are often over-surfaced with asphalt. While it may not be feasible to consider all brick roads historic resources there is always the potential of cultural deposits existing below brick pavers. This does not necessitate monitoring every patching or reconstruction project. Brick roads themselves may be eligible individually or contribute to the context of a historic route or cultural corridor. The National Road from Washington D.C. to Vandalia, Illinois is a good example. Brick surfaced Iowa historic road segments with early construction dates, stone curbing, single lanes, laid over concrete bases, or of local, state, or national significance should be treated with higher documentation and fieldwork, including monitoring, than standard urban late 19th or early 20th century brick paving.

26. For historic highway construction in Iowa the works listed in Appendix G were noted by Iowa DOT engineers in 1984 as necessary to the understanding of state highway construction. These ten seminal works explain the engineering aspects of highway construction like no others.

27. Many cut-off segments that are now on the edge of a city or urban area were once in the country. As some cities expand some of these once rural routes, sections, or segments should be evaluated within an advancing urban context. In general, old cut-off highway segments in urban areas can be evaluated much as rural ones based on route, period of construction, sociopolitical contexts, period of significance, and occasionally the designer, engineer, or builder involved.

28. While some Iowa communities and counties have realized the importance of historic transportation resources, others are not at all aware. The short early routes are the best recognized in the state. The citizens of Fredonia have put up signage designating the experimental, convict-built, Fredonia to Columbus Junction Road. The Eddyville cemetery road has long been recognized by the community and the Iowa Department of Transportation. The Half-Slab is recognized locally by citizens, the county road commission, and the county engineer as significant. The Coleman Road has posted signage. However, the long multi-county and multi-phased routes of the Blue Grass and Red Ball roads have seen much less sensitivity. While some counties see these routes as historically and economically important the counties with fast growing populations view them as impediments to growth, safety hazards, or material quarries. In none of the counties involved in the survey were Context Sensitive Solutions readily apparent, and in a few clearly ignored. Many are served best just left alone.

CONTEXT SENSITIVE SOLUTIONS

During the course of this study it was observed that a number of improvements to early arterial highways were not done with the view of preserving early intact and significant roads, structures, or landscape features. This was observed to be a statewide situation involving both state and local governments. Elements contributing to this were economic, some safety issues, some neglect, and some just lacking relevant information or its implementation. According to the American Association of State Highway Transportation Officials (AASHTO) in preserving significant highway segments with high integrity, Context Sensitive Solutions (CSS) could play an important role when engaged early in the planning process (American Association of State Highway and Transportation Officials 2001:10, 15).

Context Sensitive Solutions—also known as Context Sensitive Design (CSD)—may be viewed as creating public works projects that meet the needs of the users, the neighboring communities, and the environment. It integrates projects into the context of setting in a sensitive manner through careful planning, consideration of different perspectives, and tailoring designs to particular circumstances. This view may be applied to the resources themselves. Improved understanding and flexibility in AASHTO policies enable engineers to apply creative approaches (Prince George's County Department of Public Works and Transportation 1994; Missouri DOT 2003; American Association of State Highway Transportation Officials 2007:1).

Context Sensitive Solutions is a collaborative, interdisciplinary approach that involves all stakeholders to develop transportation facility that fits its physical setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility. CSS is an approach that considers the total context within which a transportation improvement project will exist.

As citizens' expectations for better, safer roads have increased, a growing awareness of communities' needs has also emerged among designers. These two key factors contributed to bring about this transformation in highway design and construction. Congress, the Federal Highway Administration, governors, State legislatures, and State transportation agencies have all played an integral part in this important evolution of highways. Meanwhile, public interest groups have worked to make developing better methods of highway design a major part of their agendas (American Association of State Transportation Officials 2007:2).

The following basic principles of CSS that help historic roads survive in transportation design apply (American Association of State Highway Transportation Officials 2007:3):

1. The project satisfies the purpose and needs as agreed to by a full range of stakeholders. This agreement is forged in the earliest phase of the project and amended as warranted as the project develops.
2. The project is a safe facility for both the user and the community.
3. The project is in harmony with the community, and it preserves environmental, scenic, aesthetic, historic, and natural resource values of the area, i.e. exhibits context sensitive design.
4. The project involves efficient and effective use of the resources (time, budget, community) of all involved parties.
5. The project is designed and built with minimal disruption to the community.

The characteristics of the process that contribute to excellence are:

1. Communications with all stakeholders is open, honest, early, and continuous.
2. A multidisciplinary team is established early, with disciplines based on the needs of the specific project, and with the inclusion of the public.
3. A full range of stakeholders is involved with transportation officials in the scoping phase. The purposes of the project are clearly defined, and consensus on the scope is forged before proceeding.
4. A commitment to the process from top agency officials and local leaders is secured.
5. The public involvement process, which includes informal meetings, is tailored to the project.
6. The landscape, the community, and valued resources are understood before engineering design is started.
7. A full range of tools for communication about project alternatives is used (e.g. visualization).

Through Context Sensitive Solutions Iowa's remaining significant historic highways, cultural routes, and heritage corridors can be better prepared for the future. In many instances simple design elements such as color, width, and reconditioning could have played critical roles in preservation and restoration of such roads and structures and improving the economic and esthetic impact that such historic and cultural resources can bring to a community.

Acknowledgments

The author would like to thank the following individuals and institutions. For the survey, recordation, organization, and analysis Maria Schroeder and Juliana Waechter were crucial to the successful outcome of this study. Thanks also goes to Joe Artz for information on the context of the Fredonia to Columbus Junction convict-built road. For early travel guides, photographs, plats, maps, atlases, and along with access to the Road-Maker magazine and other reference books and research materials on Iowa transportation history critical to this study I would like to thank the staff at the State Historical Society of Iowa Library at Iowa City. For access to original Iowa transportation related files, documents, photographs, maps, literature, and personal assistance I would like to thank Hank Zaletel and the Iowa Department of Transportation Library at the headquarters in Ames. Lastly I would like to thank the Iowa Department of Transportation and the Highway Archaeology Program for making this study possible and especially for the personal support shown during its preparation.

MRI

References Cited

Alleger, C. N., and C. A. Alleger

ca. 1980 *Civilian Conservation Corps: Iowa District History*. Johnston and Bordewyk Inc., Rapid City, South Dakota. Copy on file, Office of the State Archaeologist, University of Iowa, Iowa City.

American Association of State Highway and Transportation Officials (AASHTO)

2001 *The Road Beckons: Best Practices for Byways*. American Association of State Highway and Transportation Officials, Washington, D.C.

2007 *Context Sensitive Solutions*. American Association of State Highway and Transportation Officials, Washington, D.C. Online at Context Sensitive Solution.org.

Andreas, A. T.

1970 *Illustrated Historical Atlas of the State of Iowa.* Reprinted. State Historical Society of Iowa, Iowa City. Originally published 1875, Andreas Atlas, Chicago.

Arizona Department of Transportation

2004 Good Roads Everywhere: A History of Road Building in Arizona. Prepared by Melissa Keane and J. Simon Bruder. URS Cultural Resource for the Arizona Department of Transportation Environmental Planning Group. Project Number SSTP-900-0(101) TRACS #999 SW 000H3889 01D, Contract Number 97-02, URS job 23442405. Report 2003-28(AZ), March 2004.

Artz, Joe A.

1992 Archaeology and Geomorphology of a Portion of Muscatine Island and Adjacent Uplands: A Phase I Archaeological Survey of Primary Roads Project F-61(55)--20-70, a.k.a. PIN 92-70040-1, Muscatine County, Iowa. *Project Completion Report* 15(63). Copy on file, Office of the State Archaeologist, University of Iowa, Iowa City.

1995a Archaeology of the Eisele's Hill Locality: Phase II Test Excavations at Six Sites in Muscatine County, Iowa, Primary Roads Project NHS-61-4(55)--20-70, a.k.a. PIN 92-70040-1. *Project Completion Report* 18(30). Copy on file, Office of the State Archaeologist, University of Iowa, Iowa City.

1995b Phase II Archaeological Test Excavations at 11 Sites in the Montrose Bottoms: Primary Roads Project NHS-61-4(55)--20-70, a.k.a. PIN 92-70040-1. *Project Completion Report* 18(23). Copy on file, Office of the State Archaeologist, University of Iowa, Iowa City.

Asphalt Institute

1965 The Asphalt Handbook. *Manual Series No. 4*. The Asphalt Institute, College Park, Maryland.

Associated Cultural Resource Experts

2002 *Highways to the Sky: A Context and History of Colorado's Highway System*. Submitted to the Colorado Department of Transportation by Associated Cultural Resource Experts, Littleton, Colorado.

Axelrod, Alan

1979 A Century of Light: The Development of Iowa's Electric Utilities. *The Palimpsest* 60(5), pp. 142–143. Copy on file, Iowa State Historical Society Library, Iowa City.

Bain, Harry Foster

1898 The Geology of Decatur County. *Iowa Geological Survey, Annual Report, 1897*. Iowa Geological Survey, Vol. 8. F. R. Conway, State Printer, Des Moines, Iowa.

Baird, Verda J.

1989 *Highlights From "Out of The Past."* Article Compilations from the Fairfield "Ledger." Published by Dogwood Printing, Ozark, Missouri.

Baker, C. D.

1992 *In Retrospective: An Illustrated History of Wapello County, Iowa*. Dunning Publishers, Virginia Beach, Virginia.

Bartlett, Irving H.

1967 *The American Mind in the Mid-Nineteenth Century*. AHM Publishing, Northbrook, Illinois.

Bear Creek Archaeology

1992 A Cultural Resources Investigation of the U.S. 18/218 Highway Improvement Corridor, Rudd to Charles City, Floyd County, Iowa. Vols. I and II. *BCA #138*. Submitted by Bear Creek Archaeology for the Iowa Department of Transportation, Ames, Iowa. Copy on file, Office of the State Archaeologist, The University of Iowa, Iowa City.

Beard, W. F.

1911 Bithulithic Paving in Grinnell. *Transit*, Vol. 16, pp. 22–25. The University of Iowa, Iowa City.

Bellamy, S. B.

1916 Letter of June 5, 1916, to Thomas H. MacDonald, Director, Iowa State Highway Commission. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Beyer, S. W., and H. F. Wright

1922 *The Road and Concrete Material of Iowa*. University of Iowa Press, Iowa City.

Beyer, S. W. and Ira A. Williams

1922 *The Geology of Quarry Product*s. University of Iowa Press, Iowa City.

Bingham, Johnson

1916 *Iowa: Its History and Its Foremost Citizens*. Vol. II. S. J. Clarke Publishing, Chicago.

Blue Grass Road Association

1913 Letter of April 26, 1913, to Iowa State Highway Commission. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Bowman, C. E.

1899 The Effects of Freezing on Concrete. *Transit*, Vol. 7, p. 60. The University of Iowa, Iowa City.

Breed, Eltinge H.

1917 Points on Concrete Road Construction. *Road-Maker* 11(4), p. 56. Road-Maker Magazine, Chicago, Illinois.

Bremer County History Book Association

1985 Along the Red Ball Road. *History of Bremer County*. Bremer County History Book Association, Waverly, Iowa.

Briggs, John E.

1970 Along the Old Military Road. *The Palimpsest* 51(6), pp. 265–276. The State Historical Society of Iowa, Iowa City.

Brindley, John E.

1912 History of Road Legislation in Iowa. *Iowa Economic History Series*. The State Historical Society of Iowa, Iowa City.

Brown and Mossman

1913 Letter of December 19, 1913, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Bruce, Arthur G.

1934 *Highway Design and Construction*. International Textbook Company, Scranton, Pennsylvania.

Burlington Hawkeye

1914 The Road Dragging Law: Comments Section. *Road-Maker* 6(1), p. 14. Reprinted. Original from The Burlington Hawkeye. Road-Maker Magazine, Des Moines, Iowa.

Carlson, Richard J.

2000 A Phase I Historic Architectural Survey of Primary Roads Project STP-1-5(64)--2C-52, a.k.a. PIN 94-52012-1, Johnson and Linn Counties, Iowa. *Project Completion Report* 23(14), Vol. III: Iowa Site Inventory Forms 52-03799 through 52-03826 and 57-05607 through 57-05662. Copy on file, the Office of the State Archaeologist, Iowa City, Iowa.

2005 A Phase I Historic Architectural Survey of Primary Roads Project, U.S 67, Scott County, Iowa. *Project Completion Report* 28(18). Copy on file, the Office of the State Archaeologist, Iowa City, Iowa.

Carson, Robert N.

ca. 1912 When You Drive a Motorcar. Original on file, Red Ball Route Folder, Iowa DOT Library. Iowa Department of Transportation, Ames, Iowa.

1913a Letter of August 19, 1913, to Iowa State Highway Commission. Directions for Marking Red Ball Route. Original on file, Red Ball Route Folder, Iowa DOT Library, Ames, Iowa.

1913b Mileage Schedule and General Information About the Red Ball Route. Published by Robert N. Carson, Iowa City. Original on file, Red Ball Route Folder, Iowa DOT Library, Ames, Iowa.

1913c Mileage Schedule and General Information, Red Ball Route, Between St. Paul and St. Louis "The Pershing Trail." Published by Robert N. Carson, Iowa City. From Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1914 Letter of May 7, 1914, to Thomas H. MacDonald, Director, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916a Supplement of Official Route of Red Ball Route Between Waterloo and Janesville, Iowa. Map and letter based on 1913 Huebinger's Map of Black Hawk County. From Red Ball Route folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916b Letter of February 26, 1916, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916c Letter of February 2, 1916, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916d Letter of June 2, 1916, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1917a County Maps along Blue Grass Road. Based on 1917 Huebinger's County Maps of Iowa. From Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1917b Letter of October 10, 1917, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1917c Letter of October 6, 1917, to F. W. Parrot, Iowa State Highway Commission. Red Ball Route Folder. Original on File, Iowa DOT Library, Ames, Iowa.

1917d Letter of November 20, 1917, to Thomas H. MacDonald, Director, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1919a Letter of August 20, 1919, to F. W. Parrot, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1919b Letter of August 28, 1919, to Fred R. White, Chief Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1919c Letter of September 2, 1919, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920a Letter of August 30, 1920, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920b Letter of August 31, 1920 to F. W. Parrot, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920c Letter of September 7, 1920, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920d Letter of September 11, 1920, to W. H. Root, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920e Letter of October 8, 1920, to Ralph W. Gearhart, Engineer, Linn County. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920f Letter of October 9, 1920, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920g Letter of October 19, 1920, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1922a Letter of August 7, 1922, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1922b Letter of August 16, 1922, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1922c Letter of August 25, 1922, to Fred R. White, Chief Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1922d Letter of December 19, 1922, to Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on File, Iowa DOT Library, Ames, Iowa.

1922–1925 Official Red Ball Route. Original route map series on file, Red Ball Route, Red Ball Route Folder, Iowa DOT Library, Ames, Iowa.

1923a Letter of January 13, 1923, to Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1923b Letter of April 21, 1923, to Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1923c Letter of May 19, 1923, to C. R. Jones, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1923d Letter of May 24, 1923, to C. R. Jones, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1923e Letter of July 10, 1923, to C. R. Jones, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1923f Letter of July 21, 1923, to C. R. Jones, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1923g Mileage Schedule and General Information, Red Ball Route, Between Twin Cities and Keokuk, Iowa, The Pioneer Trail. Published by Robert N. Carson, Iowa City. From Red Ball Route folder. Original on file, Iowa DOT Library, Ames, Iowa.

1925a Letter of July 27, 1925, to C. R. Jones, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1925b Letter of September 9, 1925, to C. R. Jones, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1925c Letter of September 16, 1925, to C. R. Jones, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1925d Letter of November 10, 1925, to C. R. Jones, Engineer, Iowa State Highway Commission, Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Cedar Rapids Republican

1924 Letter of July 1, 1924, to Editor of Cedar Rapids Republican. Mr. Carson Makes Reply to Letter to the Editor, editorial page. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Center for Transportation Research and Education

2003a Testing New Pavement Overlay. *Technology News*, p. 3. Center for Transportation Research and Education, Iowa State University, Ames, Iowa.

2003b Understanding the Basics of Concrete Mixture Chemistry. *Technology News*, p. 5s. Center for Transportation Research and Education, Iowa State University, Ames, Iowa.

2003c Developing a Rural Roadside Safety Program. *Technology News*, p. 3. Center for Transportation Research and Education, Iowa State University, Ames, Iowa.

Childs, Oliver W.

1916 Federal Roads Aid Act–Highway Bridge Engineering. *Transit*, Vol. 12, p. 49. The University of Iowa, Iowa City.

Clark, Florence L.

1916 New Playground for the Middle West: the McGregor Road. *Road-Maker*, 10(1), pp. 3–5. Road-Maker Magazine, Moline, Illinois.

Clements, Ralph H.

1968 The Seedling Mile. *Iowan* 17(1), pp. 22–24. Mid-American Publishing, Shenandoah, Iowa.

Colton, Kenneth

1939 Bringing the Stage Coach to Iowa: 1837–1842. *Annals of Iowa* 22(l), p. 3, Third Series. Iowa State Department of History and Archives, Des Moines, Iowa.

1940 Stage Coach Travel in Iowa. *Annals of Iowa* 22(3), pp. 175–200, Third Series. Iowa State Department of History and Archives, Des Moines, Iowa.

1960a John Frink and Company, 1846–1854. *Annals of Iowa* 35(56), pp. 401–433, Third Series. Iowa State Department of History and Archives, Des Moines, Iowa.

1960b The Stagecoach Comes to Iowa. *Annals of Iowa* 35(8), pp. 161–186, Third Series. Iowa State Department of History and Archives, Des Moines, Iowa.

Comp, Allan T, and Donald Jackson

1977 Bridge Truss Types: A Guide to Dating and Identifying. American Association for State and Local History, Technical Leaflet 95, *History News* 32(5). American Association for State and Local History, Nashville, Tennessee.

Conard, Rebecca

1992 *The Lincoln Highway in Green County*. National Register Multiple Property Documentation Form Draft. Prepared by PHR Associates, Lake View, Iowa. Copy on file, State Historical Society of Iowa, Des Moines.

Concrete Highway Magazine

1924a Replacing Cuts Though Concrete Pavement. *Concrete Highway Magazine* 8(3), pp. 60–61. Portland Cement Association, Chicago.

1924b Highway Widths. *Concrete Highway Magazine* 8(6), pp. 134–135. Portland Cement Association, Chicago.

1924c Scott County Boasts Largest Paved Road Mileage. *Concrete Highway Magazine* 8(11), pp. 259–261. Portland Cement Association, Chicago.

Crum, Roy W.

1915 Grading and Testing of Concrete Aggregate. Iowa State Highway Commission *Service Bulletin* 3(4–5), pp. 8–9. Iowa State Highway Commission, Ames, Iowa.

Crum, Roy W. (editor)

1925 Reports of Research Committees and Papers. *Proceedings of the Fifth Annual Meeting of the Highway Research Board*. Division of Engineering and Industrial Research, National Research Council, Washington, D.C.

1928 Report of Committee on Character and Use of Road and Report on Guard Fence Research. *Proceedings of the Eighth Annual Meeting of the Highway Research Board*, Division of Engineering and Industrial Research, National Research Council. Washington, D.C.

1930 Reports of Research Committees and Papers. *Proceedings of the Tenth Annual Meeting of the Highway Research Board*. Division of Engineering and Industrial Research, National Research Council. Washington, D.C.

1931 Reports of Research Committees and Papers. *Proceedings of the Eleventh Annual Meeting of the Highway Research Board.* Division of Engineering and Industrial Research, National Research Council, Washington, D.C.

1934 Low Cost Steel Highway Bridges. Reports of Research Committees and Papers. *Proceedings of the Thirteenth Annual Meeting of the Highway Research Board.* Division of Engineering and Industrial Research, National Research Council. Washington, D.C.

1936 Stabilizing Soils with Portland Cement: Experiments by the South Carolina Highway Department. *Proceedings of the Sixteenth Annual Meeting of the Highway Research Board*. Division of Engineering and Industrial Research, National Research Council. Washington, D.C.

DeLorme Company

2001 *Iowa Atlas and Gazetteer*. Delorme Company, Yarmouth, Maine.

Dooley, Mathew A.

2004 Long-Term Hunter-Gather Land Use. *Plains Anthropologist* 49(190), pp. 105–127. Augstums Printing Service, Lincoln, Nebraska.

Drury, John

1955a *This is Washington County, Iowa*. The American Aerial County History Series, Iowa, No. 1. The Loree Company, Chicago.

1955b *This is Johnson County, Iowa*. The American Aerial County History Series, Iowa, No. 2. The Loree Company, Chicago.

1956 *This is Henry County, Iowa*. Inland Photo Company, Chicago, Illinois.

Federal Writer's Project, Works Progress Administration

1986 *The WPA Guide to 1930s Iowa*. Reprinted with introduction by Joseph Frazier Hall. Originally published in 1938 as: *Iowa, A Guide to the Hawkeye State.* Iowa State University Press, Ames.

Fisher, Albert E.

1916 The County Engineer in Iowa. *Transit*, Vol. 20, pp. 61–63. Chestnut Printing, Iowa City, Iowa.

Fisher, Kathy

1978 *In The Beginning There Was Land: A History of Washington County, Iowa*. The Washington County, Historical Society, Washington, Iowa.

Ford, J. F.

1919a Letter of August 28, 1919, to Fred R. White, Chief Engineer, Iowa State Highway Commission. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1919b Letter of September 10, 1919, to Fred R. White, Chief Engineer, Iowa State Highway Commission. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Fowell, John

1927 Dewey Portland Cement. *Transit*, Vol. 3, pp. 41–43. University of Iowa, Iowa City.

Fowler, Orson S.

1964 *The Octagon House: Home For All*. Reprinted. Dover Books, New York. Originally published 1848 and revised in 1853.

Fraser, Clayton B.

1993 *Iowa Historic Bridge Inventory: Inventory Report*. Vols. II–VIII (Linn, Jefferson, Johnson, Henry, Monroe, Wapello, and Washington counties). Report submitted to the Iowa Department of Transportation by Fraserdesign, Loveland Colorado. May 1993. Printed by the Iowa Department of Transportation, Ames, Iowa. Copy on file, Iowa DOT Library, Ames, Iowa.

Fraser Clayton B, and Jon Roberts

1995 *Highway Bridges in Iowa 1868–1945*. National Register of Historic Places: Multiple Property Documentation Form: Section E-I. Report on file, State Historical Society of Iowa, Des Moines.

Gearhart, Ralph. W.

1920 Letter of October 7, 1920, to Robert N. Carson, President, Red Ball Road Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Geyer, Orel R.

1915 How Iowa is Rebuilding Her Roads. *Road-Maker* 6(6), pp. 3–4. Road-Maker Magazine, Des Moines, Iowa.

Given, Robert H.

2000 The Iowa Scene. The Financing and Historic Construction of the "Coleman Road" in Lee and Henry Counties, Iowa, 1926–1948. Letter of November 13th, 2000, to J. H. Zaletel. Iowa Concrete Paving Association, Ankeny, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

Goldbeck, A. T.

1912 Methods of Testing Road Materials. *Road-Maker* 2(5), pp. 4–6. Road-Maker Magazine, Des Moines, Iowa.

Gousha, H. M.

1935 *Standard Oil Company 1935 Official Road Map: Iowa*. H. M. Gousha Company, Chicago.

Gubbels, Jack L.

1938 *American Highways and Roadsides*. Houghton Mifflin, The Riverside Press, Boston.

Hammand, O. A.

1915 300 Miles of Iowa Gravel Road in Greene County. *Road-Maker* 6(6), pp. 1–2. Road-Maker Magazine, Des Moines, Iowa.

Hansen, Marcus L.

1970 Phantoms of the Old Road. *The Palimpsest* 51(6), pp. 251–264. The State Historical Society of Iowa Library, Iowa City, Iowa.

Harger, Wilson G., and Edmund A. Bonney

1919 *Handbook for Highway Engineers*. McGraw-Hill Books, New York, N.Y.

Harlan, Edgar R.

1912 The Old Iowa State Roads. *Road-Maker*, pp. 7–8. Road-Maker Magazine, Des Moines, Iowa.

Harrison, J. H.

1925 Letter of July 28, 1925, to Robert N. Carson, President, Red Ball Road Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Harvey, Richard P.

1916 An Evolution in Concrete Construction. *Road-Maker* 10(1), pp. 6–7. Road-Maker Magazine Moline, Illinois.

Hileman, R. G.

1965 Iowa's Primary Roads System, 1919–1964: A Statistical Record. *The Palimpsest* 47(2), inside back cover. State Historical Society of Iowa, Iowa City.

Hirst, Kris

1990 Archaeological Resources of Washington and Henry Counties in Southeastern Iowa. A Phase I Archaeological Survey of Primary Roads Project F-218-2(2&3), a.k.a. PIN 84-44030-1 and 84-92040-1 & 2, Henry and Washington Counties, Iowa. *Project Completion Report* 13(76). Copy on file, Office of the State Archaeologist, Iowa City.

1994 A Supplemental Historic Architectural Survey of Primary Roads Project F-218-2(2&3), a.k.a. PIN 84-44030-1 and 84-92040-1 & 2, Henry and Washington Counties, Iowa. *Supplement to Project Completion Report* 21(7). Copy on file, Office of the State Archaeologist, Iowa City.

Hokanson, Drake

1989 Transportation and the Iowa Landscape. From *Take This Exit: Rediscovering the Iowa Landscape*. Robert F. Sayre (editor), pp. 281–297. Iowa State University Press, Ames, Iowa.

Huebinger, M.

1904 *Atlas of the State of Iowa*. Iowa Publishing Company, Davenport, Iowa.

Huebinger Publishing Company

1910 *Huebinger's Map and Guide for The River to River Road*. Iowa Publishing Company, Des Moines, Iowa. Original on file, The Iowa State Historical Society Library, Iowa City.

1912a *Huebinger's Automobile and Good Road Atlas of Iowa*. The Iowa Publishing Company, Des Moines, Iowa. Original on file, University of Iowa Library Special Collections, Iowa City.

1912b *Huebinger's Map and Guide for Blue Grass Road: A Model Dirt Road Through the Famous Blue Grass Belt of Iowa*. Iowa Publishing Company, Davenport, Iowa. Original on file, The Iowa State Historical Society Library, Iowa City.

1913 *Huebinger's Pocket Automobile Guide for Iowa*. The Huebinger Publishing Company, Davenport, Iowa. Original on file, The Iowa State Historical Society Library, Iowa City.

1915 *Huebinger's Good Roads Map of Louisa County, Iowa*. Iowa Publishing Company, Des Moines, Iowa. Original on file, Louisa County Historical Society, Wapello, Iowa.

1924 *Huebinger's Road Guide for Iowa*. The Huebinger Publishing Company, Peoria, Illinois.

Huebinger Survey and Map Publishing Company

1900 *Atlas of Johnson County, Iowa*. The Huebinger Survey and Map Publishing Company, Davenport, Iowa. Original on file, The Iowa State Historical Society Library, Iowa City.

Hunt, H. W.

1926 Good Roads in Johnson County. *Transit* 30(7), pp. 171–177. The University of Iowa, Iowa City.

Ingalls, Marlin R.

1978 *The Lost Slab: Illinois' First Poured Concrete Pavement.* A Preliminary Historical and Archaeological Reconnaissance Level Survey, Flat Rock, Crawford County, Illinois. Conducted for the Illinois Department of Transportation, Springfield, Illinois, by The Midwest Archaeological Resource Center, Illinois State University, Normal, Illinois.

1990 Agricultural Resources and Settlement Landscapes of Washington and Henry Counties in Southeastern Iowa. A Historic Architectural Survey of Primary Roads Project F-218-2(2&3), a.k.a. PIN 84-44030-1 and 84-92040-1 & 2, Henry and Washington Counties, Iowa. *A Historic Architectural Supplement to Project Completion Report* 13(76). Copy on file, Office of the State Archaeologist, Iowa City.

1994 A Phase II Historic Architectural Evaluation of the Kimball House and the Marsh Bridge. Primary Roads Project NHS-18-6(32)--19-34, a.k.a. PIN 90-34060-1, Floyd County, Iowa. *Project Completion Report* 17(58). Copy on file, Office of the State Archaeologist, University of Iowa, Iowa City.

1996 A Phase I Historic Architectural Survey of Primary Roads Project NHS-63-8(17)--19-09, a.k.a. 91-19010-1&2, PIN 91-19500-1, Bremer, Chickasaw, and Floyd Counties, Iowa. *Project Completion Report* 19(7). Copy on file, Office of State Archaeologist, University of Iowa, Iowa City.

Institute of Transportation Studies

2001 *Sources of Information on Highways: A Bibliography*. Edited by Daniel C. Krummes. Institute of Transportation Studies, University of California at Berkeley.

Iowa Department of Cultural Affairs

2005 Historic Preservation Plan. Imagine Iowa: 2010 Preservation Partner Comment Draft. State Historical Preservation Office, Iowa Department of Cultural Affairs, State Historical Society of Iowa, Des Moines.

Iowa Department of Natural Resource

2000 *Iowa–Portrait of the Land*. Published by the Iowa Department of Natural Resources, Des Moines, Iowa.

2006 1930s Digital Georectified Image of Johnson County, Iowa, in MrSid Format. Web site at http://www.igsb.iowa.edu/nrgislibx/, accessed September 15, 2006.

2006 1930s Digital Georectified Image of Linn County, Iowa, in MrSid Format. Web site at http://www.igsb.iowa.edu/nrgislibx/, accessed September 15, 2006.

Iowa Department of Transportation (Iowa DOT)

ca. 1916 Paving Folder. On file, Iowa DOT Library, Ames, Iowa.

ca. 1925a I-beam underpass structure constructed on U.S. Highway 34 between Fairfield and Mount Pleasant in Henry County, Iowa. Iowa Project WPGH 151-A. Bridges and Culverts Folder. Original on file, Iowa DOT Library, Ames, Iowa.

ca. 1925b Henry County, Mount Pleasant Bridge. Bridges and Culverts Folder. Original on file, Iowa DOT Library, Ames, Iowa.

ca. 1925c Henry County, U.S 34 West of Mount Pleasant. Bridges and Culverts Folder. Original on file, Iowa DOT Library, Ames, Iowa.

ca. 1925d Washington County Culvert. Bridges and Culverts Folder. Original on file, Iowa DOT Library, Ames, Iowa.

ca. 1926 Cattle Pass (photo). Miscellaneous Folder. Original on file, Iowa DOT Library, Ames, Iowa.

ca. 1927a Coleman Road Folder. On file, Iowa DOT Library, Ames, Iowa.

ca. 1927b Alexander Coleman and Others (photo). Coleman Road Folder. Article on file, Iowa DOT Library, Ames, Iowa.

ca. 1928 Washington County, Carson Culvert. Bridges and Culverts Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1986 *Registered Highway Routes of Iowa: 1914 to 1925*. Map prepared by the Transportation Cartographic Section. Published by the Iowa Department of Transportation, Ames, Iowa.

ca. 1995a *Iowa Scene: Financing and 1927 Construction of the Coleman Road, Lee and Henry Counties, Iowa.* Coleman Road Folder. Copy on file, Iowa DOT Library, Ames, Iowa.

ca. 1995b *Iowa Scene: Financing and Historic Construction of the Coleman Road, Lee and Henry Counties, Iowa: 1926–1948.* Coleman Road Folder. Copy on file, Iowa DOT Library, Ames, Iowa.

1997 *Building Better Roads: Iowa's Contribution to Highway Engineering 1904–1974*. Iowa Department of Transportation. Center for Transportation Research and Education at Iowa State University, Ames, Iowa.

1999 *Discovering Historic Iowa Transportation Milestones*. Iowa Department of Transportation, Director's Staff Division, Ames, Iowa.

2001 General Highway and Transportation Maps: Black Hawk, Bremer, Chickasaw, Des Moines, Floyd, Henry, Jefferson, Johnson, Lee, Linn, Lucas, Mitchell, Monroe, Wapello, Washington Counties, Iowa. Published by the Iowa Department of Transportation, Ames, Iowa.

2005 *Historic Bridges of Iowa*. Iowa Department of Transportation, Ames, Iowa. Web site link at: http://www.ole.dot.state.ia.us/historicbridge/default.asp

Iowa Journal of History and Politics

1920 From Stage to Buss Line. *Iowa Journal of History and Politics* 18(1), p. 146, The State Historical Society of Iowa, Iowa City. Originally published in the Des Moines Register, Dec. 21, 1919.

Iowa State Highway Commission

1905a *Manual for Iowa Highway Officers*. Iowa Highway Commission, Ames, Iowa. On file at Iowa DOT Library, Ames, Iowa.

1905b Reinforced Concrete Test Culverts of the Iowa Highway Commission, Iowa State College, Ames, Iowa (photo). *Iowa State Highway Commission Annual Report*, p. 28. Iowa Highway Commission, Ames, Iowa.

1905c *First Annual Report of the Iowa State Highway Commission*. Iowa State Highway Commission, Ames, Iowa. Murphy, State Printer, Des Moines, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1906 *Iowa Highway Commission First Annual Report*, pp. 30–35, 42–46, 60, 71–74. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1907 *Iowa Highway Commission Second Annual Report*. Iowa State Highway Commission, Ames, Iowa. Emory H. English, State Printer, Des Moines, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1909 *Iowa State Highway Commission Third Annual Report*. Iowa State Highway Commission, Ames, Iowa. Emory H. English, State Printer, Des Moines, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1913a Registration of Highway Routes: Application for Red Ball Route. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1913b Methods of Testing Road Materials. *Iowa State Highway Commission Service Bulletin*, Supplement of 2(5), pp. 2–12. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1914a Registration of Routes. *Iowa State Highway Commission Report*: *1913–1914*, p. 73. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1914b History of the Iowa Road Law. *Iowa State Highway Commission Service Bulletin*, Supplement of 2(5), pp. 2–12. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1914c Convicts Building Concrete Road at Columbus Junction. *Iowa State Highway Commission Report: Special Assignments*, Part 2, Section 3, p. 94. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1914d Convicts Building Concrete Road at Columbus Junction. *Iowa State Highway Commission Report: Special Assignments* 2(10), pp. 3–5, 13. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1914e Wapello Banishes the Wooden Death Trap on County Roads. *Iowa State Highway Commission Service Bulletin* 2(7), p. 7. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915a Convict Culvert and Lyons County Bridge (photos & captions). *Iowa State Highway Commission Second Annual Report*, pp. 12, 55. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915b The Commission's Standard Design for Handrails on Concrete Slab and Girder Bridges (photo & caption). *Iowa State Highway Commission Second Annual Report*, p. 53. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915c Concrete Headwall Construction (photo & caption). *Iowa State Highway Commission Second Annual Report*, pp. 53, 78. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915d Experiments, Tests, and Technical Investigation. Core Testing (photo). *Iowa State Highway Commission Second Annual Report*, pp. 7–10, 134–135. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames. Iowa.

1915e Railroad Crossings in Iowa Total 8,676. *Iowa State Highway Commission Service Bulletin* 3(1), pp. 3–4, 16. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915f Old and New Metal Bridges in Iowa: Standard Pony Truss in Striking Contrast to the Flimsy Bridges of "The Good Old Days" in Bridge Building. *Iowa State Highway Commission Service Bulletin* 3(2–3), pp. 3–5. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915g Farm Entrance Concrete Bulkhead Culvert (photo & caption). *Iowa State Highway Commission Service Bulletin* 3(4–5), pp. front cover, 1–4. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915h How to Stop Iowa's Annual Grade Crossing Slaughter. *Iowa State Highway Commission Service Bulletin* 3(1), front cover. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915i Iowa Spent on Bridges and Culverts During 1914, $5,027,000. *Iowa State Highway Commission Service Bulletin* 3(4), pp. front cover. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915j Iowa Standard Concrete Box Culvert with Flaring Wing Walls, "Iowa Built 5,000 concrete culverts during 1914." *Iowa State Highway Commission Service Bulletin* 3(4–5), p. 6. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915k Low Record on Steel Erected. *Iowa State Highway Commission Service Bulletin* 3(4–5), p. 13. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915l Twenty Thousand Dollars Worth of Bridges Rejected. *Iowa State Highway Commission Service Bulletin* 3(7), pp. 7–10. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915m Muscatine County Proposes Adopting Uniform Road Numbering System. *Iowa State Highway Commission Service Bulletin* 3(7), p. 13. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915n Road Building at State Institutions. *Iowa State Highway Commission Service Bulletin* 3(7), pp. 12–13. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915o Northwest Road Congress at Cedar Rapids. *Iowa State Highway Commission Service Bulletin* 3(8), p. 8. Iowa Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915p County Engineers and Their Headquarters. *Iowa State Highway Commission Service Bulletin* 3(8), p. 15. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915q Iowa is Using 100 Convicts in Road Building Camps. *Iowa State Highway Commission Service Bulletin* 3(9–10), pp. 3–5, 15. Iowa State Highway Commission, Ames, Iowa.

1915r Convict Labor Has Big Job Building North Road at Iowa State College. *Iowa State Highway Commission Service Bulletin* 3(9–10), pp. front cover, 1–5. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915s Highway Signs in Henry County. *Iowa State Highway Commission Service Bulletin* 3(9), p. 12. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1915t Picture of Agency Road out of Burlington. *Iowa State Highway Commission Service Bulletin* 3(11), front cover. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1916a *Iowa Road Building and Maintenance: Photographs of Types and Methods.* Book A. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1916b Iowa Road and Bridge Expenditures for 1915. *Iowa State Highway Commission Service Bulletin* 4(3), pp. 2–3. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1916c Tourist Trail Organizations Fail to Register Routes. *Iowa State Highway Commission Service Bulletin* 4(4), pp. 11–12. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1916d Thousands of Impassable Mud Holes Marred Iowa Highways During the Spring Months. *Iowa State Highway Commission Service Bulletin* 4(5–6). Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1916e Deck Girder Bridge with Ornamental Handrail near West Union; Other Girder Concrete Bridges; and Map of the Dubuque–Dyersville Post Road (photo). *Iowa State Highway Commission Service Bulletin* 4(12), pp. 3–7. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1917a Can Appalling List of 1916 Highway Fatalities Shock Iowans Into Saner Driving in 1917? and Iowa Spent $14,337,056 During 1916 on Roads and Bridges. *Iowa State Highway Commission Service Bulletin* 5(1–3), pp. 3–10. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1917b Federal Aid Project #9: Johnson County, Red Ball and River to River Route. *Iowa State Highway Commission Report*. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1917c Columbus Junction–Fredonia Oiled Road. Iowa State Highway Commission Service Bulletin 5(4–5), p. 4. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1917d Ringgold With Hills and Valleys Galore Faces Heroic Task in Building Roads and Bridges. *Iowa State Highway Commission Service Bulletin* 5(8), pp. 4–6. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1917e Completed Registration Application. Letter from Iowa State Highway Commission to the Blue Grass Road Association. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1918a Table of Road and Bridge Expenditures for 1914–1917 and Drop Culvert photo. *Iowa State Highway Commission Service Bulletin* 6(3–4), pp. cover–9, 55. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1918b Report on Existing Bridges and Culverts on Eight Principal Highway Routes. *Iowa State Highway Commission Fifth Annual Report*, Chapter IV, p. 55. Bridge Department. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1919a Registration of Highway Routes. *Iowa State Highway Commission Report*, p. 23. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1919b Traveling Through Gravel Not Over It. Iowa State Highway Commission Service Bulletin 7(5–6), front cover. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1919c *Iowa Primary Roads System Map*. Published by Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library Map Drawer.

1920a Summary of 1920 Road Program by Counties. *Iowa State Highway Commission Service Bulletin* 8(1), p. 6. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1920b Iowa Primary Roads to be Marked with Official Standard Symbol and Number, July 12 to 17. *Iowa State Highway Commission Service Bulletin* 8(5–6), pp. 3–4. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1921a Iowa During 1920 Spent $28,024,924 for Road and Bridge Building on 104,082 Miles of Highway: Iowa Primary Roads System Condition Records Show Good Progress Made During 1920; Iowa Has Enough Laws to Produce Roads as Fast as Economic Conditions Permit. *Iowa State Highway Commission Service Bulletin* 9(1), pp. 3–9. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1921b Eldora Automobilist Would Have Mileage Painted on Number Signs. *Iowa State Highway Commission Service Bulletin* 9(1), p. 12. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1921c List of District and County Engineers of the State of Iowa. Iowa State Highway Commission Service Bulletin 9(2), p. 15. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1921d Sixty Contractors With Probably 200 Individual Dirt Moving Outfits Making Dirt Fly on Grading Contracts. Iowa State Highway Commission Service Bulletin 9(5–6), p. 36. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1921e Unique Guard Rail. *Iowa State Highway Commission Service Bulletin* 9(3–4), p. 12. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1921f *Iowa State Highway Commission Service Bulletin* 9(9–10), front cover. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1921g Road Signs Should be Placed So They Will Not Interfere with Road Maintenance. *Iowa State Highway Commission Service Bulletin* 9(11–12), pp. 9–10, 15. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1922a Advertising Sign Ban and No Rails (photo). *Iowa State Highway Commission Service Bulletin* 10(1), pp. 9, 14. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1922b Improvement Program Planned and Proposed for Iowa Primary Roads System in 1922. *Iowa State Highway Commission Service Bulletin* 10(2), p. 8. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1922c Iowa Roads—Maintenance and Improvement Procedure. The Iowa Road System. *Iowa State Highway Commission Service Bulletin,* Supplement to 10(3), pp. 3–16. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1922d End of 12 Foot Bridges. *Iowa State Highway Commission Service Bulletin* 10(4–5), p. 4. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1922e "Slow Turn" Signs Takes Place of Arrows Indicating Turns on the Iowa Primary Roads System. *Iowa State Highway Commission Service Bulletin* 10(4–5), pp. 9–11, 13. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1923f Guard Rail Construction is One of the Heavy Expenses on the Primary Roads System (photo). *Iowa State Highway Commission Service Bulletin* 11(1–3), pp. 5, 8. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1923g Penalty for Tearing Down Highway Signs May be Year in the Pen. *Iowa State Highway Commission Service Bulletin* 11(4–6), p. 9. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1924 Deck Truss Bridge of Big Creek on Road No. 8 Between Mount Pleasant and Rome (photo). *Iowa State Highway Commission Eleventh Annual Report*, pp. 176–177. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1925a Map of Iowa Primary Roads Condition—January 1925. *Iowa State Highway Commission Service Bulletin* 12(1–3), p. 8. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1925b Standard Specifications for Bridge and Culvert Materials. *Service Bulletin of The Iowa State Highway Commission* Supplement to 8(5). Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1925c Standard Specifications for Highway Bridges, Culverts and Incidental Structures. *Service Bulletin of The Iowa State Highway Commission* Supplement to 13(5). Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1925d Map of Primary Roads Condition at end of Three Year Road Building Program–December 31, 1928. *Iowa State Highway Commission Service Bulletin* 13(7–9), p. 2. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1925e Map for the Construction Program for the 1926 Season: Tables of 1926–1928. Detailed Construction and Financial Program. *Iowa State Highway Commission Service Bulletin* 13(7–9), pp. 5–16. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1925f Iowa Primary Roads Soon to be Renumbered and Remarked to Conform to U.S. System of Interstate Highways. *Iowa State Highway Commission Service Bulletin* 13(10–12), pp. 3–12. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1926a Front Cover and Road Condition Map–January 1, 1926. *Iowa State Highway Commission Service Bulletin* 14(1–3). Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1926b Alexander Coleman, Retired Farmer Gives Quarter Million Dollars to Build a Paved Road. *Iowa State Highway Commission Service Bulletin* 14(4–6), pp. 6–7. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1926c Twelve Iowa Counties Authorize 421 Miles of Pavement Since January 1, 1926. *Iowa State Highway Commission Service Bulletin* 14(4–6). Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1926d Iowa Primary Roads System Now Permanently Marked. *Iowa State Highway Commission Service Bulletin* 14(10–12), pp. 7, 8, 14. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1926e Painted Center Line On Iowa Pavements Says–"Keep on Your Own Side of the Road." *The Iowa State Highway Commission Service Bulletin* 14(79), front cover. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1926f Two-Man Crew Spends Three Months Painting Center Line Mark For Accident Prevention. *The Iowa State Highway Commission Service Bulletin* 14(7–9), pp. 3–8. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1926g 1920 and 1926 Maps of County Seat Towns Reached from Des Moines on Surfaced Roads. *Iowa State Highway Commission Service Bulletin* 14(10–12), pp. 4–5. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1927a Deaths, Injuries, Accidents, Compared with Number of Cars Registered 1916–1926 and Accidents in Which No Fatalities Occurred January 1, 1926 to January 1, 1927. *Iowa State Highway Commission Service Bulletin* 15(1–3), p. 9. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1927b 1927 District and County Engineers of Iowa. *Iowa State Highway Commission Service Bulletin* 15(1–3), p. 12. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1927c Iowa is Wiping Out Her Mud Roads at the Rate of Two Miles of Paving per Day. *Iowa State Highway Commission Service Bulletin* 15(4–6), pp. 3–5, 9. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1927d Road Condition Map–December 15, 1926. *Iowa State Highway Commission Service Bulletin* 15(7–9), p. 4. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1927e Standard Specifications for Road Construction. *Service Bulletin of the Iowa State Highway Commission* Supplement to 15(5). Reprint of Series of 1925. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1930a Organization of Commission. *Iowa State Highway Commission Seventeenth Annual Report*. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa, pp. 12–14.

1930b Standard Specifications for Construction Work on the Secondary Road System. *Service Bulletin of the Iowa State Highway Commission* Supplement to 18(4). Iowa State Highway Commission, Ames, Iowa.

1930c Standard Specifications for Materials for Construction Work on the Primary and Secondary Road Systems. Reprint of Part IV. Standard Specifications of 1930. *Service Bulletin of the Iowa State Highway Commission* Supplement to 18(5). Iowa State Highway Commission, Ames, Iowa.

1930d Roads Completed Across State. *Iowa State Highway Commission Seventeenth Annual Report*, pp. 5–6. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

1931 Winter Condition. Weekly Service Map: Type of Roadway and Construction Condition. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

Iowa State Highway Commission–Letters

1913a Letter from Iowa State Highway Commission, September 18, 1913, to the Blue Grass Road Association). Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1913b Letter of October 27, 1913, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1913c Letter of October 23, 1913, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Road Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1913d Letter of November, 1913, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1913e Letter of December 23, 1913, from Iowa State Highway Commission to the Blue Grass Road Association. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1913f Letter of December 23, 1913, from Iowa State Highway Commission to Brown and Mossman. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1913g Letter of December 25, 1913, from Iowa State Highway Commission to Robert N. Carson. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1913h Letter of December 27, 1913, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1913i Letter of December 29, 1913, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1914a Letter of January 12, 1914, from Iowa State Highway Commission to Treasurer of the State of Iowa. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1914b Letter of May 6, 1914, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1914c Letter of June 12, 1914, from Iowa State Highway Commission to Dr. Mark A. Newland. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1914d Letter of August 13, 1914, from Iowa State Highway Commission to Robert N. Carson, President, Iowa Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1914e Letter of October 5, 1914, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1914f Letters of November 2 and 5, 1914, from Iowa State Highway Commission on Red Ball Route Association. Red Ball Route Folder. Original on File, Iowa DOT Library, Ames, Iowa.

1916a Letter of February 14, 1916, from Iowa State Highway Commission to the Blue Grass Route Association. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916b Letters of February 12 and 23, 1916, from State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916c Letters of February 23 and 25, 1916, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916d Letter of March 2, 1916, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916e Letter of May 16, 1916, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916f Letter of May 19, 1916, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916g Letter of May 29, 1916, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916h Letter of June 2, 1916, from Iowa State Highway Commission to S. B. Bellamy. Blue Grass Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916i Letter of June 2, 1916, from Iowa State Highway Commission to F. O. Martin. Blue Grass Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1916j Letter of September 7, 1916, from Iowa State Highway Commission to the Blue Grass Route Association. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1917a Letter of October 8, 1917, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1917b Letter of November 1, 1917, from Iowa State Highway Commission to Blue Grass Route Association. Blue Grass Road Folder, Original on file, Iowa DOT Library, Ames, Iowa.

1917c Letter of December 14, 1917, from Iowa State Highway Commission to Blue Grass Route Association. Blue Grass Road Folder, Original on file, Iowa DOT Library, Ames, Iowa.

1919a Letter of January 3, 1919, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1919b Letter of February 5, 1919, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1919c Letter of February 25, 1919, from Iowa State Highway Commission Road Engineer to L. M. Martin to Blue Grass Route Association. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1919d Letter of August 27, 1919, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1919e Letter of August 27, 1919, from Iowa State Highway Commission to National Trail Markers Association. Blue Grass Road Folder, Original on file, Iowa DOT Library, Ames, Iowa.

1919f Letter of September 18, 1919, from Iowa State Highway Commission to the Blue Grass Route Association. Blue Grass Road Folder, Original on file, Iowa DOT Library, Ames, Iowa.

1919g Letter of September 25, 1919, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1919h Letter of September 29, 1919, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920a Letter of August 31, 1920, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920b Letter of September 1, 1920, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920c Letter of September 1, 1920, from Iowa State Highway Commission to W. P. Rawn, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920d Letter of September 1, 1920, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920e Letter of September 1, 1920, from Iowa State Highway Commission to W. P. Rawn, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920f Letter of September 1, 1920, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920g Letter of September 11, 1920, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920h Letter of October 4, 1920, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920i Letter of October 4, 1920, from Iowa State Highway Commission to Ralph W. Gearhart, Engineer, Linn County. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920j Letter of October 16, 1920, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920k Letter of October 23, 1920, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1920l Letter of October 26, 1920, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1921a Letter of July 7, 1921, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1921b Letter of July 15, 1921, from Iowa State Highway Commission to Red Ball Route Association on Changes Through Floyd County. Back of ISHC Form #227. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1921c Letter of July 16, 1921, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1922 Letter of August 14, 1922, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1923a Letter of January 17, 1923, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1923b Letter of April 23, 1923, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1923c Letter of April 25, 1923, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1923d Letter of April 26, 1923, from Iowa State Highway Commission to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1925a Letter of July 14, 1925, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1925b Letter of September 24, 1925, from Iowa State Highway Commission to Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Iowa State Highway Commission–Maps

1920–1948 *Iowa Primary Roads System Map*. Published by Iowa State Highway Commission, Ames, Iowa. Originals on file, Iowa DOT Library Map Drawer, Ames, Iowa.

1932 *Official Map of Primary Roads System: State of Iowa*. Iowa State Highway Commission, Ames, Iowa.

Iowa State Highway Commission–Plans

1918a FA-3. Plan and Profile of Proposed Inter-County Highway, Federal Aid Project No. 3. Jefferson County: From Batavia to Fairfield and Glendale. 42 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1918b Plan and Profile of Proposed Inter-County Highway, Federal Aid Project No. 20. Monroe County: From Albia East to County Line. 18 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1920 FA-56. Plan and Profile of the Primary Roads System, Federal Aid Project No. 56. Henry County: North and Southeast from Mount Pleasant to the County Lines. 41 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1922–1926 FA 294. Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 294–June 1926. Jefferson County: From the Henry County Line West Thru Lockridge. 18 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1921 Plan and Profile of Proposed Improvement on the Primary Roads System, Primary Roads Project No. 97. Johnson County: South of Iowa City. 5 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1922a Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 159. Wapello County: West of Ottumwa and From Ottumwa North to County Line. 38 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1922b Plan and Profile of Proposed Improvement on the Primary Roads System. Johnson County: Northwest from North Liberty and Northwest from Tiffin. 18 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1923a Plan and Profile of Proposed Improvement on the Primary Roads System, Primary Roads Project No. 311. Johnson County: South of Iowa City. 15 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1923b Plan and Profile of Proposed Improvement on the Primary Roads System, Primary Roads Project No 78, Section A. Monroe County: West and South of Albia. 9 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1923c Plan and Profile of Proposed Improvement on the Primary Roads System, Primary Roads Project No 78, Section B, Albia Extension. Monroe County, West and South of Albia. 9 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1926a Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 240. Monroe County: From the Lucas County Line East Toward Albia. 22 Sheets. Original on File, Iowa State Highway Commission, Ames, Iowa.

1926b Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 246: Section B. Wapello County: From Ottumwa East through Agency to the Jefferson County Line: Construction Plans Showing Project as Built. 35 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1926c FA-53. Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid No. 53. Louisa County: Southeast of Wapello From Wapello Northwest to Columbus Junction and From Columbus Junction East to Grand View. 49 Sheets (8 extant). Original on file, Iowa State Highway Commission, Ames, Iowa.

1926d FA-151 A, B, D, E. Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 151, Sections A & B. Henry County: From the Jefferson County Line East To Mount Pleasant. 28 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1926e FA 294. Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 294, June 1926. Jefferson County: From the Henry County Line West Thru Lockridge. 18 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1926f FA 3. Plan and Profile of Proposed Inter-County Highway, Federal Aid Project No. 3, June 1926. Jefferson County: From Batavia to Fairfield and Glendale: Final Construction Plans–1926 Paving. 19 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1926g FA 3. Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 3, 1926 Grading. Jefferson County: West of Fairfield. 9 Sheets: August 1926. Original on file, Iowa State Highway Commission, Ames, Iowa.

1926h FA 3. Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 3, 1926 Paving. Jefferson County: From Fairfield West to the Wapello County Line. 53 Sheets (23 extant): November 1926. Original on file, Iowa State Highway Commission, Ames, Iowa.

1927a Plan and Profile of Proposed Improvement on the Primary Roads System, Primary Roads Project No. 554. Monroe County: Out of Albia West to the Lucas County Line. 37 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1927b Plan and Profile of Proposed Improvement on the Primary Roads System, Primary Roads Project No. 554. Monroe County: Out of Albia West to the Lucas County Line. 39 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1927c FA-56. Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 56. Henry County: U.S. Road No. 34 From the Des Moines County Line Northwest Through New London into Mount Pleasant. 23 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1927d FA-151. Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 151. Henry County: U.S. Road No. 34 From Mount Pleasant West to the Jefferson County Line. 28 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1927e FA 3. Plan and Profile of Proposed Inter-County Highway, Federal Aid Project No. 3–June 1926. Jefferson County: From Batavia to Fairfield and Glendale: Final Construction Plans, 1926 Paving. 19 Sheets: June 1926. Original on file, Iowa State Highway Commission, Ames, Iowa.

1928a Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 559, Corrected Plans. Wapello County: U.S. Road No. 34 From Ottumwa West to the Monroe County Line. 16 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1928b Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 559, 1928 Paving. Wapello County: U.S. Road No. 34 From Ottumwa West to the Monroe County Line. 28 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1929a Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 20, 1927 Paving. Monroe County: Out of Albia East to the Wapello County Line. 25 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1929b Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 578, Sections A, B, C, D, & F. Washington County: U.S. Road No. 161 From the Henry County Line North Through Crawfordsville. 43 Sheets: Revised March 1929. Original on file, Iowa State Highway Commission, Ames, Iowa.

1929c Plan and Profile of Proposed Improvement on the Primary Roads System, Primary Roads Project No. 412. Johnson County: U.S. Road No. 161 From Iowa City South. 13 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1929d F-56 D, E, F, G. Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 56, Section D, E, F, G, 1929 Paving. Henry County: U.S. Road 161 Out of Mount Pleasant North Through Olds to the Washington County Line. 29 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1930 Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 578, Section F. Washington County: U.S. Road No. 161 From the Johnson County Line South. 26 Sheets: Revised Jan. 1930. Original on file, Iowa State Highway Commission, Ames, Iowa.

1930–1932 Plan and Profile of Proposed Improvement on the Primary Roads System, Primary Roads Project No. 412, Construction Plans Showing Project as Built (February 1932). Johnson County: U.S. Road No. 161 From Iowa City South. 10 Sheets. Original on file, Iowa State Highway Commission of Iowa.

1931a Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 327, 1931 Paving. Washington County: U.S. Road No. 161 From Ainsworth North to the Johnson County Line. 67 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1931b Plan and Profile of Proposed Improvement on the Primary Roads System, Primary Roads Project No. 311, 1931 Paving. Johnson County: U.S. Road No. 161 From the Washington County Line North. 3 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1931–1933 Plan and Profile of Proposed Improvement on the Primary Roads System, U.S. Works Program Highway Project No. W. P. H. 9. Johnson County: U.S. Road No. 161 From Iowa City Northwest. 5 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1932a Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 9, 1932 Paving. Johnson County: U.S. Road No. 161 North of Iowa City. 12 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1932b Plan and Profile of Proposed Improvement on the Primary Roads System, Primary Roads Project No. 656: Construction Plans Showing Project as Built, 1930 Paving. Johnson County: U.S. Road No. 161 South of Iowa City Toward the Washington County. Line. 20 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1933 Plan and Profile of Proposed Improvement on the Primary Roads System, Federal Aid Project No. 578. Washington County: U.S. Road No. 161 From Ainsworth South to Henry County Line, Construction Plans Showing Project as Built. 22 Sheets: August 1933. Original on file, Iowa State Highway Commission, Ames, Iowa.

1939 Plan and Profile of Proposed Improvement on the Primary Roads System, U.S. Works Program Highway Project No. W. P. S. S. 570, Section A Grading. Johnson County: Primary Roads No. 153 From U.S. Road No. 161 South Towards Coralville. 9 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

1943 W.P.G.H 151 A. Plan and Profile of Proposed Improvement on the Primary Roads System, U.S. Works Program Grade Crossing Project No. W.P.G.H. 151, Section A Paving. Henry County: Overpass on U.S. Road No. 34 & C.B. & Q. R.R. West of Rome. 22 Sheets. Original on file, Iowa State Highway Commission, Ames, Iowa.

Iowa State Highway Commission and Department of Justice

1915 Recent Road Legislation of Iowa. Part I: Basic Road Law and General Index, pp. 5, 95–103. *Published by Iowa State Highway Commission and Department of Justice*. Original on file, Iowa DOT Library, Ames, Iowa.

Iowa State University

2006 Iowa Geographic Map Server. Iowa State University GIS Facility. Iowa State University Geographic Information Systems Support and Research Facility, Ames, Iowa. Web site at http://cairo.gis.iastate.edu/.

Iowan Magazine

1918a Cut Out Guessing About Roads. *The Iowan Magazine* 2(5), pp. 7, 46, 47. The Greater Iowa Association, Davenport, Iowa

1918b Paved Roads in Iowa–The Mason City-Clear Lake Road. *The Iowan Magazine* 2(5), p. 36. The Greater Iowa Association, Davenport, Iowa.

1918c Editorial: “Good Roads.” *The Iowan Magazine* 2(6), pp. 5–16. The Greater Iowa Association, Davenport, Iowa.

1918d People Demand Permanent Roads. *The Iowan Magazine* 2(6), pp. 10–21. The Greater Iowa Association, Davenport, Iowa.

Iowa Writers' Program
1942 *Ringgold County History, Iowa*. Compiled and written by the Iowa Writers' Program of the Works Projects Administration in the State of Iowa. Jessie M. Parker, State Superintendent of Public Instruction, State-Wide Sponsor of the Iowa Writers' Program, Mount Ayr, Iowa. Copy on file, The University of Iowa Libraries, Iowa City.

Jackson, F. S.
1916 Lockridge Auto Company (advertisement). *Lockridge Times* 7(49), p. 1. Original on file, Iowa DOT Library, Ames, Iowa.

Jacoby, Henry S., and Roland P. Davis
1941 *Foundations of Bridges and Buildings*. McGraw-Hill, New York.

Jester, Thomas C. (editor)
1995 *Twentieth-Century Building Materials: History and Conservation.* McGraw-Hill, produced by Archetype Press, Washington, D.C.

Jones, C. R.
1923a Letter of May 23, 1923, to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.
1923b Letter of May 28, 1923, to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.
1923c Letter of July 24, 1923, to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.
1925 Letter of September 14, 1925, to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.
1925 Letter of October 15, 1925, to Robert N. Carson, President, Red Ball Route Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Kelley, E. F.
1915 Old and New Metal Bridges in Iowa. *Iowa State Highway Commission Service Bulletin,* 3(2–3), pp. 3–5. Iowa State Highway Commission, Ames, Iowa. Original on file, Iowa DOT Library, Ames, Iowa.

Kenyon and Company
1919 *Map of Iowa Showing Principal Automobile Routes*. The Kenyon Company, Des Moines.

Kirkpatrick, Inez
1975 *Stage Coach Trails in Iowa*. J-B Publishing, Crete, Nebraska.

Koster, George E.
1997 *A Story of Highway Development in Nebraska*. Published by the Department of Roads, Lincoln, Nebraska.

Landis, Leo
1997 *Building Better Roads: Iowa's Contribution to Highway Engineering 1904–1974*. Center for Transportation Research and Education, Iowa State University, Ames, Iowa.

Levan, Alvin
1916 Reinforced Concrete Arch Bridge at Yellowstone National Park. *Transit*, Vol. 20, p. 40. University of Iowa, Iowa City.

Lichtenstein Consulting Engineers, Inc.
2000 *Delaware's Historic Bridges. Survey and Evaluation of Historic Bridges with Historic Contexts for Highways and Railroads*. Prepared for Delaware Department of Transportation, Division of Highways Location and Environmental Studies Office. Second Edition Revised 2000. Delaware Department of Transportation, Dover.

Loper, S. L.
1916 Letter of 1916, to Iowa Blue Grass Road Association. Blue Grass Road Folder, Original on file, Iowa DOT Library, Ames, Iowa.

Lockridge Times
1916a Advertisement for Lockridge Livery and Auto Service, 7(48), p. 6. Lockridge Times, Lockridge, Iowa.
1916b Iowa News Section, September 22, 1916, 7(48), p. 2. Lockridge Times, Lockridge, Iowa.
1916c Advertisement for Lockridge Auto Company, September 29, 1916, 7(49), p. 1. Lockridge Times, Lockridge, Iowa.
1916d Advertisement for Union Auto School, 7(49), p. 2. Lockridge Times, Lockridge, Iowa.
1916e State Awaiting Federal Road Aid Share, 7(50), p. 2. Lockridge Times, Lockridge, Iowa.

1916f Iowa News: Wapello County Road Improvements, 7(50), p. 2. Lockridge Times, Lockridge, Iowa.
1916g Iowa News: The Modern Highwayman, 7(50), p. 6. Lockridge Times, Lockridge, Iowa.
1916h Auto Toll is Heavy, 7(50), p. 3. Lockridge Times, Lockridge, Iowa.
1916i New Road Plan, 7(51), p. 4. Lockridge Times, Lockridge, Iowa.
1916j Iowa News: Advertisement for Algona Concrete Paving, 7(51), p. 5. Lockridge Times, Lockridge, Iowa.
1916k The Greatest State: Iowa Ranks First in Number of Autos Per Person, 7(53), p. 1. Lockridge Times, Lockridge, Iowa.
1916l Iowa News: Street Paving, October 20, 1916, 7(53), p. 2. Lockridge Times, Lockridge, Iowa.
1916m Farmers Gravel the Streets: 1 day…100 Loads of Gravel, 7(54), p. 5. Lockridge Times, Lockridge, Iowa.
1916n Iowa News: Okoboji Trail Association: Spirit Lake/Okoboji Road, 7(55), p. 6. Lockridge Times, Lockridge, Iowa.
1916o Federal Road Aid, 7(55), p. 6. Lockridge Times, Lockridge, Iowa.
1916p Board of Supervisor's News: Contract for Merrimac Bridge Let to Ottumwa Steel, 7(55), p. 1. Lockridge Times, Lockridge, Iowa.
1916q Iowa News: Jefferson County Paving Costs, December 8, 7(55), p. 2. Lockridge Times, Lockridge, Iowa.
1916r Buy Auto Licenses: Remarkable Increase in Number of Cars, December 8, 1916, 7(55), p. 2. Lockridge Times, Lockridge, Iowa.
1916s Sioux City Paves 19 Miles of County Roads under Farr Paving Law, December 15, 1916, 7(55), pg. 2. Lockridge Times, Lockridge, Iowa.
1916t Iowa News: Graveling Roads in Greene County, December 29, 1916, 7(55), p. 2. Lockridge Times, Lockridge, Iowa.
1917a Road Report Filed: Highway Commission on Surfacing Practices, Convict Labor, Materials and Loads, January 12, 1917, 7(55), p. 4. Lockridge Times, Lockridge, Iowa.
1917b Iowa News, 7(55), p. 3. Lockridge Times, Lockridge, Iowa.
1917c Prepare Highway Tax, 7(55), p. 4. Lockridge Times, Lockridge, Iowa.
1917d Senate Favors Wide Roads, 7(55), p. 4. Lockridge Times, Lockridge, Iowa.
1917e Ask For New Road Near Lockridge, 7(55), p. 1. Lockridge Times, Lockridge, Iowa.
1917f Good Roads Help Boost: Lockridge Trustees Favor Better Roads, 7(55), p. 1. Lockridge Times, Lockridge, Iowa.
1917g Notice to Road Draggers, 7(55), p. 1. Lockridge Times, Lockridge, Iowa.
1917h Third Road Bill Offered, 7(55), p. 2. Lockridge Times, Lockridge, Iowa.
1917i Road Bills Killed, 7(55), p. 3. Lockridge Times, Lockridge, Iowa.
1917j Another Road Bill, 7(55), p. 3. Lockridge Times, Lockridge, Iowa.
1917k Would Regulate Trucks, 7(55), p. 3. Lockridge Times, Lockridge, Iowa.
1917l Bill to Aid Gravellers, 7(55), p. 3. Lockridge Times, Lockridge, Iowa.
1917m State May Make Cement, 7(55), p. 13. Lockridge Times, Lockridge, Iowa.
1917n Iowa News: Mount Pleasant City Council on Highway Act, 7(55), p. 2. Lockridge Times, Lockridge, Iowa.
1917o Investigation to Discover Alleged Difficulties in Cement Business, 7(55), p. 2. Lockridge Times, Lockridge, Iowa.
1917p Location and Design of Various Roads: Cross-Sections of Roadways, 7(55), p. 3. Lockridge Times, Lockridge, Iowa.
1917q Earth Road Graded: Stability of Embankments and Materials, 7(55), p. 5. Lockridge Times, Lockridge, Iowa.
1917r Board of Supervisor's News, 7(55), p. 1. Lockridge Times, Lockridge, Iowa.
1917s Gravel Road Work, 7(55), p. 3. Lockridge Times, Lockridge, Iowa.
1917t Earth Roads Work: Typical Cross-section and Equipment Used, 7(55), p. 4. Lockridge Times, Lockridge, Iowa.
1917u Board of Supervisor's News, 7(55), p. 6. Lockridge Times, Lockridge, Iowa.
1917v Board of Supervisor's News, 7(55), p. 4. Lockridge Times, Lockridge, Iowa.
1917w Board of Supervisor's News, 7(55), p. 4. Lockridge Times, Lockridge, Iowa.
1928a Board of Supervisor's News, p. 4. Lockridge Times, Lockridge, Iowa.
1928b Board of Supervisor's News, p. 4. Lockridge Times, Lockridge, Iowa.
1928c Work Started on Road South of Lockridge: Bridge Out, April 26, p. 1. Lockridge Times, Lockridge, Iowa.

1928d Board of Supervisor's News, May 17, p. 3. Lockridge Times, Lockridge, Iowa.
1928e New Road Open Soon, June 21, p. 1. Lockridge Times, Lockridge, Iowa.
1928f Board of Supervisor's News, June 21, back of p. 1. Lockridge Times, Lockridge, Iowa.
1928g In a Line or Two, June 28, p. 1. Lockridge Times, Lockridge, Iowa.
1928h Board of Supervisor's News, July 18, p. 1. Lockridge Times, Lockridge, Iowa.
1928i Board of Supervisor's News, August 16, back of p. 1. Lockridge Times, Lockridge, Iowa.
1928j Board of Supervisor's News: Good Roads and Safety Linked, September 13, p. 3. Lockridge Times, Lockridge, Iowa.
1928k Board of Supervisor's News, September 20, back of p. 1. Lockridge Times, Lockridge, Iowa.
1928l Board of Supervisor's News, October 25, back of p. 1. Lockridge Times, Lockridge, Iowa.
1928m Board of Supervisor's News, March 18, p. 2. Lockridge Times, Lockridge, Iowa.
1928n Iowa Road Bond Bill, Supplement of November 1, p. 2. Lockridge Times, Lockridge, Iowa.
1928o Board of Supervisor's News, March 18, p. 1. Lockridge, Iowa.
1928p Let's Put the Road Bond Bill Over Jefferson County, November 6, p. 4. Lockridge Times, Lockridge, Iowa.
1928q Motorists Pay Big Tax Over Poor Highways, November 16, p. 4. Lockridge Times, Lockridge, Iowa.
1928r Board of Supervisor's News, Supplement, November 22. Lockridge Times, Lockridge, Iowa.
1928s In a Line or Two, December 27, p. 1. Lockridge, Iowa.
1929t Board of Supervisor's News, January 10, back of p. 1. Lockridge Times, Lockridge, Iowa.
1929u Board of Supervisor's News, January 24, back of p. 1. Lockridge Times, Lockridge, Iowa.
1929v Treasurer's Semi-Annual Report, February 14, back of p. 2. Lockridge Times, Lockridge, Iowa.
1929w Board of Supervisor's News, February 21, back of p. 1. Lockridge Times, Lockridge, Iowa.
1929x Asphalt Roads Prove Worthy, March 14, p. 3. Lockridge Times, Lockridge, Iowa.
1929y Slaughter Pens of Human Beings, March 14, p. 4. Lockridge Times, Lockridge, Iowa.
1929z Board of Supervisor's News, April 18, p. 3. Lockridge Times, Lockridge, Iowa.
1929aa Car Skidding is Studied by Iowa State College, May 9, p. 3. Lockridge Times, Lockridge, Iowa.
1929bb Board of Supervisor's News, May 23, p. 4. Lockridge Times, Lockridge, Iowa.
1929cc Board of Supervisor's News, June 27, p. 4. Lockridge Times, Lockridge, Iowa.
1929dd Board of Supervisor's News, July 11, p. 4. Lockridge Times, Lockridge, Iowa.
1929ee Treasurer's Semi-Annual Report, July 25, p. 4. Lockridge Times, Lockridge, Iowa.
1929ff Board of Supervisor's News, October 17, p. 4. Lockridge Times, Lockridge, Iowa.
1929gg Road Improvements, November 9, p. 1. Lockridge Times, Lockridge, Iowa.
1929hh Wider Highways are Great Needs, November 9, p. 4. Lockridge Times, Lockridge, Iowa
1929ii Board of Supervisor's News, November 28, p. 4. Lockridge Times, Lockridge, Iowa.
1929jj Board of Supervisor's News, December 12, p. 4. Lockridge Times, Lockridge, Iowa.
1933a Board of Supervisor's News, February 16, p. 4. Lockridge Times, Lockridge, Iowa.
1933b Board of Supervisor's News, March 23, p. 4. Lockridge Times, Lockridge, Iowa.
1933c Board of Supervisor's News, March 30, p. 4. Lockridge Times, Lockridge, Iowa.
1933d Board of Supervisor's News, April 27, p. 4. Lockridge Times, Lockridge, Iowa.
1933e Board of Supervisor's News, May 25, p. 4. Lockridge Times, Lockridge, Iowa.
1933f Board of Supervisor's News, June 22, p. 4. Lockridge Times, Lockridge, Iowa.
1933g Board of Supervisor's News, July 13, p. 4. Lockridge Times, Lockridge, Iowa.
1933h Board of Supervisor's News, August 24, p. 4. Lockridge Times, Lockridge, Iowa.
1933i Repair of Bridge at Coppock, September 14, p. 1. Lockridge Times, Lockridge, Iowa.
1933j Board of Supervisor's News, October 12, p. 4. Lockridge Times, Lockridge, Iowa.
1933k Board of Supervisor's News, November 30, p. 4. Lockridge Times, Lockridge, Iowa.
1933l Board of Supervisor's News, December 28, p. 4. Lockridge Times, Lockridge, Iowa.
1934a Board of Supervisor's News, January 18, p. 4. Lockridge Times, Lockridge, Iowa.
1934b Board of Supervisor's News, January 25, p. 4. Lockridge Times, Lockridge, Iowa.
1934c Board of Supervisor's News, February 22, p. 4. Lockridge Times, Lockridge, Iowa.
1934d Board of Supervisor's News, March 25, p. 4. Lockridge Times, Lockridge, Iowa.
1934e Board of Supervisor's News, June 13, p. 4. Lockridge Times, Lockridge, Iowa.
1934f Board of Supervisor's News, July 12, p. 4. Lockridge Times, Lockridge, Iowa.
1934g Board of Supervisor's News, August 16, p. 4. Lockridge Times, Lockridge, Iowa.

1934h Board of Supervisor's News, September 27, p. 4. Lockridge Times, Lockridge, Iowa.
1934i Board of Supervisor's News, October 18, p. 4. Lockridge Times, Lockridge, Iowa.
1934j Board of Supervisor's News, November 29, p. 4. Lockridge Times, Lockridge, Iowa.

MacDonald, Thomas H.
1912 The Bridging of Drainage Ditches. *Road-Maker*, pp. 5–6. Des Moines, Iowa.

Marriot, Paul Daniel
1997 *Saving Historic Roads*. Prepared for America's Byways Resource Center by the National Trust for Historic Preservation. National Trust, Washington, D.C.
2004 *From Milestones to Mile-Markers: Understanding Historic Roads*. Prepared for America's Byways Resource Center by the National Trust for Historic Preservation. National Trust, Washington, D.C.

May, George S.
1965a The Good Roads Movement in Iowa: The Old Roads. *The Palimpsest* 46(2), pp. 65–80. Iowa State Historical Society, Des Moines.
1965b The Good Roads Movement in Iowa: Road Administration. *The Palimpsest* 46(2), pp. 81–95. Iowa State Historical Society, Des Moines.
1965c The Good Roads Movement in Iowa: Getting Out of the Mud. *The Palimpsest* 46(2), pp. 96–115. Iowa State Historical Society, Des Moines.

McKay, Joyce
1989 *Civilian Conservation Corps Properties in Iowa State Parks: 1933–1942*. Multiple Property Listing for National Register of Historic Places Nomination. Copy on file, State Historical Society of Iowa, Des Moines.
1992 National Register of Historic Places Multiple Property Document: Municipal, County, and State Corrections Properties in Iowa. Iowa Corrections Institutions: 1839–1942; Section E, p. 60. Copy on file, State Historical Society of Iowa, Des Moines, Iowa.

Merrian-Webster
1981 *Webster's Third New International Dictionary*. Merrian-Webster Inc., Springfield, Mass.

Minnesota Department of Transportation
2003 *Context Sensitive Design*. Center for Transportation Studies, University of Minnesota, Minneapolis.
2006 *Context Sensitive Solutions*. Center for Transportation Studies, University of Minnesota, Minneapolis.

Missouri Department of Transportation (Missouri DOT)
2003 Context Sensitive Design. CSD Pamphlet. Missouri Department of Transportation. Jefferson City, Missouri.

Moore, Ray N.
1917 Iowa's Gravel Road Building Materials. *Road-Maker* 11(3), pp. 26–27. Road-Maker Magazine, Chicago, Illinois.

Morrison, J. S.
1920 Letter of September 7, 1920, to W. H. Root, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Morrison, William G.
1913 The Business of a Highway Bridge Engineer. *Transit*, Vol. 18, pp. 5–12. University of Iowa, Iowa City.

Nash, Jan Olive
2000 *"Will Likely Last a Thousand Years"*: *Coon Rapids Bridge, Symbol of Progress*. Prepared for Calhoun-Burns and Associates and the City of Coon Rapids. Iowa Historic Property Study in connection with Coon Rapids Bridge (Sumpter Avenue Bridge) over the Middle Raccoon River, Coon Rapids, Carroll County, Iowa, FHWA #002540, BRM-1542(1)00--8N-14. Tallgrass Historians, Iowa City, Iowa.
2003 U.S. 275 Historical/Architectural Intensive-Level Survey. Pottawattamie County, Iowa, Council Bluffs Vicinity, STP-275-3(27)--2C-78. Submitted to the Iowa Department of Transportation, DOT contract No. 05469, Work Order #2. Tallgrass Historians, Iowa City, Iowa.

National Park Service
2004 Lincoln Highway; Special Resource Study/Environmental Assessment. National Park Service, U.S. Department of the Interior, Washington, D.C.

National Register Branch, Interagency Resources Division, National Park Service
1997 How to Apply the National Register Criteria for Evaluation. *Bulletin #15*. U.S. Government Printing Office, Washington, D.C. Web site-http://www.cr.nps.gov/nr/publications/bulletins.htm

2005 Historic Roads. *Landscape Lines 16*. Park Historic Structures and Cultural Landscapes Program, National Park Service, U.S. Department of the Interior, Washington, D.C.

2006a How to Evaluate and Nominate Designed Historic Landscapes. *Bulletin #18*. U.S. Government Printing Office, Washington, D.C.

2006b Guidelines for Evaluating and Documenting Rural Historic Landscapes. *Bulletin #30*. U.S. Government Printing Office, Washington, D.C.

2006c Guidelines for Evaluating and Documenting Properties Associated with Significant Persons. *Bulletin #32*. U.S. Government Printing Office, Washington, D.C.

National Register of Historic Places

1984 National Register of Historic Places–Iowa [1966–1982]. Chadwyck-Healey Ltd., Teaneck, New Jersey. Microfiche on file, State Historical Society of Iowa, Iowa City.

1985 National Register of Historic Places–Iowa [1966–1982]. Chadwyck-Healey Ltd., Teaneck, New Jersey. Microfiche on file, State Historical Society of Iowa, Iowa City.

Nauman, Molly

2003 The John and Livinia Bangs Residence. National Register of Historic Places Nomination. National Park Service, Washington, D.C. Copy on file, State Historical Society of Iowa, Des Moines, Iowa.

New London Journal

1975 *The New London Journal Centennial Edition, 1875–1975*, pp. 52, 103, 133–134. New London Centennial Commission, New London, Iowa.

Norris, D. W., Jr.

1915 Financing a Good Roads System. *Road-Maker* 6(4), pp. 3–4. Road-Maker Magazine, Des Moines, Iowa.

Ogle, George A.

1905 *Standard Atlas of Jefferson County, Iow*a. George A. Ogle Company, Des Moines, Iowa

1908 *Standard Atlas of Wapello County, Iowa*. George A. Ogle Map Company, Des Moines, Iowa.

Outwater, H. G.

1921 *Designs for American Homes*. Dodd, Mead and Company, New York.

Parrish, John Carl

1970 Phantoms of the Old Military Road. *The Palimpsest* 51(6), pp. inside of back cover, 249–250. The State Historical Society, Iowa City, Iowa.

Patton, M. C., G. E. Shafer, H. E. Cotton, C. W. Bean, and W. H. Spindler

1937 *Handbook of Culvert and Drainage Practice*. Iowa Culvert and Pipe Company, Des Moines, Iowa.

Patton, Phil

1986 *The Open Road: A Celebration of the American Highway*. Simon and Schuster, New York.

Peterson, William J.

1970 The Old Road—Then and Now. *The Palimpsest* 51(6), inside of back cover. The State Historical Society, Iowa City, Iowa.

Portland Cement Association

1949 *Concrete Pavement Inspector’s Manual*. Portland Cement Association, Chicago, Illinois.

Pratt, LeRoy

1967 “Ten Cents a Mile and a Fence Rail.” *Annals of Iowa*, Vol. 39/summer, pp. 597–603. Iowa State Department of History and Archives, Des Moines, Iowa.

Press Citizen

1916 New Auto Route Through Solon, Tuesday, May 16, p. 8. Iowa City, Iowa. Article on file, Iowa DOT Library, Ames, Iowa.

Prince George’s County Department of Public Works and Transportation

1994 *Design Guidelines and Standards for Scenic and Historic Roads: Prince George’s County, Maryland.* Printed by Prince George’s County Department of Public Works and Transportation, Prince George’s County, Maryland. Copy on file, Office of the State Archaeologist, Iowa City.

Prior, Jean C.

1991 *Landforms of Iowa*. University of Iowa Press, Iowa City.

Public Roads Journal

1918 Iowa’s First Project Nearly Complete. *Public Roads Journal* 1(1), p. 32. Office of Public Roads and Rural Engineering, Washington, D.C. Original on file, Iowa DOT Library, Ames, Iowa.

1919a Building an Arizona Project. *Public Roads Journal* 1(11), pp. 17–20. Office of Public Roads and Rural Engineering, Washington, D.C. Original on file, Iowa DOT Library.

1919b Life's Pathway. *Public Roads Journal* 2(13), pp. 12–16. Office of Pubic Roads and Rural Engineering, Washington, D.C. Original on file, Iowa DOT Library, Ames, Iowa.

1919c Federal Aid Project Approvals and Agreements for October-September, 1919. *Public Roads* 2(18–19), pp. 28–35. Office of Public Roads and Rural Engineering, Washington, D.C. Original on file, Iowa DOT Library, Ames, Iowa.

1920a Mechanical Concrete Road Finisher. *Public Roads Journal* 2(23), pp. 3–5. Office of Public Roads and Rural Engineering, Washington, D.C. Original on file, Iowa DOT Library, Ames, Iowa.

1920b Federal-Aid Allowances, February 1920. *Public Roads* 2(23), pp. 26–27. Office of Public Roads and Rural Engineering, Washington, D.C. Original on file, Iowa DOT Library, Ames, Iowa.

1929 Qualities Required in Paving Concrete. *Public Roads Journal* 9(12), pp. 234–236. Office of Public Roads and Rural Engineering, Washington, D.C. Original on file, Iowa DOT Library, Ames, Iowa.

1931 Motion-Picture Films on Road Construction Available. *Public Roads Journal*, 11, pp. 18–19. Office of Public Roads and Rural Engineering, Washington, D.C. Original on file, Iowa DOT Library, Ames, Iowa.

Rand McNally

1923 *Official 1923 Auto Trails Map: District Number 10*. Rand McNally, Chicago.

Rawn, W. P.

1920 Letter of September 1, 1920, to W. H. Root, Engineer, Iowa State Highway Commission. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Riggs Brothers

1919 Letter of February 11, 1919, to the Iowa State Highway Commission. The Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Road-Maker

1912a Midland Metal Manufacturing Company, Ottumwa, Iowa. Corrugated Galvanized Culverts (advertisement). *Road-Maker* 1(1), inside of front cover. Road-Maker Magazine, Des Moines, Iowa.

1912b Adjustable Culvert Mold. The Township Supply Company, Des Moines, Iowa (advertisement). *Road-Maker* 1(1), p. 2. Road-Maker Magazine, Des Moines, Iowa.

1912c The Fort Dodge Corrugated Metal Culvert, Fort Dodge, Iowa. Corrugated Culverts (advertisement). *Road-Maker* 1(1), inside of back cover. Road-Maker Magazine, Des Moines, Iowa.

1912d A Road Scene Near Ottumwa, Iowa. *Road-Maker* 1(2), p. 5. Road-Maker Magazine, Des Moines, Iowa.

1912e Tourists Routes of the West. A Mountain Scene in Iowa: A View Taken of the Blue Grass Road a Few Miles Southeast of Council Bluffs. *Road-Maker* 1(3), p. 3. Road-Maker Magazine, Des Moines, Iowa.

1912f Merillat Culvert Built in Dallas County, Iowa (advertisement). *Road-Maker* 1(3), p. 9. Road-Maker Magazine, Des Moines, Iowa.

1912g Road News. *Road-Maker* 1(3), pp. 11–13. Road-Maker Magazine, Des Moines, Iowa.

1912h A Great Object Lesson in Good Roads: The Keokuk Dam. *Road-Maker* 1(5), pp. 1–2. Road-Maker Magazine, Des Moines, Iowa.

1912i The Good Roads Problem: A Road Scene Near Ottumwa. *Road-Maker* 1(6), p. 5. Road-Maker Magazine, Des Moines, Iowa.

1912j A Stretch of Blue Grass Road near Mount Pleasant, Iowa (photo). *Road-Maker* 2(2), p. 3. Road-Maker Magazine, Des Moines, Iowa.

1913a Iowa Roads and Their Future. *Road-Maker* 2(5), pp. 1–2. Road-Maker Magazine, Des Moines, Iowa.

1913b Red Ball Route. *Road-Maker* 4(1), pp. 9, 14. Road-Maker Magazine, Des Moines, Iowa.

1913c Minneapolis Steel and Machinery Company. Peck's Collapsible Culvert Forms (advertisement). *Road-Maker* 2(6), p. 17. Road-Maker Magazine, Des Moines, Iowa.

1913d Iowa Pure Iron Culvert Company, Des Moines, Iowa. Ingot Iron Culverts (advertisement). *Road-Maker* 3(5), p. 11. Road-Maker Magazine, Des Moines, Iowa.

1914a Iowa Road Improvements Section: Promoters of the Red Ball Route. *Road-Maker* 5(2), p. 21. Road-Maker Magazine, Des Moines, Iowa.

1914b The Blue Grass Road Elects Officers. *Road-Maker* 5(3), p. 13. Road-Maker Magazine, Des Moines, Iowa.

1914c Convict Labor at Columbus Junction. *Road-Maker* 6(1), pp. 12–13. Road-Maker Magazine, Des Moines, Iowa.

1914d Iowa: Current Happenings. *Road-Maker* 6(1), p. 18. Road-Maker Magazine, Des Moines, Iowa.

1914e Henry County Road Gang Doing Grading and a Concrete Bridge Recently Constructed in Dallas County (photos). *Road-Maker* 6(2), p. 6. Road-Maker Magazine, Des Moines, Iowa.
1914f Humboldt County's Model Roads. *Road-Maker* 6(2), p. 7. Road-Maker Magazine, Des Moines, Iowa.
1914g The Situation in Dubuque County. *Road-Maker* 6(2), p. 9. Road-Maker Magazine, Des Moines, Iowa.
1914h Iowa: Current Happenings. *Road-Maker* 6(2), p. 18. Road-Maker Magazine, Des Moines, Iowa.
1914i Macadam Pavement at Keokuk (advertisement). *Road-Maker* 6(2), p. 21. Road-Maker Magazine, Des Moines, Iowa.
1914j Northwestern Brand Concrete (advertisement). *Road-Maker* 6(3), p. 46. Road-Maker Magazine, Des Moines, Iowa.
1915a Good Roads Machinery Company (advertisement). *Road-Maker* 6(4), p. 12. Road-Maker Magazine, Des Moines, Iowa.
1915b Prisoners Can Help Families. *Road-Maker* 6(4), p. 17. Road-Maker Magazine, Des Moines, Iowa.
1915c Iowa: Current Happenings. *Road-Maker* 6(4), p. 19. Road-Maker Magazine, Des Moines, Iowa.
1915d Is Iowa Ready for 365 Day in the Year Roads? *Road-Maker* 6(6), p. 8. Road-Maker Magazine, Des Moines, Iowa.
1915e Iowa: Current Happenings. *Road-Maker* 6(6), p. 19. Road-Maker Magazine, Des Moines, Iowa.
1915f The Automatic Shovel Company (advertisement). *Road-Maker* 6(4), p. 21. Road-Maker Magazine, Des Moines, Iowa.
1916a A Sermon Without Words (photo and caption). *Road-Maker* 9(10), p. 5. Road-Maker Magazine, Moline, Illinois.
1916b Security Culvert Co., Minneapolis, Minnesota (advertisement). *Road-Maker* 8(6), p. 26. Road-Maker Magazine, Moline, Illinois.
1916c Hall Interlocking Concrete Culvert Company, Chicago, Illinois (advertisement). *Road-Maker* 9(1), p. 20. Road-Maker Magazine, Moline, Illinois.
1916d Iowa: Current Happenings. *Road-Maker* 9(1), pp. 27–28. Road-Maker Magazine, Moline, Illinois.
1916e Lock-Joint Cast Iron Culvert Pipe, American Casting Company, Omaha, Nebraska (advertisement). *Road-Maker* 9(1), p. 32. Road-Maker Magazine, Moline, Illinois.
1916f U.S. Pipe and Foundry Company, Burlington, N. J. (advertisement). *Road-Maker* 9(1), p. 34. Road-Maker Magazine, Moline, Illinois.
1916g Gunn's Guider Road Builder and Planner (advertisement). *Road-Maker* 9(2), p. 29. Road-Maker Magazine, Moline, Illinois.
1916h Why Indeed? *Road-Maker* 9(2), pp. 39–40. Road-Maker Magazine, Moline, Illinois.
1916i Ames–Gilbert Road (photo) and State Road Conditions. *Road-Maker* 9(5), p. 5. Road-Maker Magazine, Moline, Illinois.
1916j Will Save Taxpayers nearly $400,000 and Ames–Story City Road Near State Epileptic Center at Woodward (photo). *Road-Maker* 9(5), pp. 6–7. Road-Maker Magazine, Moline, Illinois.
1916k White Good Roads Trucks (advertisement). *Road-Maker* 10(1), p. 1. Road-Maker Magazine, Moline, Illinois.
1916l New Playground for Middle West. *Road-Maker* 10(1), pp. 3–5. Road-Maker Magazine, Moline, Illinois.
1916m Have You Any Death Traps? (advertisement). *Road-Maker* 10(2), back of front cover. Road-Maker Magazine, Moline, Illinois.
1916n How Eagle Grove Maintains Roads. *Road-Maker* 10(2), pp. 3–4. Road-Maker Magazine, Moline, Illinois.
1917a Zeidler Concrete Pipe, Co. Muscatine, Iowa (advertisement). *Road-Maker* 11(3), p. 3. Road-Maker Magazine, Chicago, Illinois.
1917b Points on Concrete Road Construction. *Road-Maker* 11(4), pp. 56, 58, 60. Road-Maker Magazine, Chicago, Illinois.
1917c The Standard Truck Specifications. *Road-Maker* 11(6), pp. 34–41. Road-Maker Magazine, Chicago, Illinois.
1917d Iowa: Current Happenings. *Road-Maker* 11(6), p. 63. Road-Maker Magazine, Chicago, Illinois.
1917e Iowa's Interest in the Lincoln Highway. *Road-Maker* 11(6), p. 71. Road-Maker Magazine, Chicago, Illinois.
1917f Stages of Road Grading (photos). *Road-Maker* 11(7), p. 8. Road-Maker Magazine, Chicago, Illinois.
1917g Oiling Iowa Earth Roads. *Road-Maker* 11(7), p. 78. Road-Maker Magazine, Chicago, Illinois.

1917h More Iowa Road and Bridge Cooperation. *Road-Maker* 11(8), p. 66. Road-Maker Magazine, Chicago, Illinois.

1919 Dependable Highway Edging. *Road-Maker* 13(8), p. 54. Road-Maker Magazine, Chicago, Illinois.

Rogers, Leah D.

1997 Phase I Archaeological Survey of Lions Park Lincoln Highway Interpretive Site, Green County, Iowa. ISTEA Enhancement Project No. STP-ES-37(28)--8I-37. Prepared for Greene County Lincoln Highway Association, Jefferson Iowa. Copy file, Office of the State Archaeologist, Iowa City.

2004 Documentation of the Historic Lincoln Way Pavement: for the Lincoln Way Rehabilitation/Restoration Transportation Enhancement Project. City of Woodbine, Harrison County, Iowa. Project No. STP-E-8525(602)--8V-43. Submitted to JEO Consulting Group by Tallgrass Historians, Iowa City, Iowa.

Rogers, Leah D., and Clare L. Kernek

2004 *The Lincoln Highway Association's "Object Lesson:" The Seedling Mile in Linn County, Iowa.* Tallgrass Historians, Iowa City, Iowa.

Schlereth, Thomas J.

1997 *Reading The Road: U.S. 40 and the American Landscape*. The University of Tennessee Press, Knoxville.

Schultz, J. O.

1897 Iowa Building Stone–Mason City Dolomite. *Transit*, Vol. 5, p. 160. The University of Iowa, Iowa City.

Simpson, Pamela H, Harry J. Junderman and Deborah Simpson.

1995 Concrete Block. *Twentieth Century Building Materials*. McGraw-Hill/Archetype Press, Washington, D. C.

Sloan, Eric

1992 *Eric Sloane's America*. Promontory Press, New York.

State Historical Society of Iowa

2006 Draft Preservation Document. Department of Cultural Affairs, State Historical Society of Iowa, Des Moines.

Smith, Sam C.

1912 The Iowa Road Dragging Law. *Road-Maker*, pp. 6–8. Road-Maker Magazine, Des Moines, Iowa.

Soike, Lowell, and John H. Panning

1986 The Lake City Rainbow Arch Bridge. National Register of Historic Places Multiple Property Documentation Form. Prepared by Lowell Soike and John A. Panning. Submitted to the National Park Service Regional Office, Denver, Colorado. Copy on file, State Historical Society of Iowa, Des Moines, Iowa.

Spaulding, Frederick P.

1921 *Masonry Structures*. John Wiley and Sons, New York.

Spencer, C. R.

1912 The Good Roads Problem. *Road-Maker* 1(1), p. 5. Road-Maker Magazine, Des Moines, Iowa.

State Historical Society of Iowa, Historic Preservation Program

1993a Rural Property Guidelines, Information to be Gathered for Section 106 Purposes. State Historical Society of Iowa, Des Moines.

Stewart, LeRoy C.

1936 Design and Operation of Plants for Producing Stabilized Soil-Bound Road Material. *Proceeding of the Sixteenth Annual Meeting of the Highway Research Board*, pp. 369–379. Ray W. Crum, editor. Division of Engineering and Industrial Research, National Research Council. Washington, D.C. Original on file, Iowa DOT Library, Ames, Iowa.

Thomas, C. H.

1917 Notes on Blue Grass Road, November 8, 1917. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Thompson, William H.

1989 *Transportation in Iowa. A Historical Summary*. Iowa Department of Transportation, Ames.

TIB

1918 *Automobile Route Book of 1918: Iowa State Edition*. The TIB Auto Route Book Company, Kansas City, Missouri.

Tilghman, R. C.
1839 Map of the Road From Dubuque Iowa to the Northern Boundary of Missouri. *Cartographic Records Relating to the Territory of Iowa, 1838–1846*. Compiled by Laura E. Kelsay and Fredrick W. Pernall. From files of the office of the Chief of Engineers. Special List No. 27 printed by the National Archives, National Archives Record Service, General Services Administration, Washington, D.C., 1971. Microfilm on file, Iowa Office of the State Archeologist, The University of Iowa, Iowa City.

Transit
1893 Utica and Milwaukee Cement. *Transit* 1(1), p. 16. The University of Iowa, Iowa City.
1895 Portland Cement. *Transit*, Vol. 3, pp. 17, 121, 142. The University of Iowa, Iowa City.
1908 The Ottumwa Bridge Company—Structural Steel and Iron—Steel Bridges, Water Towers, Culvert Pipes (advertisement). *Transit*, Vol. 13, p. iii. The University of Iowa, Iowa City.
1909 Clinton Bridge and Iron Works—Manufacturers of Steel Bridges, Culverts and Metallic Structures and Builders of Concrete Bridges (advertisement). *The Transit*, Vol. 14, p. 137. The University of Iowa, Iowa City.
1910 Portland Cement Company (advertisement). *Transit*, Vol. 15, p. 6. The University of Iowa, Iowa City.
1911 Bithulithic Paving: The Warren Brother's Patent. *Transit*, Vol. 16, pp.22–25. The University of Iowa. Iowa City.
1922 Construction Machinery Company (advertisement). *Transit* 26(3), p. A3. The University of Iowa, Iowa City.
1926a The Koehring 27-E Cement Mixer (advertisement). *Transit* 30(4), p. 95. The University of Iowa, Iowa City.
1926b "Them Ways Is Gone Forever" (photo). *Transit* 30(6), p. 36. The University of Iowa, Iowa City.
1926c The Northwestern States Portland Cement Company—Mason City, Iowa (advertisement). *Transit* 30(7), p. 171. The University of Iowa, Iowa City.
1926d View of Improvement of U.S. 62 west of Bellevue showing timbering of Small Gauge Railroad. *Transit* 30(6), pp. 197–198). The University of Iowa, Iowa City
1927 Hawkeye Cement (advertisement). *Transit* 31(3), p. 81. The University of Iowa, Iowa City.
1939 Cement Mixer (advertisement). *Transit* 47(8), p. 9. The University of Iowa, Iowa City.

United States Congress
1854 Congressional Mail Contracts in Iowa. Serial Set 789, Doc. 86. Microfiche Documents on file, Government Documents Collection, University of Iowa Library, Iowa City.

United States Department of Agriculture (U.S.D.A)
1905 Cement Mortar and Concrete: Preparation and Use for Farm Purposes. *Farmers' Bulletin No. 235*. Government Printing Office, Washington, D.C.
1908 Small Farms in the Corn Belt. The Use of the Split-Log Drag on Earth Roads. *Farmer's Bulletin No. 321*. Government Printing Office, Washington, D.C.

United States Department of Agriculture, Natural Resources Conservation Service (U.S.D.A, N.R.C.S.)
2001 1990's Airphoto Mosiac for Henry, Jefferson, Johnson, Monroe, Wapello, Washington Counties, Iowa. Web site at http://www.igsb.uiowa.edu/nrgislibx, accessed February 2, 2006.

United States Department of the Interior, National Park Service
2002a Highway Bridges of Colorado; Multiple Property Submission. *Publication 632*. National Register of Historic Places. Department of the Interior, National Park Service, National Register of Historic Places. Web site at www.coloradohistory-oahp.org/publicatons/contexts.htm.
2002b Colorado State Roads and Highways. Multiple Property Listing. *Publication 646*. Department of the Interior, National Park Service, National Register of Historic Places. Web site at www.coloradohistory-oahp.org/publicatons/contexts.htm.

United States Geologic Survey (U.S.G.S.), Global Land Information System (G.L.I.S.)
1990s U.S.G.S. 3.75' Digital Orthophoto Quadrangle. U.S.G.S. Global Land Information System, United States Department of the Interior, Washington, D.C. Iowa Geographic Image Map Server. Web site at http://ortho.gis.iastate.edu. Accessed 7/30/2006.

Universal Portland Cement Company
1912 *Small Farm Buildings of Concrete*. Universal Portland Cement Company, Chicago-Pittsburg-Minneapolis.

Vale, Thomas R., and Geraldine R. Vale

1983 *U.S. 40 Today: Thirty Years of Landscape Change in America*. University of Wisconsin Press, Madison, Wisconsin.

Van Buren County Register

1982 *Committee Formed to Improve Coleman Road*. Van Buren County Register, January 21, Keosauqua, Iowa. Original on file, Coleman Road Folder, Iowa DOT Archives/Library, Ames, Iowa.

Wallace's Farmer

1914 Atlas Portland Cement (advertisement). *Wallace's Farmer*, April 14, 1914. Wallace's Farmer, Des Moines, Iowa.

Weber, Irving

1985 Thomas C. Carson and Carson Implement. *Historic Stories About Iowa City*, Vol. 3, p. 151. Reprinted from Iowa City Press Citizen. Published by Iowa City Lions Club, Iowa City.

1989 Stuck in the Mud: Part I. *Historic Stories About Iowa City*, Vol. 5, p. 46. Reprinted from Iowa City Press Citizen. Published by Iowa City Lions Club, Iowa City.

1990 Stuck in the Mud: Part II. *Historic Stories About Iowa City*, Vol. 6, pp. 133, 175. Reprinted from Iowa City Press Citizen. Published by Iowa City Lions Club, Iowa City.

1992 The Butler Bridge. *Historic Stories About Iowa City*, Vol. 7, p. 48. Reprinted from Iowa City Press Citizen. Published by Iowa City Lions Club, Iowa City.

Webster's Dictionary

1968 *Webster's New World Dictionary*, Second College Edition. World Publishing Company, New York and Cleveland.

Weingroff, Richard F.

2002a From 1916 to 1939: The Federal-State Partnership at Work. U.S. Department of Transportation, Federal Highway Administration, Infrastructure. Web site at www.fhwa.dot.gov/infrastructure/rw96c.htm.

2002b Federal Aid Road Act of 1916: Building the Foundation. U.S. Department of Transportation, Federal Highway Administration: Infrastructure. Web site at www.fhwa.dot.gov/infrastructure/rw96a.htm

White, F. R.

1919a Letter of August 29, 1919, to J. F. Ford, Engineer, Iowa State Highway Commission. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1919b Letter of September 15, 1919, to J. F. Ford, Engineer, Iowa State Highway Commission. Blue Grass Road Folder. Original on file, Iowa DOT Library, Ames, Iowa.

1922 Letter of August 22, 1922, to Robert N. Carson, President, Red Ball Road Association. Red Ball Route Folder. Original on file, Iowa DOT Library, Ames, Iowa.

Wilson, Ben Hur

1935a Burlington Westward. *The Palimpsest* 16(10), pp. 305–308. The State Historical Society of Iowa, Iowa City.

1935b Planked From Burlington. *The Palimpsest* 16(10), pp. 309–323. The State Historical Society of Iowa, Iowa City.

1935c From Planks to Rails. *The Palimpsest* 16(10), pp. 324–334. The State Historical Society of Iowa, Iowa City.

Wood, L. W.

1935 The Road and Concrete Materials of Southern Iowa. *Iowa Geological Survey*, Vol. 36 (Annual Reports 1930–1933). Published for The Iowa Geological Survey by The State of Iowa, Des Moines.

Aerial Photographs Consulted

United States Department of Agriculture, Agricultural Stabilization and Conservation Service. Photos on file, Map Collection, The University of Iowa Main Library, Iowa City. These historic aerial photographs were used for tracking the study roads, their routes, and various changes to the roads included in this study.

U.S. 34–BLUE GRASS ROAD

Adams Co. 1966: BJV-1GG-29(1), BJV-1GG-58(2), BJV-1GG-124(10), BJV-1GG-156(11), BJV-2GG-16(3), BJV-2GG-73(4), BJV-2GG-102(5), BJV-2GG-159(6), BJV-2GG-188(7), BJV-2GG-147(8), BJV-2GG-291(9), BJV-3GG-51(12)

Clarke Co. 1967: BJX-2HH-59(8), BJX-1HH-12(12), BJX-1HH-80(11), BJX-1HH-101(10), BJX-2HH-150(6), BJX-2HH-82(7), BJX-2HH-150(6), BJX-2HH-170(5), BJX-3HH-11(3), BJX-3HH-75(1), BJX-3HH-98(2), BJX-4HH-34(9), BJX-4HH-56(4)

Des Moines Co. 1978: 178-105(1), 178-115(2), 178-116(3), 178-121(4)

Henry Co. 1957: TG-1R-16(9), TG-1R-42(8), TG-1R-74(7), TG-1R-100(6), TG-1R-158(4), TG-1R-191(3), TG-1R-132(5), TG-2R-132(5), TG-2R-39(1), TG-2R-97(2), TG-2R-98(10), TG-2R-100(11), TG-2R-102(12), TG-2R-104(13), TG-2R-106(14), TG-2R-108(15), TG-2R-110(16), TG-2R-112(17), TG-2R-114(18)

Henry Co. 1941: TG-1B-20, TG-1B-22, TG-1B-43, TG-1B-47, TG-1B-50, TG-1B-52, TG-1B-55, TG-1B-57, TG-1B-59, TG-1B-79, TG-1B-82, TG-2B-6, TG-2B-8, TG-2B-48

Jefferson Co. 1969: TF-1KK-27(1), TF-1KK-56(2), TF-1KK-152(11), TF-1KK-179(3), TF-1KK-259(4), TF-2KK-71(6), TF-2KK-116(8), TF-2KK-175(4), TF-2KK-201(12)

Jefferson Co. 1941: TF-1B-24, TF-1B-42, TF-1B-71, TF-1B-94-95, TF-1B-122, TF-1B-143, TF-1B-145, TF-1B-147, TF-1B-194, TF-2B-84

Lee Co. 1940: FP-1A-4, FP-1A-6, FP-1A-8, FP-1A-10, FP-1A-12, FP-1A-37, FP-1A-39, FP-1A-40, FP-1A-42, FP-1A-75, FP-1A-77, FP-1A-104, FP-1A-152, FP-1A-181, FP-2A-27, FP-3A-19

Louisa Co. 1978: 178-197(1), 178-202(2), 178-204(3), 178-216(5), 178-218(4)

Louisa Co. 1941: TD-1B-63, TD-1B-78, TD-1B-80, TD-1B-86, TD-1B-88, TD-1B-105, TD-1B-109, TD-1B-111, TD-1B-113, TD-1B-114, TD-1B-144, TD-1B-145, TD-2B-24

Lucas Co. 1967: AJG-1HH-192(2a), AJG-1HH-211(9), AJG-2HH-150(4), AJG-3HH-31(1), AJG-3HH-62(2), AJG-3HH-113(3), AJG-3HH-128(6), AJG-3HH-130(5), AJG-3HH-147(7), AJG-3HH-180(8), AJG-3HH-204(10), AJG-3HH-227(11)

Monroe Co. 1967: AJF-2HH-192(2a), AJF-2HH-195(3b), AJF-3HH-16(13), AJF-3HH-79(12), AJF-3HH-104(11), AJF-3HH-164(10), AJF-3HH-190(9), AJF-3HH-254(8), AJF-4HH-43(1a), AJF-4HH-45(2b), AJF-4HH-48(1b), AJF-4HH-105(4b), AJF-4HH-108(3a), AJF-4HH-166(5), AJF-4HH-191(6), AJF-4HH-255(7)

Monroe Co. 1941: AJF-1B-40, AJF-1B-62, AJF-1B-89, AJF-1B-113, AJF-1B-138, AJF-1B-162, AJF-2B-25, AJF-2B-53, AJF-2B-77, AJF-2B-102, AJF-2B-127

Muscatine Co. 1969: TC-1KK-201(4), TC-1KK-203(3), TC-2KK-3(2), TC-2KK-90(1)

Union Co. 1967: BKT-1HH-33(10), BKT-1HH-36(11), BKT-1HH-54(9), BKT-1HH-73(8), BKT-1HH-97(7), BKT-1HH-116(6), BKT-1HH-138(5), BKT-1HH-159(4), BKT-1HH-180(3), BKT-1HH-210(2), BKT-1HH-222(1), BKT-1HH-264(2)

Wapello Co. 1969: TE-1KK-14(1), TE-1KK-74(2), TE-1KK-102(3), TE-1KK-160(4), TE-1KK-186(5), TE-1KK-247(6), TE-1KK-273(7), TE-2KK-15(8), TE-2KK-39(9a), TE-2KK-40(9b), TE-2KK-80(10a), TE-2KK-83(10b), TE-2KK-143(11b), TE-2KK-168(12a), TE-2KK-173(12b)

Wapello Co. 1963: TE-2DD-284(11a)

Wapello Co. 1941: TE-2B-10, TE-2B-41, TE-2B-60, TE-2B-62, TE-2B-91, TE-2B-116, TE-1B-12, TE-1B-41, TE-1B-65, TE-1B-173

U.S. 218–RED BALL ROAD

Henry County 1941: TG-2B-28, TG-2B-30, TG-2B-32, TG-2B-34, TG-2B-36, TG-2B-39, TG-2B-41, TG-2B-43, TG-2B-71

Henry County 1937 (Mosaic Index Only) TG-6-514, TG-6-559 through TG-6-570

Johnson County 1937: Sy-3-228, Sy-3-232, Sy-3-234-245, Sy-3-283, Sy-3-288 through Sy-3-293, Sy-5 499, Sy-5-500, Sy-5-501

Johnson County 1951: Sy-2H 12 through Sy-2H 14, Sy-2H 39 through Sy-2H 42, Sy-2H 58 through Sy-2H 72, and Sy-1H 116 through Sy-2H 125

Linn County 1940: FT 3A-73, FT 3A-75, FT 3A-77, FT 3A-79, FT 3A-81, FT 3A-83

Washington County 1937: TB1-60, TB1-62, TB1- 64, TB1-66, TB1-67, TB1-69, TB1-71, TB1-74, TB1-76, TB1-78, TB1- 80, TB1- 82, TB1- 84

United States Department of Agriculture, Agricultural Stabilization and Conservation Service. Photos on file, Map Collection, The University of Iowa Main Library, Iowa City.

Iowa Department of Natural Resources
2006 1930's Digital Georectified Image of Johnson County, Iowa, in MrSid Format, Web site at http://www.igsb.uiowa.edu/nrgislibx/, accessed September 15, 2006.

Archival Materials Used in this Study

INTRODUCTION

The archival documents reviewed for this study consisted of primary and secondary sources. Primary sources were the most important for the study as much of their content concerned topics not commonly covered before. The original maps, documents, plans, reports, and photographs collected by the staff took over a year to analyze. The size of the area to be initially reviewed, which was essentially the whole state in order to find the study routes, provided far more documentation than could be assimilated in the time allotted.

OVERVIEW

As the first element of the study was to locate two study routes, the hunt for primary documents showing where these routes were located was the first priority. The primary archive for the period Automobile Guides was the State Historical Society Library in Iowa City. They have the largest and most complete series of these period automobile travel guides in the state.

The State Historical Society Library in Iowa City also contains the original issues of Road-Maker Magazine. Published in Iowa during the early auto transportation years, they contained an abundance of specific road building facts related to the study routes and gave an overall view of what was happening both within the state and nationally.

With all of the possible study route candidates across the state explored and evaluated focus was shifted to the two chosen routes. Once the two study routes had been chosen documentary research could concentrate on the local newspapers, historical societies, and communities along the chosen roads. When the study routes were chosen the focus changed from a general understanding of the routes, periods, and origins to specific information of each study route and especially concentrating on the sections where intensive survey would be conducted. The best source for finding original information at the state level was at the Iowa Department of Transportation. Their holdings in the library were unsurpassed for period photographs, bulletins, and technical data. Their Plan Review Division was the best source for the original road plans starting in 1918. However, for plans and road data prior to 1918 the county engineer's offices in each county were the best sources. The Johnson County engineer's office had an especially large holding of such materials.

An additional source of data both for road survey and for developing historic contexts was the materials held both at the Office of the State Archaeologist and within the Government Documents collections of the University of Iowa Main Library. Both current U.S. 34 and U.S. 218 have undergone major improvements requiring federal Section 106 Review and Compliance since the 1970s. A number of private consultants and consulting companies have researched many Iowa roads and their submitted reports are on file at the Office of the State Archaeologist, although the SHSI in Des Moines has the most complete repository for CRM reports.

Another important resource is the online documents available from federal and state governments. Some states have conducted historic roads studies in the last decade and their reports are available online. One important online source was the National Park Services HABS/HAER web site that lists the significant engineering sites in Iowa and nationally. Many significant nonextant structures are recorded here with technical drawings, histories, and locational data. Similarly, the National Park Service's web site for the National Register of Historic Places provided information on significant buildings, monuments, and structures that were not based only on engineering criteria.

HISTORIC ROADS ARCHIVAL SOURCES

State Historical Society Library, Iowa City

1. Period Automobile Travel Guides
2. Road-Maker Magazine
3. Newspaper Archives
4. Articles from Iowa Publications including
    a. Iowan Magazine
    b. Palimpsest
    c. Iowa Journal of History and Politics
    d. Annals of Iowa
    e. various periodicals
5. Large general and multi-state holdings
6. County plats and atlases and map collections
7. City Directories
8. Photo archives
9. InfoHawk—State Historical Society of Iowa catalog

State Historical Society Museum and Library, Des Moines

1. Period Automobiles
2. Period Iowa automobile and transportation memorabilia from oil cans to cars
3. Books, periodicals, photographs, maps

Iowa Department of Transportation Headquarters, Ames

1. Transportation Related Publications
    a. Iowa State Highway Commission's Service Bulletins and Standards
    b. U.S. Department of Agriculture Bureau of Public Roads
    c. Highway Research Board proceedings
    d. Transportation related legal materials on federal acts, state laws, and counties
    e. Various information folders on early road histories
2. Original maps of Registered Routes
3. Official state highway maps
4. Official period county maps
5. Rare and hard to find publications (transportation and engineering)
6. Original highway plans after 1918 to the present
8. Iowa transportation photo collection
9. Some movie footage from 1950s onward
10. National publications on highway engineering
11. Highway materials and testing information
12. Biographical information

Office of the State Archaeologist

1. In-house highway related Section 106 review and compliance Reports
2. Outside consultants and contractors reports on file
3. Numerous file folder holdings by subject
4. State archaeological site files
5. Library
6. Archaeological data recovered from transportation contexts

7. GIS database
8. Location of University of Iowa Highway Archaeology Program

University of Iowa Library System

1. State Map Collections of all kinds (Main Library)
2. U.S.G.S. headquarters (Trowbridge Hall)
3. Government Documents Section
4. Rare book room with early transportation books
6. Microfiche and microfilm on early government mail routes and road contracts
7. Online library access through InfoHawk
8. Transportation-related theses and dissertations
9. Engineering Library
10. U.S.D.A. Aerial photographs (1930s to present)

Iowa State University Library, Ames

1. Limited holdings on period transportation related maps
2. Limited holdings on period transportation related articles, magazines, and books
3. Individual holdings of the departments of Engineering and Agriculture
4. Strong early association with highway department but extent and locations of various holding types unknown at present.
5. Excellent GIS map web site for Iowa.

Center for Transportation Research and Education, Ames.

1. Large holdings on early and modern Iowa transportation history.
2. Primary location for ISU's transportation related archive materials.
3. Information on current technology, work, innovations.

The National Transportation Museum: Detroit, Michigan

1. Large amount of Iowa information and materials
2. Lincoln Highway holdings

Federal Highway Administration

1. E-Library

National Archives and Library of Congress

1. Iowa maps, photographs, and history
2. Transportation related archives
3. Congressional records

County Courthouses

1. Plats and atlases
2. Recorder of Deeds (grantee/grantor or tract books, property owners, right-of-ways, easements)
3. County road commissioner's and supervisor's meeting notes
4. Old county engineer plans, notes, meetings, records
5. County Engineer's office
6. Tax records, wills, registered farm records, and chattels
7. Township records

Local Libraries and Historical Societies

1. May or may not have local newspapers from period, often not on microfilm
2. Local newspapers
3. Occasional relevant information or a picture
4. Local history books
5. Local surveys
6. City directories
7. Maps, plats, and atlases
8. Photos, diaries, and scrapbooks
9. Oral histories
10. Local historians and informants
11. Local National Register nominations and architectural or historical surveys

National Park Service

1. National Register listings for Iowa
2. HABS/HAER listings for Iowa
3. Secretary of Interior's Guidelines
4. National Register Bulletins
5. Comparative studies, surveys, and nominations

Others

1. The Portland Cement Association
2. Concrete Highway Magazine
3. Society for Commercial Archaeology
4. Public Roads Journal
5. The Asphalt Institute
6. Universal Portland Cement Company
7. Wallace's Farmer

INTERNET WEB SITES

Libraries:

University of Iowa Libraries www.lib.uiowa.edu

Transportation Library of Northwestern University www.library.northwestern.edu/transportation

Trust for Public Land www.tpl.org

Institute of Museum and Library Sciences www.imls.gov

Historic Mapping:

TerraServer www.terraserver.com/

MapServer http://mapserver.gis.umn.edu/

Iowa State University

Iowa Geographic Map Server. Iowa State University GIS Facility
http://ortho.gis.iastate.edu/
http://cairo.gis.iastate.edu/

Google Earth http://earth.google.com/

Engineering and Building:

The Iowa Department of Transportation www.dot.state.ia.us/autotrails/indexauto.htm

Iowa's Historic Bridges www.ole.dot.state.ia.us/historicbridge/default.asp

Center for Transportation Research and Education at Iowa State University www.ctre.iastate.edu

American Association of State Highway Transportation Officials (AASHTO)
http://www.transportation.org/

Context Sensitive Solutions
http://environment.transportation.org/environmental_issues/context_sens_sol/

National Park Service
Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER)
http://www.nps.gov/history/hdp/standards/haerguidelines.htm
http://www.nps.gov/history/hdp/index.htm

Transportation Research Board–Interstate Articles http://www.trb.org/

Institute for Transportation Research and Education http://itre.ncsu.edu/ADC50/publications.htm

Highways: Standards and Historical Integrity by Bruce Seely
http://itre.ncsu.edu/ADC50/downloads/seely_paper.pdf

Significance Determinations for Interstate Highways by Lynne Sebastian
http://itre.ncsu.edu/ADC50/downloads/sebastian_paper.pdf

Federal Highway Administration www.fhwa.dot.gov

American Concrete Pavement Association www.**acpa**.org/

American Concrete Pipe Association www.**concrete**-pipe.org/

National Ready Mixed Concrete Manufacturer's Association www.nrmca.org/

National Asphalt Pavement Association www.hotmix.org/history.php

National Transportation Enhancements Clearing House www.enhancements.org

National Transportation Enhancements Funding Program www.enhancements.org/funding.asp

Surface Transportation Policy Project www.transact.org

Preservation:

Advisory Council on Historic Preservation www.achp.gov

American Byways Resource Center www.bywaysonline.org

Scenic America www.scenic.org

National Trust for Historic Preservation www.nationaltrust.org

National Trust for Historic Preservation Main Street www.mainstreet.org

National Trust for Historic Preservation Rural Heritage www.nationaltrust.org/rural_heritage

National Conference of State Historic Preservation Officers www.ncshpo.org

Preservation Notes, the semiannual newsletter. Editor: Mary Alfson, CHRS, Inc.. Publisher: CHRS, Inc., 403 E. Walnut Street, North Wales, PA 19454. Send ideas or suggestions to Mary Alfson malfson@chrsinc.com or call (215) 699-8006.

Preservation notes: 2005 Fall Newsletter http://itre.ncsu.edu/ADC50/downloads/Newsletter_Fall2005.pdf

Missouri Department of Transportation
http://itre.ncsu.edu/ADC50/downloads/reeder_HistoricInterstates.pdf
(Missouri's Historic Interstates?; by Bob Reeder).

Office of the State Archaeologist–Highway Archaeology Program www.uiowa.edu/~osa

Tourism, Byways, and Trails:

The Iowa Highways Page http://iowahighways.home.mchsi.com

America's Byways Resource Center www.byways.org

National Park Service, Rivers, Trails and Conservation Assistance Program
www.nps.gov/ncrc/programs/rtca

National Park Service, National Register of Historic Places www.nps.gov/history/nr

America's Byways Community–National Scenic Byways Program www.bywaysonline.org

America's Byways: National Scenic Byways Online www.byways.org

Rails-to-trails Conservancy: Creating a nationwide network of trails from former rail lines
www.railtrail.org

Partners in Tourism   www.nasaa-arts.org/artworks/partners.shtml

Scenic America   www.scenic.org

Travel Industry Association of America   www.tia.org

North American Auto Trails   www.marion.ohio-state.edu/fac/schul/trails/trails.html

U.S. Highways: From US 1 to US 830   http://www.us-highways.com

Historic Roads   http://www.historicroads.org/sub2_1.htm

History and Museums:

State Historical Society of Iowa   www.iowahistory.org

The Library of Congress   www.loc.gov

History of American Roads and the First Federal Highway
http://inventors.about.com/library/inventors/blcar3.htm

American Association of Museums   www.aam-us.org

American Association of State and Local History   www.aaslh.org

United States Department of Agriculture:

USDA Cooperative State Research, Education, and Extension Service (CSREES)   www.csrees.usda.gov

USDA Rural Development Home Page   www.rurdev.usda.gov

USDA Forest Service   www.fs.fed.us

Additional Sites:

Abandoned U.S. 34-Southeast Iowa   http://nbratney.tripod.com/us34/index.htm

1927 U.S. Numbered Highways (RVD)   www.us-highways.com/1927us.htm

1925 USDA BPR plan for U.S. Numbered Highways (RVD)   www.us-highways.com/1925bpr.htm

LOCATION OF STUDY ROUTES 1 AND 2

U.S. 34 AND U.S. 218

The Blue Grass an8d Red Ball Roads

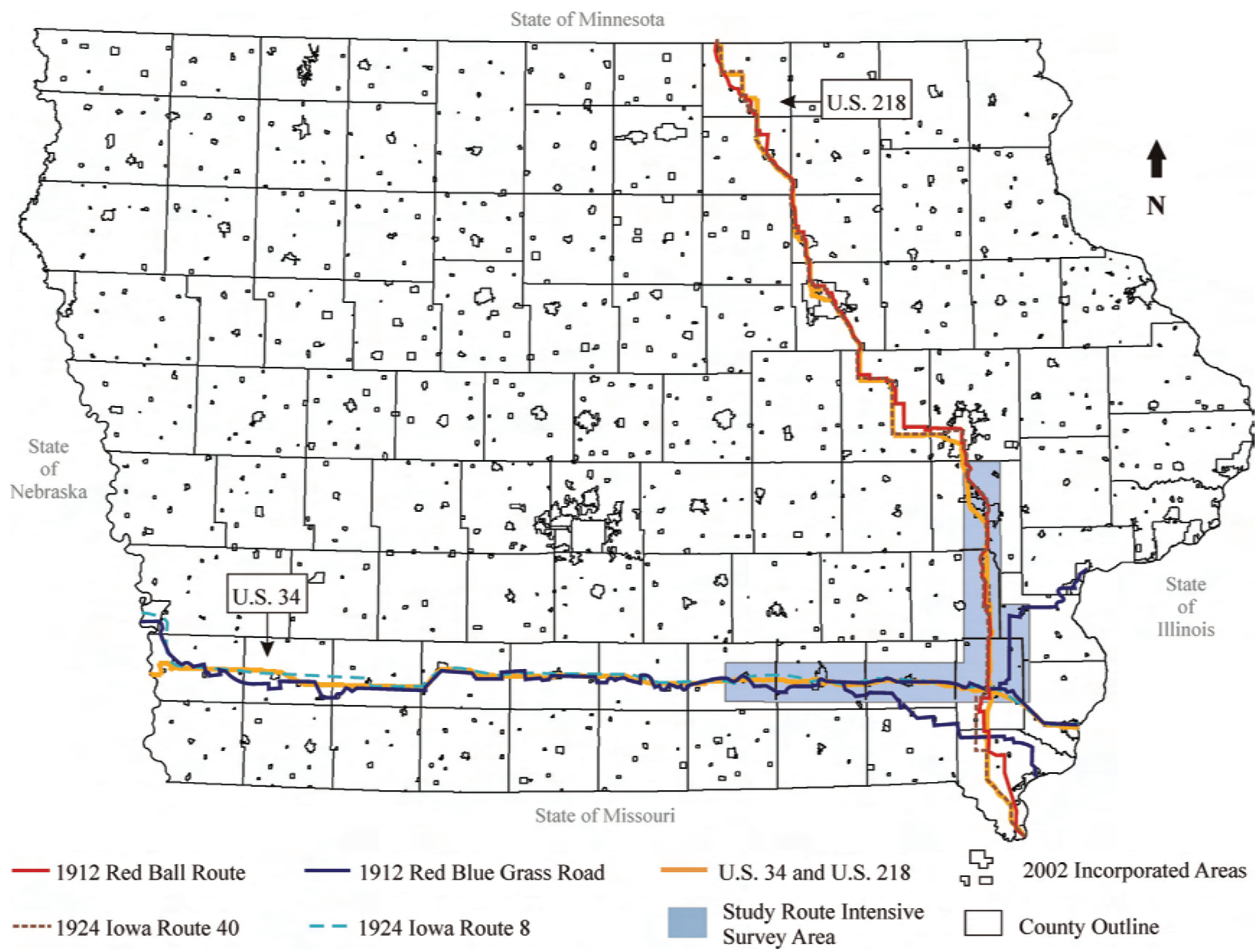


Figure 116. Location of modern, 1924, and 1912 routes of U.S. 34 (Blue Grass Road) and U.S. 218 (Red Ball Route).

U.S. 34–Study Route 1

THE BLUE GRASS ROAD

Maps of Sections and Segments

Figure 117. Location of the Blue Grass Road from Burlington to Ottumwa. Showing the North Diagonal and South Diagonal study route segments of the Blue Grass Road from Muscatine to Mount Pleasant and Fort Madison to Agency in 1912.

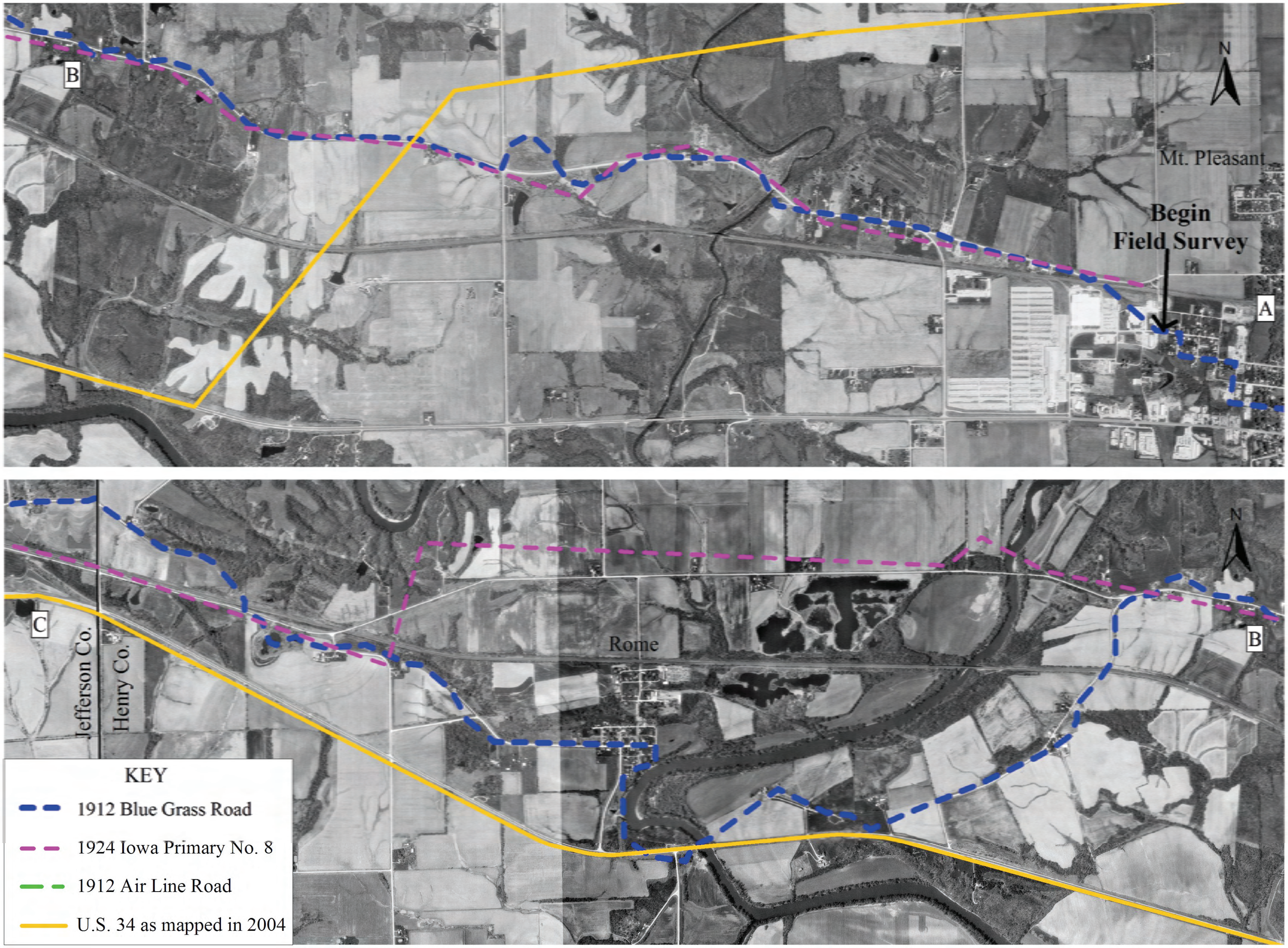
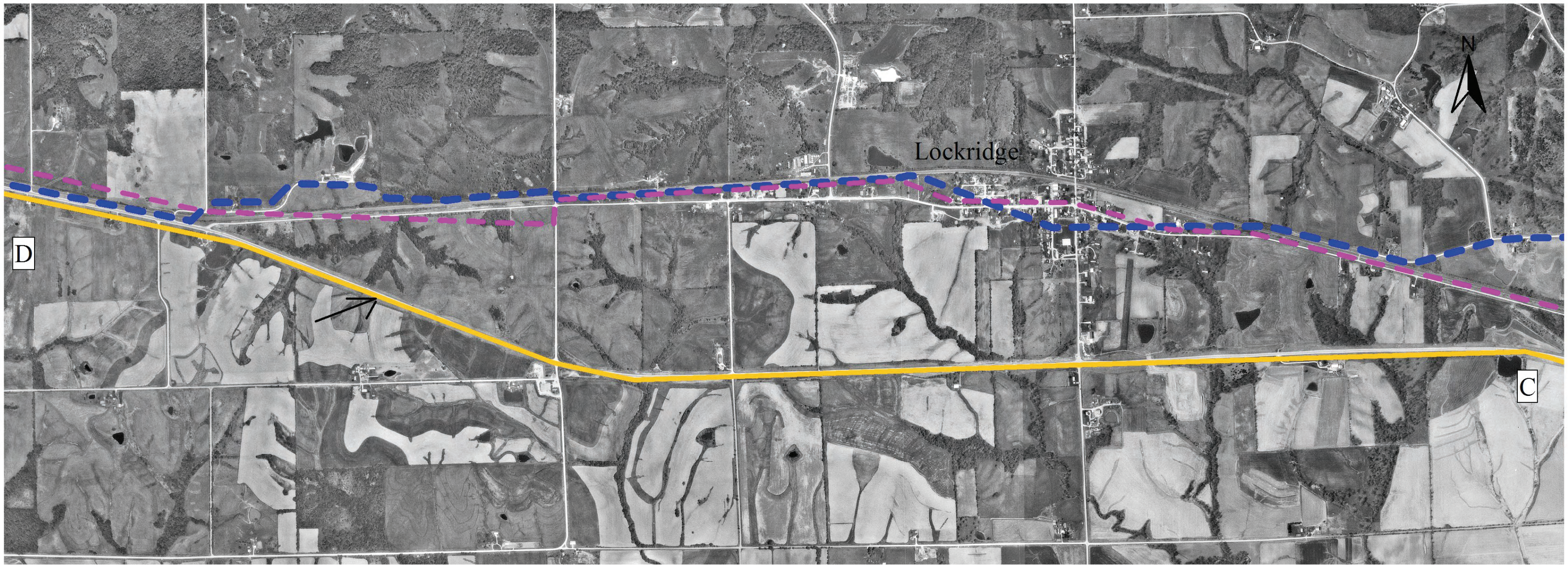


Figure 118. Aerial map Sections A–C, road Segment 1 (Mount Pleasant to west of Rome) showing 1912, 1924, and 2004 alignments of U.S. 34, the Blue Grass Road (Base Map: U.S.D.A., G.L.I.S. digital orthophoto 1990s). Scale 1:32,000. Key applies to Figures 119–127.



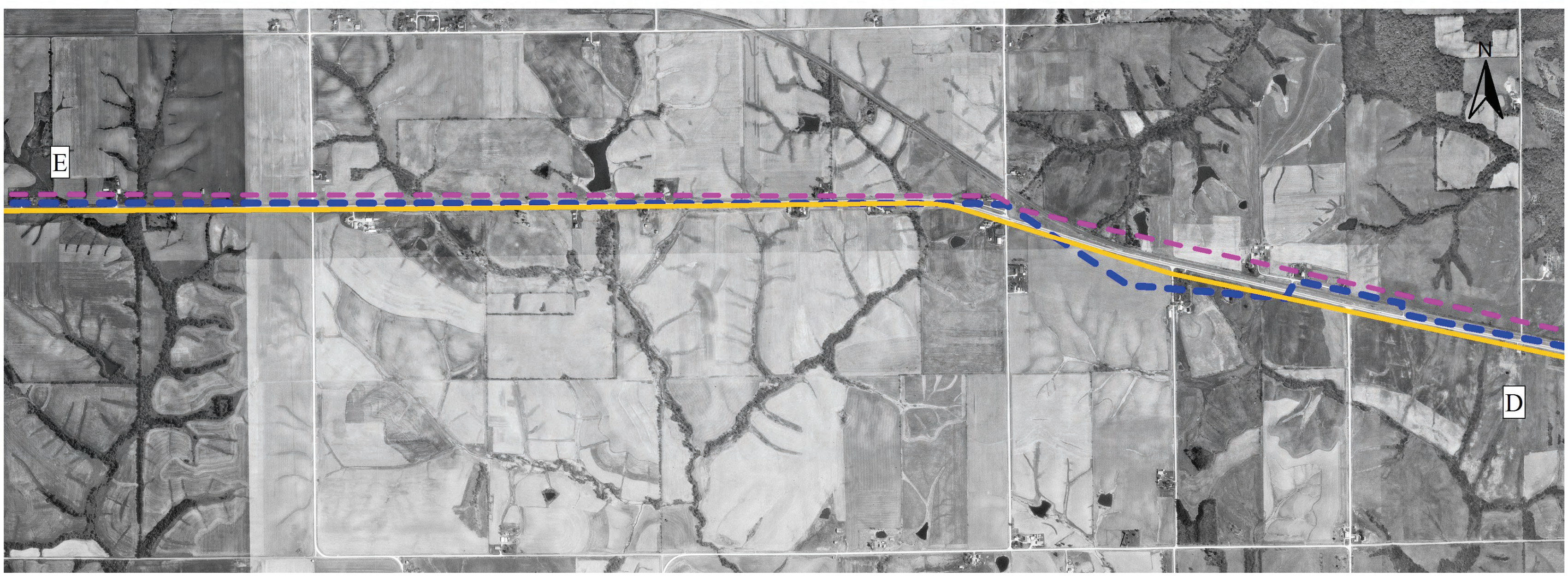


Figure 119. Aerial map Sections C–E, road Section D (Segments 1–2, Sub-segments A–H) (1 mi east of Lockridge to 2½ mi east of Fairfield) showing 1912, 1924, and 2004 alignments of U.S. 34 (Base map: U.S.D.A.,G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

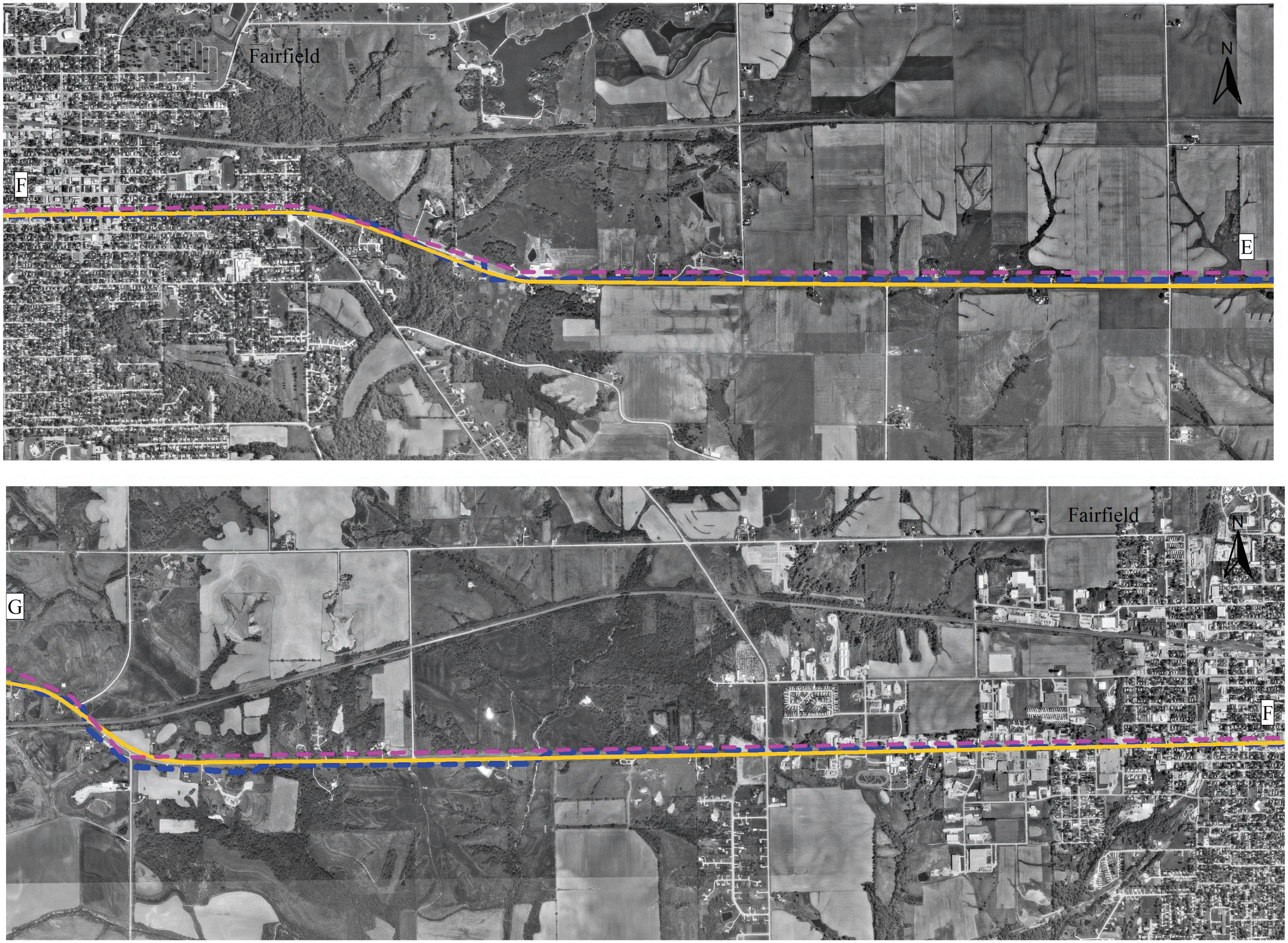


Figure 120. Aerial map Sections E–G, road Sections E (Segment 4) and F (Segment 1) (2¼ mi east of Fairfield to 2 mi west of Fairfield) showing 1912, 1924, and 2004 alignments of U.S. 34 (Base map: U.S.D.A., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

Figure 121. Aerial map Sections G–I, road Section F (Segments 1 and 2) (2½ mi east of Batavia to 1½ mi west of Batavia) showing 1912, 1924, and 2004 alignments of U.S. 34, the Blue Grass Road (Base map: U.S.D.A., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

Figure 122. Aerial map Sections I–K, road Section G (Segments 1 and 2) (2½ mi east of Agency to eastern edge of Ottumwa) showing 1912, 1924, and 2004 alignments of U.S. 34, the Blue Grass Road (Base map: U.S.D.A., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

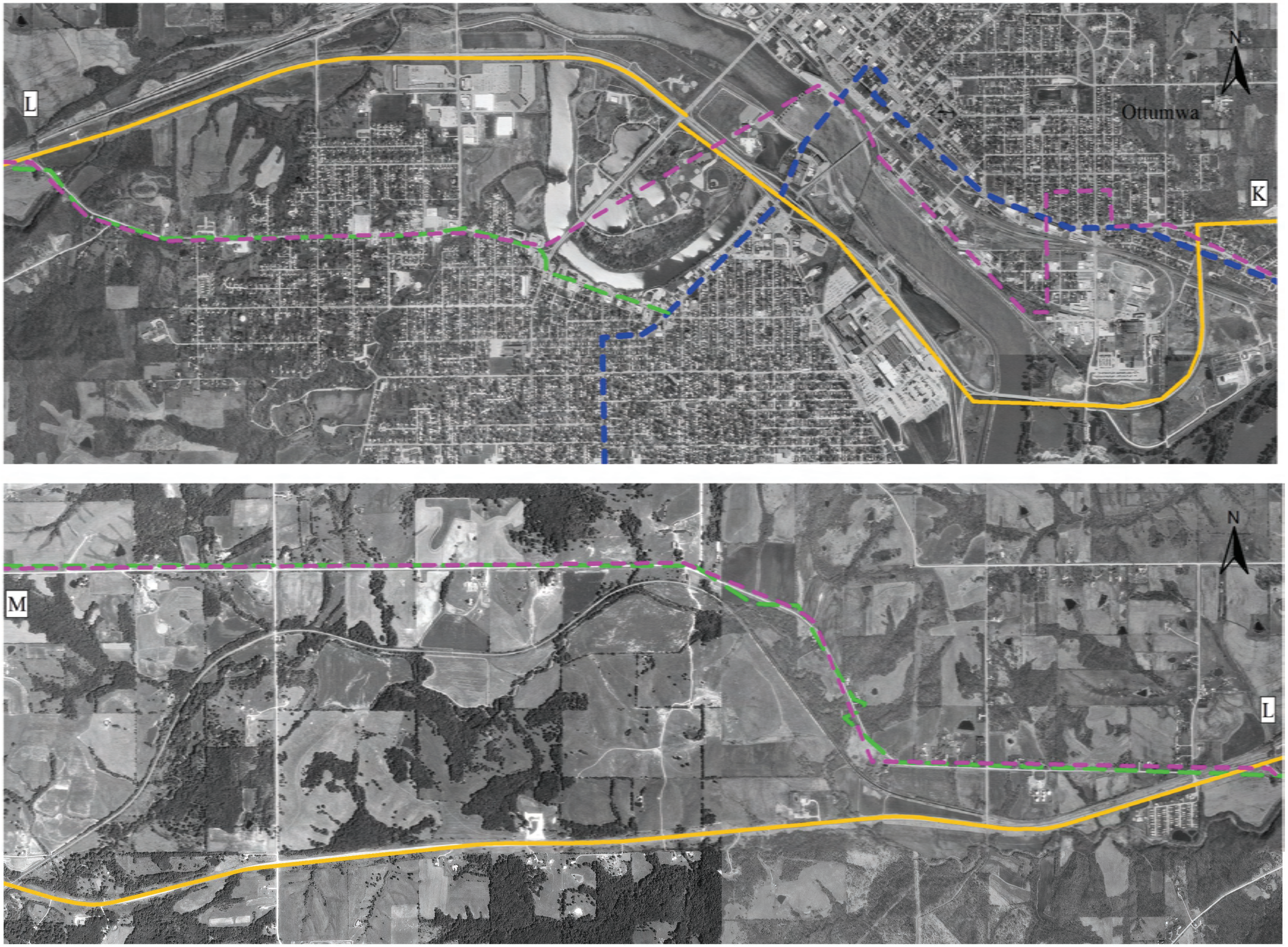


Figure 123. Aerial map Sections K–M, road Sections G and H (eastern edge of Ottumwa to 2½ mi west of Ottumwa) showing 1912, 1924, and 2004 alignments of U.S. 34, the Blue Grass Road (Base map: U.S.D.A., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

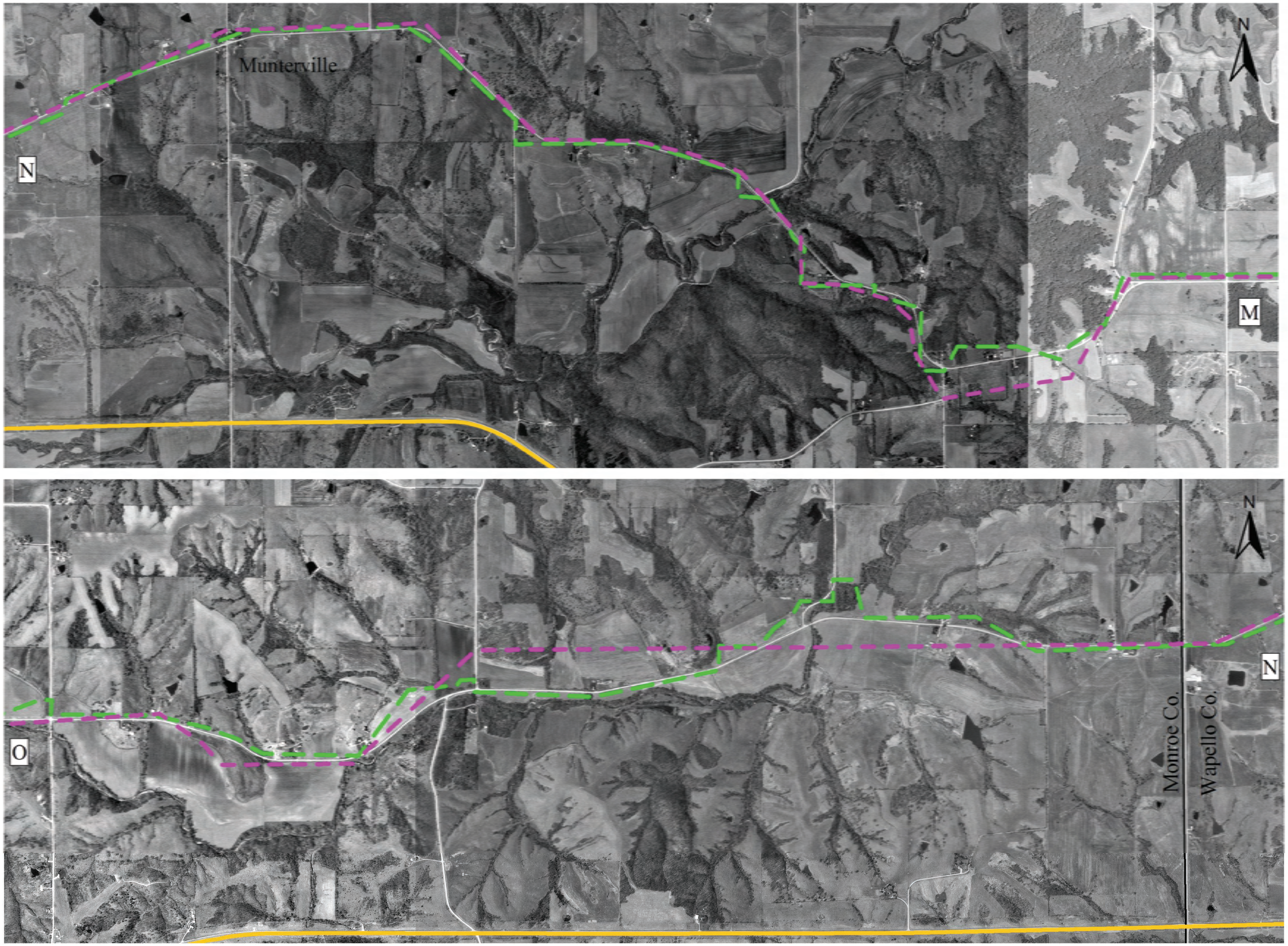


Figure 124. Aerial map Sections M–O, road Segment H (Sub-segments 1 and 2)(2½ mi east of Ottumwa to 3½ mi east of Albia) showing 1912, 1924, and 2004 alignments of U.S. 34, the Blue Grass Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

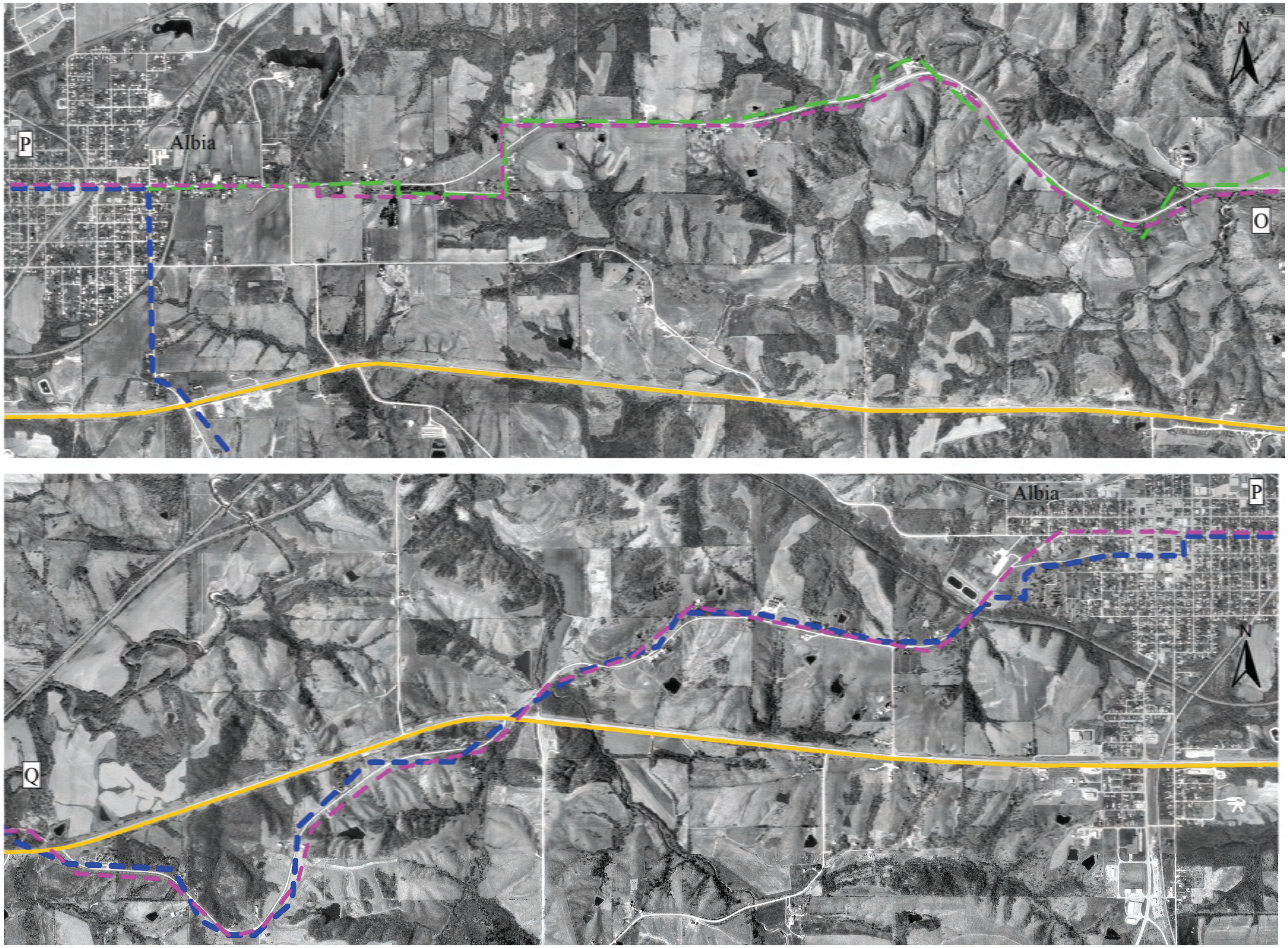


Figure 125. Aerial map sections O–Q, road Segment H (Sub-segments 1–3)(2½ mi east of Albia to 2½ mi west of Albia) showing 1912, 1924, and 2004 alignments of U.S. 34, the Blue Grass Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

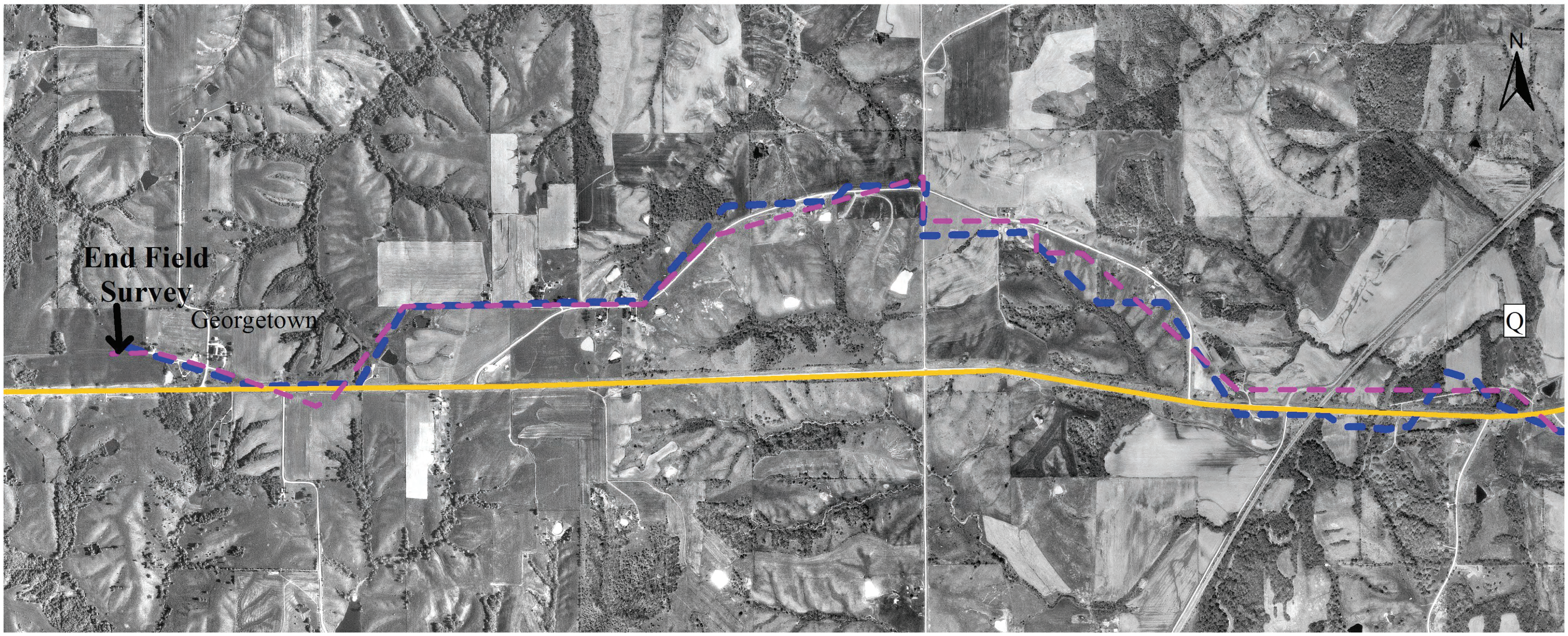


Figure 126. Aerial map Section Q, road Segment H (2½ mi west of Albia to ½ mi west of Georgetown) showing 1912, 1924, and 2004 alignments of U.S. 34, the Blue Grass Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

U.S. 218–Study Route 2

THE RED BALL ROAD

Maps of Sections and Segments

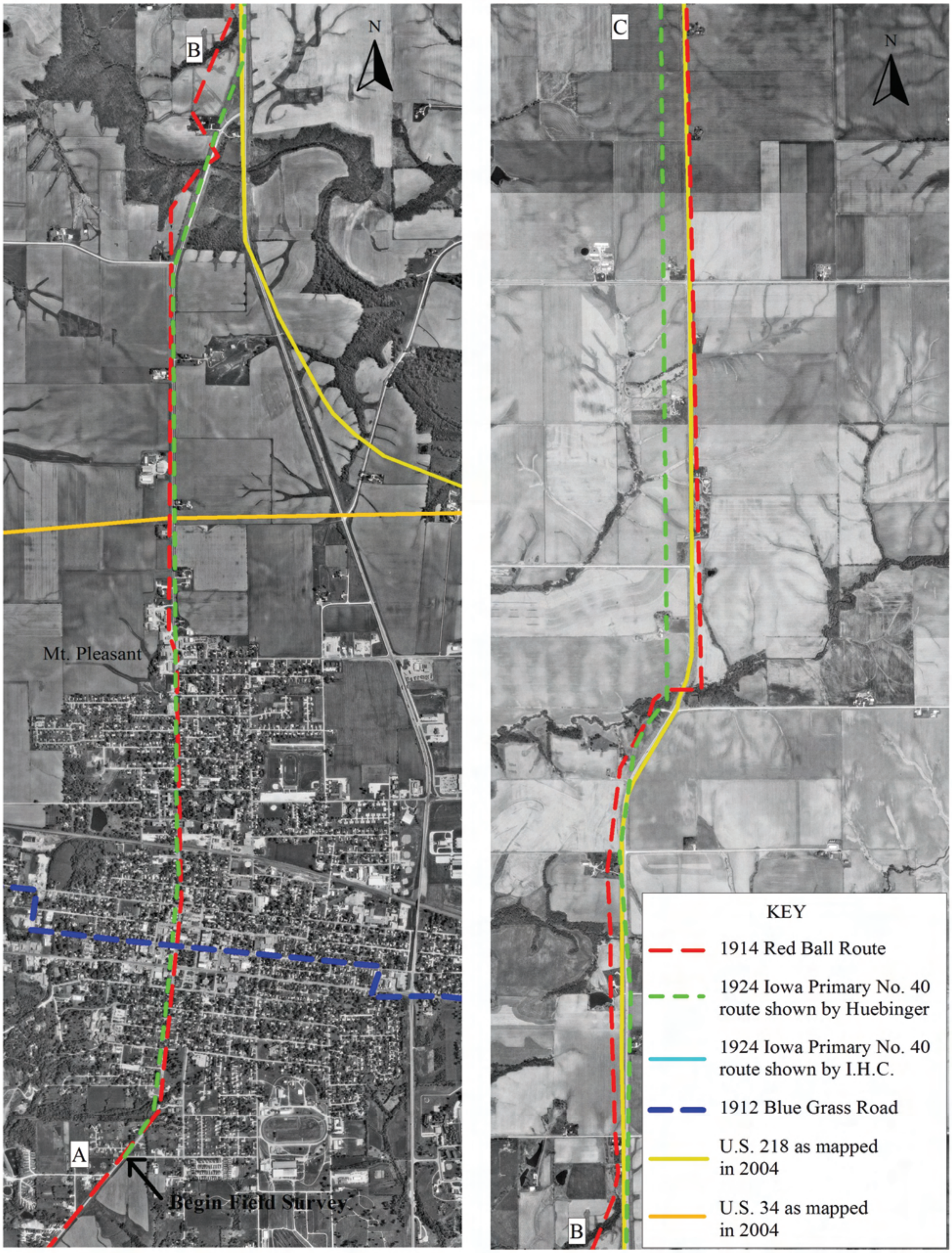


Figure 127. Aerial map Sections A–B, road Section A, Segment B (south Mount Pleasant north to current U.S. 218) showing 1914, 1924, and 2004 alignments of U.S. 218, the Red Ball Road and paths of the 1912 Blue Grass Road and old U.S. 34 through town (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000. Key applies to Figures 128–136.

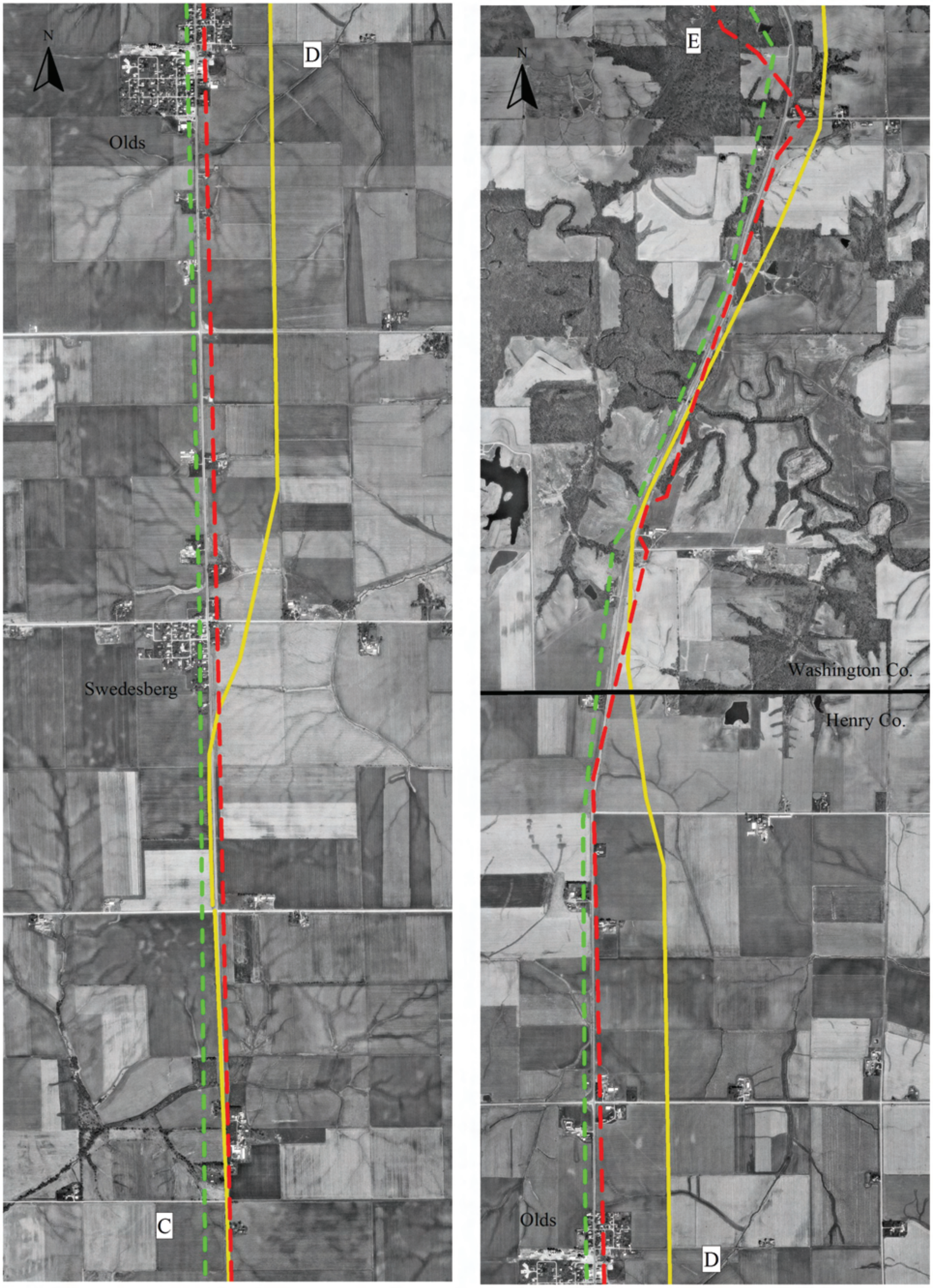


Figure 128. Aerial map Sections B–D, road Section B (2¼ mi south of Swedesburg to 4¼ mi north Olds) showing 1914, 1924, and 2004 alignments of U.S. 218, the Red Ball Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

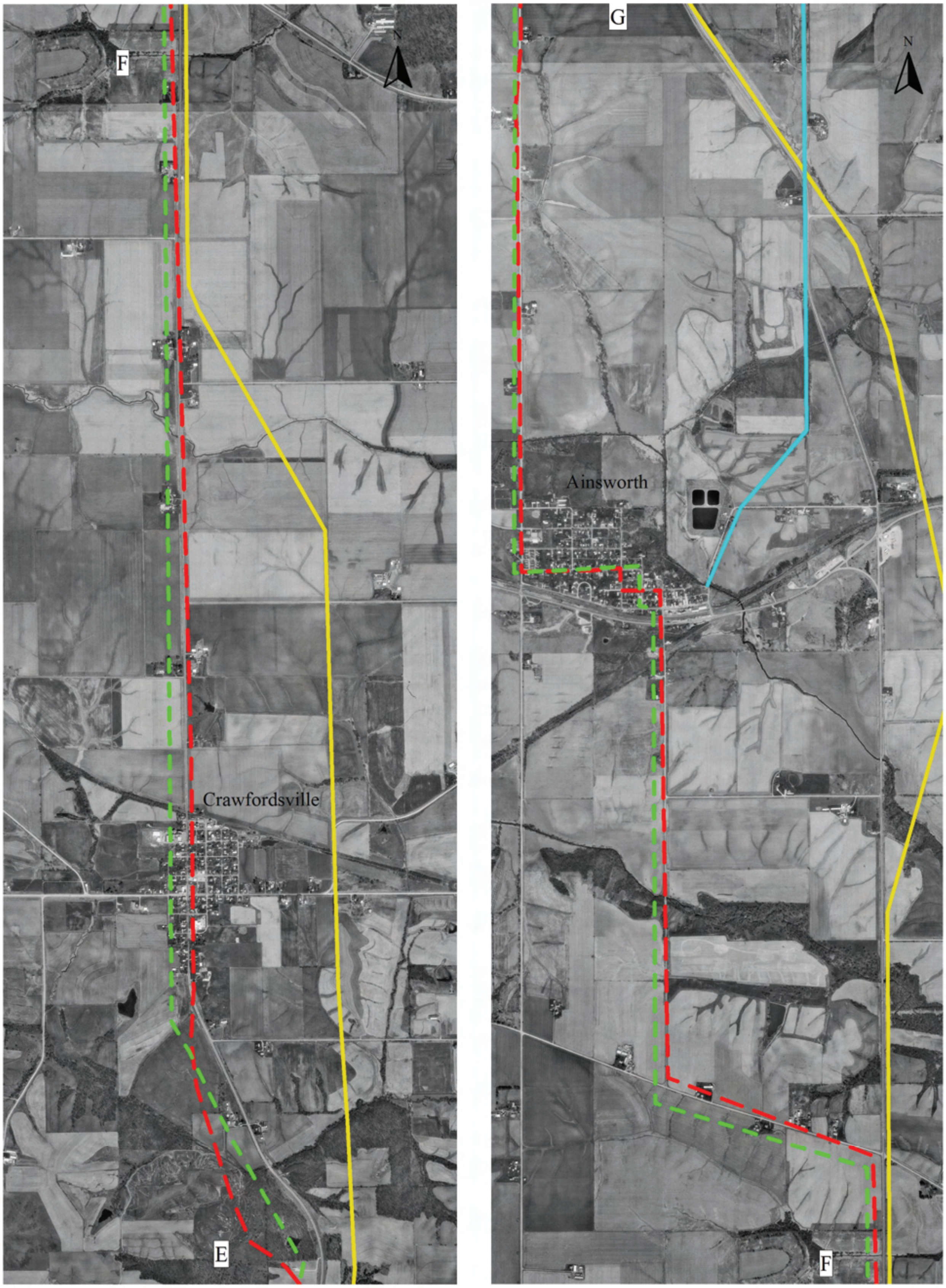


Figure 129. Aerial map Sections D–F, road Sections B, C, and D (Segments 1 through 3) (1½ mi south of Crawfordsville to 2 mi north of Ainsworth) showing 1914, 1924, and 2004 alignments of U.S. 218, the Red Ball Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale 1:32,000.

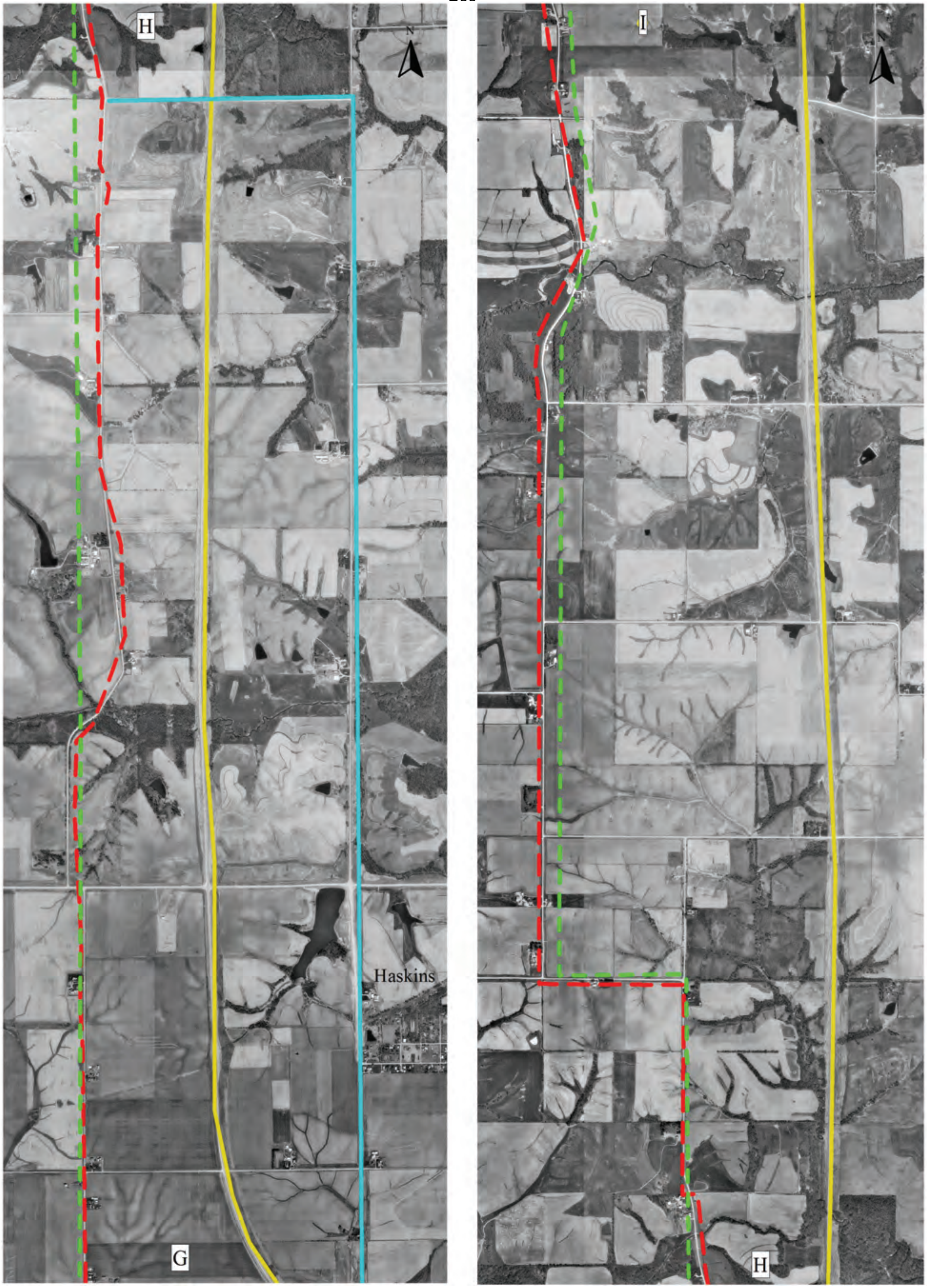


Figure 130. Aerial map Sections F–H, road Section E, Segments 1 through 4 (2 mi north of Ainsworth to 2 mi south of Riverside) showing paths of 1914, 1924, and 2004 alignments of U.S. 218, the Red Ball Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

Figure 131. Aerial map Sections H–J, road Section E, Segment 4 (1½ mi south of Riverside to 1½ mi north of Hills) showing paths of 1914, 1924, and 2004 alignments of U.S. 218, the Red Ball Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale 1:32,000.

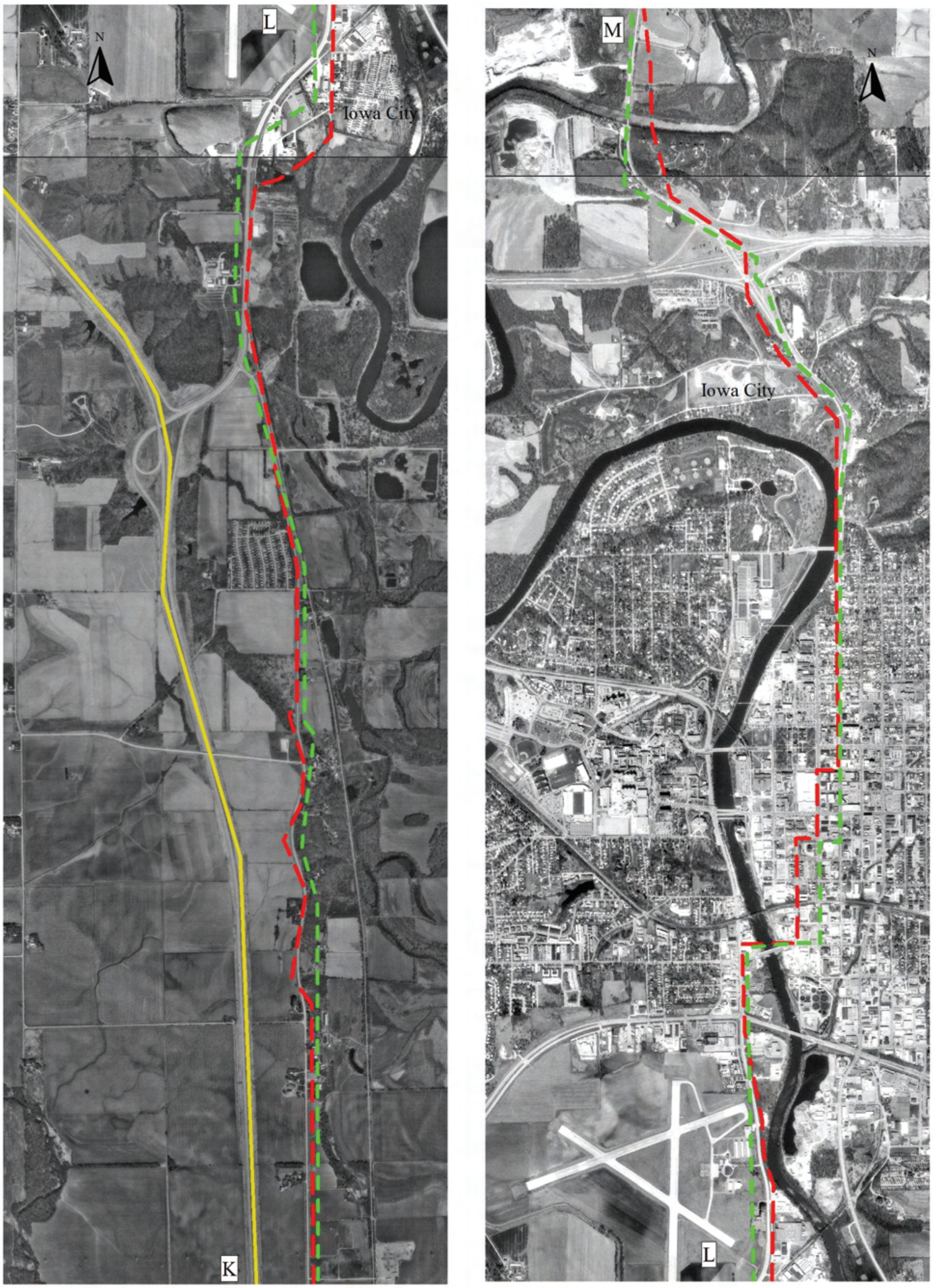


Figure 132. Aerial map Sections J–L, road Sections E and F, Segments 1 through 3 (3¼ mi south of Iowa City, to 1 mi north of I-80) showing paths of 1914, 1924, and 2004 alignments of U.S. 218, the Red Ball Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

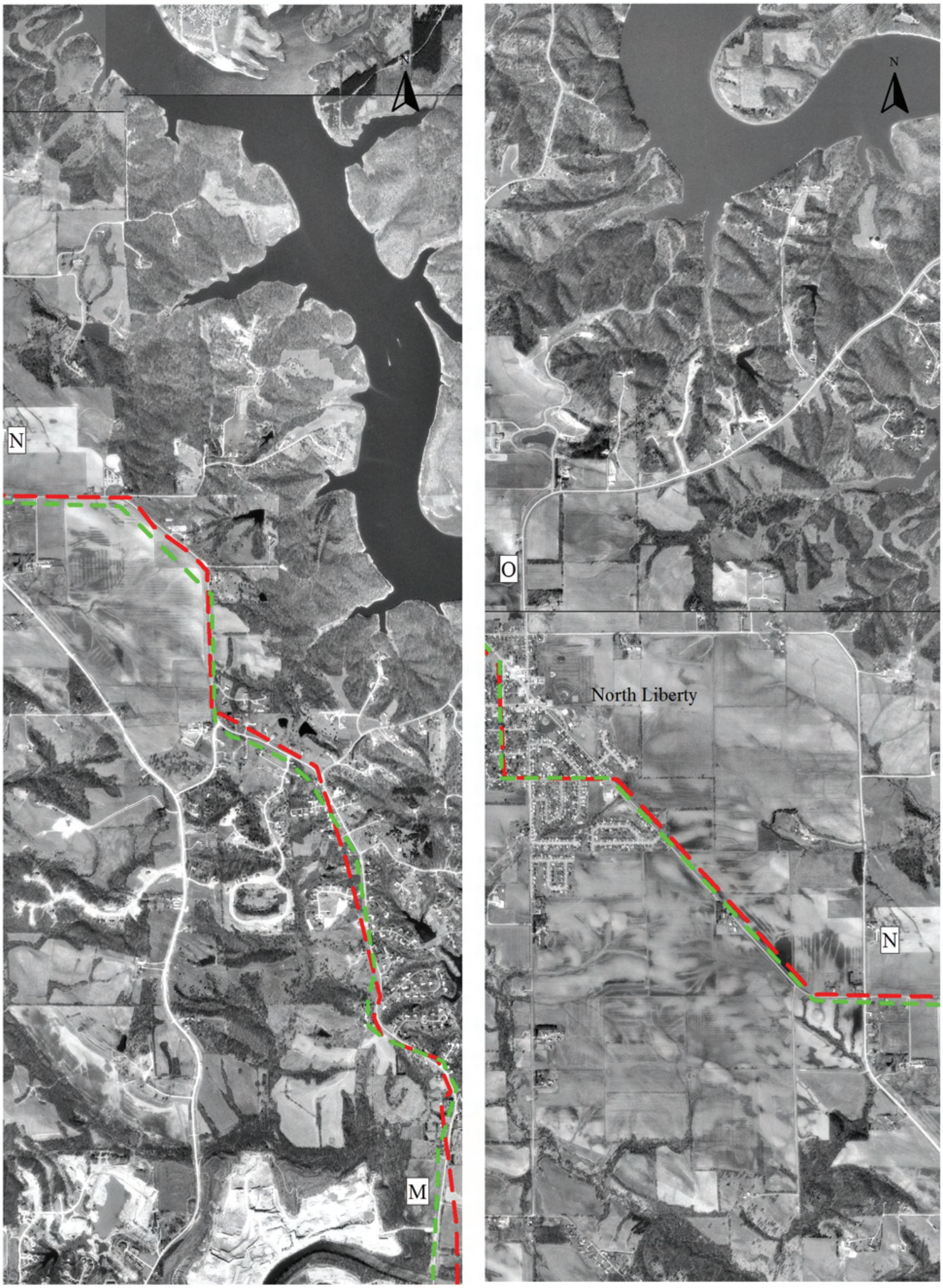


Figure 133. Aerial map Sections L–N, road Section F and G (1 mi north of I-80 to the north side of North Liberty) showing paths of 1914, 1924, and 2004 alignments of U.S. 218, the Red Ball Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

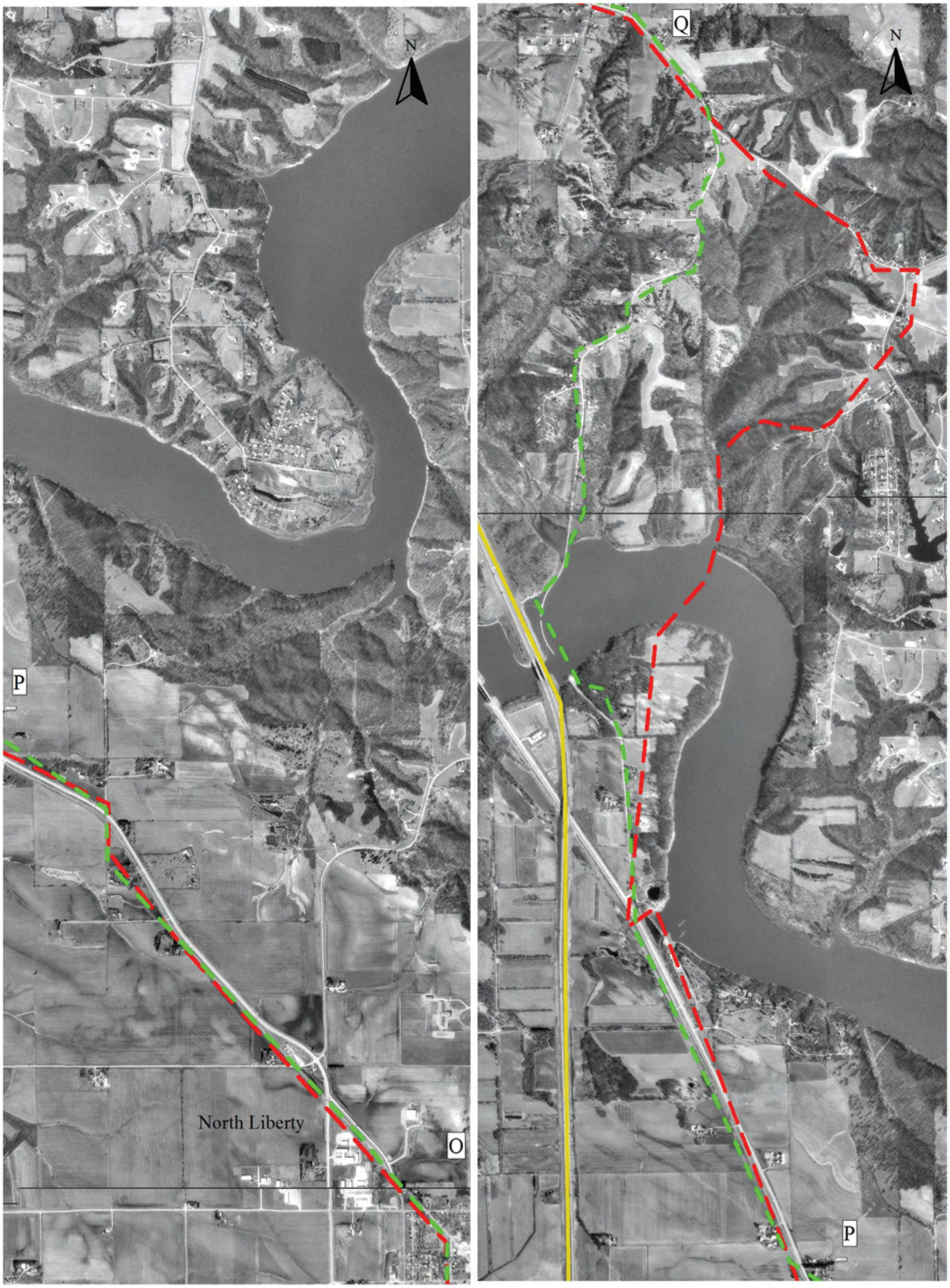


Figure 134. Aerial map Sections N–P, road Sections G and H (Segments 1 through 3) (1½ mi northwest of North Liberty to ½ mi south of Shueyville) showing 1914, 1924, and 2004 alignments of U.S. 218, the Red Ball Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale1:32,000.

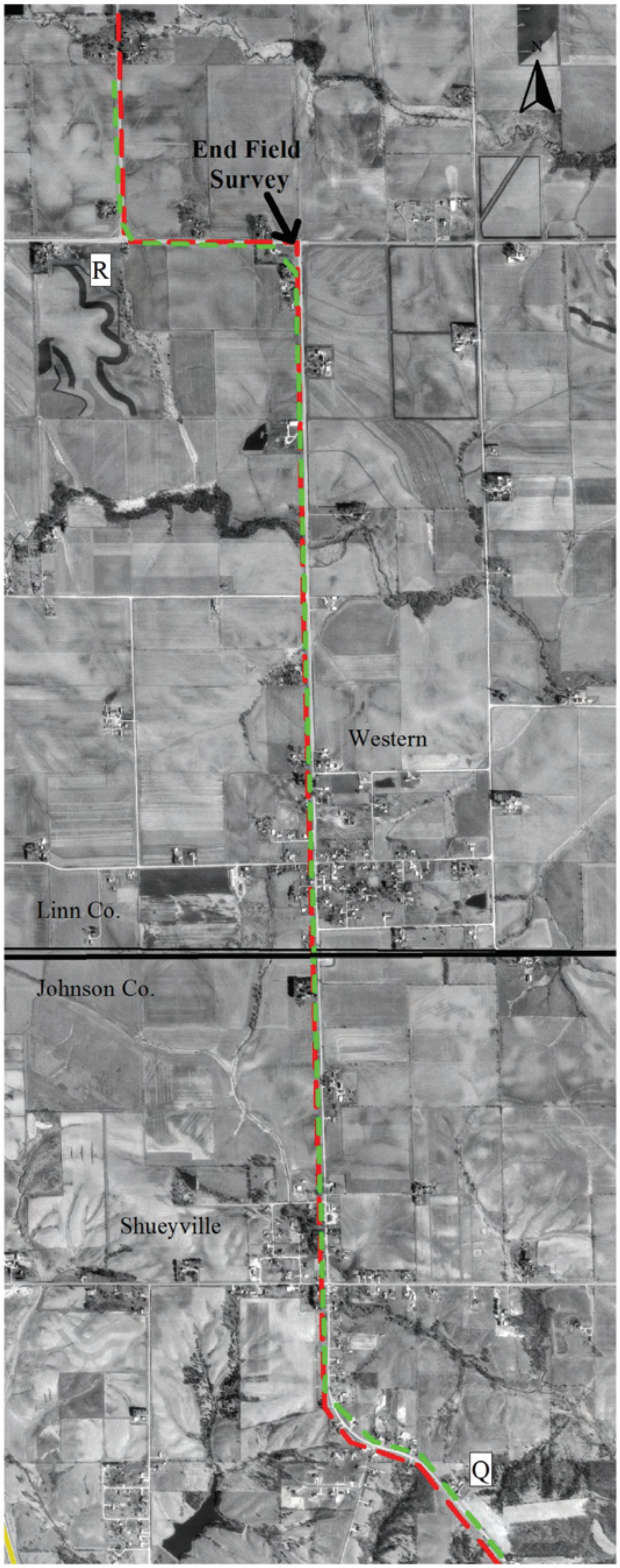


Figure 135. Aerial map Section Q–R, road Section H (½ mi south of Shueyville north to Cedar Rapid corporate limit) showing paths of 1914, 1924, and 2004 alignments of U.S. 218, the Red Ball Road (Base map: U.S.G.S., G.L.I.S. digital orthophoto quadrangle 1990s). Scale 1:32,000.

Appendix A

SCOPE OF WORK
NATIONAL REGISTER STUDY OF PRE-1948 ARTERIAL HIGHWAYS IN IOWA
NHS-61-4(55)--19-70, MUSCATINE COUNTY PRIMARY ROADS

Introduction. Outlined below are the proposed research requirements for the National Register Study of Pre-1948 Arterial Highways in Iowa. This project is the result of a Memorandum of Agreement (MOA) for the mitigation of NHS-61-4(55)--19-70. The goals of this study are to provide a means by which Iowa's 1900–1948 arterial highways can be evaluated for National Register significance. A discussion of the form of the final report will be made after Step 2 below so that all parties are aware of what is needed in the final phase of research and how the final report will look and what it will contain. Discussions will consider the size of the final document, its form, Iowa Department of Transportation (Iowa DOT) and State Historical Society of Iowa (SHSI) expectations, level of investigation, and depth of research.

As the MOA states, the study is to examine an issue of importance to performing preservation activities in Iowa. It is to be written for a broad public audience—kept simple, direct, and free of technical and academic jargon. The information is to be presented (i.e., edited, catalogued, and packaged) in accordance with SHSI guidelines. In so doing, the report will meet the Secretary of Interior's standards for preservation planning (48 FR 44716).

The Iowa DOT has recommended the focus be limited to the roads and rights-of-way, with minimal attention to peripheral elements. The Iowa DOT has also suggested a two-year period for completion of the report, noting that this study is not on a tight schedule, and higher priority projects may take precedence. The first year's investigations will concentrate on archival research. This will involve travel to numerous libraries and repositories around the state and along potential project corridors. During year two the archival phase will shift after the study units are identified, and direction will be oriented toward recordation of the chosen resources and report writing.

Central Question. When can stretches of Iowa's oldest roads, whether abandoned or in current use, individually meet National Register criteria rather than simply being contributing elements within a historic district relationship of other buildings, structures or features? Certain of these issues have been addressed previously, for example with reference to sections of the Lincoln Highway and cut-off, abandoned, or remnant sections of other Iowa highways previously evaluated over the years. These surveys and evaluations need refinement for determining whether, or on what basis, Iowa highways may be significant in themselves to qualify for listing on the National Register of Historic Places. The process of selecting and reporting two important arterial highways will include the following three steps.

Step 1. Preliminary Research and Evaluation

1. Preliminary research on the location of possible routes for study will be undertaken. This will consist of a review of period maps. The maps will date from 1900 to around 1948. Routes chosen for survey will meet as closely as possible all basic criteria suggested in the MOA.
2. Investigative research into period transportation literature, maps, photographs, histories, and other possible sources will be undertaken for analysis.
3. The candidate roads will meet the following criteria, as outlined in the original MOA.
    a. In existence between 1900 and 1948.
    b. Cross an area or have a length sufficient to include as many of the possible property types and outlined periods as possible. A multi-county length is recommended.

4. Major highways that have been reconstructed will be avoided. The Lincoln Highway will not be a candidate, as an ongoing study is underway.
5. Preliminary contact with relevant parties at the Iowa DOT and SHSI will be made and a primary contact person established within each agency.
6. The archival holdings of both the SHSI and Iowa DOT will be reviewed along with relevant archival holdings in other libraries, institutions, and government agencies. The product of these holdings will be consulted, analyzed, and applied where relevant.
7. Peripheral elements of the highway, such as service and filling stations, transportation-related commercial enterprises, roadside attractions, objects, travel courts, scenic vistas, significant local individuals, and materials sources will be evaluated only where directly contributing and essential to the road bed's interpretation.

Step 2. Statewide Survey of Selected Alignments

1. What kind of road was it, and what were its beginnings as an early arterial road? Where did the route go, and what kind of traffic was it designed for?
   a. Roads prior to Registered Highway Routes Roads that may have evolved into arterials from contexts such as the Iowa Good Roads Movement.
   b. Transcontinental, trans-state, point to point (city to city) roads' evolution and significance.
   c. Early but unregistered routes.
   d. Section of state and topography.
2. The following designated time periods or stages may be used. Background research indicates these periods are related to significant movements and organization within the Iowa DOT and relevant to local, statewide, and nationwide road-building movements.
   a. 1900–1905 (Start of study period to end of Iowa Good Roads Movement).
   b. 1906–1918 (Establishment of State Highway Commission Standards and Registered Highway Era).
   c. 1919–1925 (End of World War I until Federal Transportation Act).
   d. 1926–1948 (Era of increased mechanization to post-World War II).
3. The survey of selected alignments will include recordation of specific contributing elements.
   a. Length of individual sections.
   b. Date of construction of sections.
   c. Significant engineering/architectural, historical, and social elements within sections and their probable dates.
   d. Types of paving and width.
   e. Shoulders, curbing, and crown.
   f. Ditches and right-of-way widths.
   g. Bridges, culverts, drains, or other intact significant or relevant/related features.
   h. Probable dates and sources of significant engineering principles, materials, and construction.
   i. Survival, integrity, and distribution of above outlined elements.
4. Based on data collected observations and interpretations will be made concerning overall aspects such as:
   a. Condition/integrity.
   b. Sense of time and place.
   c. Landscapes and views.
   d. Affect on regional or local transportation, businesses.
   e. Other road-related economic and social aspects.
5. A simple comparative system for rating integrity and significance will be derived and discussed. This will allow for the comparison and evaluation of potentially significant elements using the National Register standards and SHPO guidelines and standards for evaluation.

a. For final survey type, depth of investigation, and route choice, the merits of specific high-scoring highways or sections of highways will be compared, examples given, and standards for evaluations set.
b. This will be applicable to producing a preliminary statewide model.

Step 3. Report Preparation—The Two Iowa Highways Today

1. *Introduction:* The project's purpose will be described, including the time frame when research and fieldwork occurred and limitations of the project.
   a. The MOA anticipates a narrative report of approximately 25 pages.
   b. The final document will give an overview of the routes, what they contain, the integrity and significance of their engineering, construction, and social impact. It will provide a rating system that allows for comparisons between like features or elements on other Iowa highways and a grading system of evaluation for interpreting their potential National Register eligibility.
2. *Part I:* The Two Iowa Highways Today will take the reader to the two selected routes and describe their relationship to routes designated as U.S. and Iowa highways generally. This section will identify where the two routes are situated and important physical characteristics of their setting and landscape features.
   a. The document will address the varieties of period design characteristics, right-of-way features, and general appearance in relation to their classification and present use.
3. *Part II:* Historical background explains when and how the state's arterial system of roads evolved from its beginnings in Iowa. This will provide three perspectives.
   a. Important trends in the creation of highway design standards at federal and state levels.
   b. How the standards were implemented over the years through the shaping influence of federal and state requirements and funding.
   c. Local, regional, and national effects.
4. *Part III:* Construction History. Summarizes the physical evolution of each of the two selected arterial highways in Iowa and their story of development. This would include:
   a. An annotated chronology of the construction of each from unpaved road to paved highway.
   b. Identification of major subsequent changes along each route through discussing:
      1. Alteration in location and alignment of the route.
      2. Alterations in width of right-of-way.
      3. Alterations in elevation profile.
      4. Alterations of the pavement itself, including curb removal.
   c. Evolution of the cross-section (i.e., composition from foundation base to the road surface) from, for example, high modified railroad embankment type roads with deep ditches to lower and flattened varieties.
   d. Successive engineering structures and design (bridges, culverts, grade separations, intersections, esplanades, roadside parks and structures, turnouts, scenic overlooks).
      1. Identification and evaluation of the survivability of original materials, design, construction, and/or replacement.
      2. Compare and contrast such elements to other structures with similar engineering characteristics, design, or innovative approaches.
   e. A summary of which segments reflect which era of each route's development will be developed.
5. *Part IV:* A discussion of the significance of state arterial highways will bring together for the reader recommendations in the form of:
   a. Guidelines for evaluating the significance and integrity of roads.
   b. Evaluations about where the greatest probability for National Register eligible features are to be found on the two selected routes, accounting for integrity, authenticity, and significance. An annotated ranking of highway stretches into those with high, low, and no potential eligibility to be

listed under one or more criteria. The report will discuss any highway sections associated with important initial employment of new construction practices, design standards, or use of materials.

c. The report section will explain the two highways as having or lacking interpretive value to telling the state's transportation story. Photographs and illustrations, along with site plans may be integrated into the narrative as needed to help convey significant elements.

Report Preparation. Relevant parties throughout its development and preparation will discuss the form and content of the report draft. Both Iowa DOT and SHPO staff will review the final draft. The finished publication format and requisite number of copies of the final report will be determined at that time.

References. As related in the MOA, a statement will be included concerning the quantity and quality of information consulted and its location, noting any conflicts in source materials, their accuracy, biases, or noteworthy historical perspective. This will be followed by a bibliography of the reference source materials.

Appendices. This section will contain materials not presented elsewhere in the report, such as maps, black and white and color field photos (with an annotated photograph catalog field sheet for each sleeve), negatives, photo-logs, and contact print sheets. Other relevant information, such as photocopies of advertisements, biographical information about noteworthy highway designers, promoters, good roads organizations, prominent road builders associated with construction of Iowa highways, and other sketches and architectural drawings that are not integrated into the report will be included in this section.

MEMORANDUM OF AGREEMENT
NHS-61-4(55)--19-70

STIPULATIONS

FHWA will ensure that the following measures are carried out:

1. The Iowa Department of Transportation shall implement the Data Recovery Plan attached as appendix 2 to recover information from archaeological sites 13MC15, 13MCl20, 13MC134, 13MC135, and 13MCl69 which is significant to the understanding of prehistory in Iowa.
2. The Iowa DOT shall have the data recovery cited in stipulation one conducted by a person(s) or firm(s) who is acceptable to the SHPO and whose education and professional experience meets the Secretary of the Interior's professional qualification standards.
3. The SHPO will be provided with monthly progress reports and will make one or more site visits in order to review the data recovery field work for thoroughness and compliance with the DRP, so that at its completion, the letting of the highway construction project may be allowed to proceed and will not be delayed while the labwork and writing of the report are being finished.
4. The SHPO will review the completed documentation report for professional and technical compliance with the data recovery plan included in appendix 2 and with the Secretary of Interior's guidelines. The completed documentation will be filed with the State Historical Society of Iowa and with the Office of the State Archaeologist. Material recovered from the site will be archived at an approved facility in Iowa so as to be available for future study by archaeologists.
5. As mitigation for the removal of site 13MC133, the Iowa DOT shall prepare a planning report in accordance with the recommendations and guidelines attached as appendix 1, *Iowa Preservation Issue Report: Deciding the National Register Eligibility of pre-1947 Arterial Highways in Iowa.*
6. The Iowa DOT shall have the plan cited in stipulation five prepared by a person or firm who is acceptable to the SHPO and whose education and professional experience meets the Secretary of the Interior's professional qualification standards.
7. The SHPO will review the completed report for professional and technical compliance with the recommendations and guidelines in appendix 1.

Appendix 1

Iowa Preservation Issue Report: Deciding the National Register Eligibility of Pre-1948 Arterial Highways in Iowa

The study identified below is to examine an issue of importance to performing preservation activities in Iowa. It is to be written for a broad public audience--kept simple, direct, and free of technical and academic jargon. The information is to be presented (i.e., edited, cataloged and packaged) in accordance with State Historical Society of Iowa guidelines. In so doing the report will meet the Secretary of Interior's standards for preservation planning (48 FR 44716).

Based on field reconnaissance work and archival research, the writer will prepare a report which establishes an historical framework for evaluating the significance of highways and which remnants or portions retain their authenticity to meet National Register criteria. For purposes of this project, two of Iowa's oldest corridors will be selected for analysis as examples of what developed into major arterial highways between 1900 and 1948. One of the selected routes will be east/west and one will be north/south. These routes typically have varied in alignment over the years and sometimes have been renamed or renumbered.

By limiting the scope of work to a few selected highways, some things will necessarily be left out. Local haul road networks will receive no attention (until the turn of the century, most of Iowa's dirt roads served only local needs enabling shippers and travelers to reach a nearby rail connection). Multi-county main-traveled roads associated with the earlier stagecoach era will only be covered through assessing now-abandoned stretches of one or the two highways. Most attention here will be with the four decades after 1900 when the role of roads greatly expanded. This massive effort produced a new extensive system of improved and hard surface routes designed to satisfy the long distance capabilities of the automobile and truck.

Are there highways in Iowa other than the transcontinental Lincoln Highway which could be eligible for listing in the National Register? If so, what are the means by which this can be evaluated? That is the central question to be answered here: when can stretches of such roads, whether abandoned or in current use, <u>individually</u> meet National Register criteria rather than simply being a contributing element within a historic district relationship of other buildings, structures or features. Certain of these circumstances have been addressed and met through a previous National Register project to nominate Green County sections of the Lincoln Highway—our nation's first transcontinental route through Iowa. These need to be refined and added to for deciding whether, or on what basis, other Iowa highways may be significant, in themselves, to also qualify for listing in the National Register of Historic Places. It is one thing for a highway to be *associated* with transportation history, but quite another to be a National Register eligible highway that is associated with something *significant* in transportation history or as exemplifying significant construction practices.

This issue deserves attention in order to avoid inconsistent findings of eligibility. It is not an easy task, given the constantly evolving nature of highways which focuses concern on what kinds of authenticity should be satisfied in order to maintain eligibility. Within the limits of this project, the report is expected to produce guidelines for evaluating the significance of Iowa highways and the kinds of authenticity/integrity that would need to be satisfied, plus a list of the most promising segments along the two highways, if any, which likely meet National Register criteria.

The information prepared for inclusion in the State Historical Society of Iowa's records must meet the requirements below. The Society retains the right to refuse to accept the report for inclusion in its collections when it's information (edited, cataloged, and packaged) does not meet requirements as specified below.

Kinds of Documentation to be Gathered:

1. *Iowa Site Inventory Number, Historical Architectural Data Base Number, and Photograph (black and white film roll number and color slide sheet) Numbers:* Three kinds of project reference numbers are to be obtained from the statewide inventory coordinator at the State Historical Society's historic preservation office. The first is the Iowa Site Inventory Number, which can be assigned upon providing a specific street address in a town or city or, for rural areas, its quarter section, township and range. This number would be cited in the report, appear on reference maps and site plans, and be identified on photographic prints, slides, etc. The second number refers to the number assigned for entering this report into the state's Historic Architectural Data Base (HADB) through completing the HADB form for inclusion in the appendix. The third class of numbers are film roll numbers and color slide 20-slot sheet number to be obtained from the State Historical Society's Inventory Coordinator so that images can be cataloged into the agency's file system and cross-referenced to Iowa Site Inventory Forms.

2. *Photographs:* Field photography will illustrate various aspects of right-of-way, profile, cross section, and associated engineering structures (e.g., culverts, bridges, grade separations, intersections) which can assist in evaluating a highway through using the two selected highway examples. For field photography, take black and white views with ASA-125 or less film, and color slides with Kodachrome-64 film. The black and white photographs shall be on fiber-based papers or on resin-coated papers of double or medium-weight paper that have been processed in trays in order to meet guidelines outlined in National Register Bulletin 16A. The documentation is to meet requirements for ready inclusion in the records of the State Historical Society of Iowa.

3. *Drawings:* Unless stipulated elsewhere, the standard coverage will comprise straightforward, one-line drawings no larger than 8 1/2 by 11 inches in size showing elements in correct relation and proportion to one another, with label, north arrow, overall dimensions, and the date sketched. Drawings might include former highway routes in relation to those in current use or a cross-section of a paving technique.

4. *Available historic photographs or illustrations* that reveal an early highway construction method, a typical right-of-way, profile, cross section, associated engineering structure or, perhaps, views comparing the historic and present character of an existing stretch of the selected highway.

5. *Narrative Report* of approximately twenty-five pages with statements within the narrative footnoted as to their sources, where appropriate. The format for presentation is stated below.

Format for the Narrative Report:

Cover Page:
Includes report title, governmental entity or source of support for sponsoring the survey, author/authors, name of affiliated firm or research organization, date of report.

Acknowledgments (if applicable)
This might include acknowledgment of valuable oral informants, or recognition of those who provided useful research leads, or tendered special library assistance or helped locate and access useful courthouse archives.

Introduction:
The project's purpose is described, including the time frame when research and field work occurred, and limitations of the project.

Part I: The Two Iowa Highways Today takes the reader to the two selected routes, describing their relationship to routes designated as U.S. and Iowa highways generally. The section would identify where the two routes are situated and important physical characteristics of their setting and landscape features that have influenced the way they are. It would also address the varieties of design characteristics that they have in relation to the classification of their present use and right-of-way features, general appearance and arrangement.

Part II: Historical Background steps back to explain when and how the state's arterial system of roads evolved from its beginnings in Iowa. This would provide two perspectives:

1. Important trends in the creation of highway design standards at federal and state levels and of how the standards were implemented over the years through the shaping influence of federal and state funds and requirements.
2. Notable instances of road/highway development. Included here might be places that mark the first implementation of an important construction standard, the introduction of an important experimental construction method, early significant examples of gravel, macadam, soil stabilization, brick, concrete, asphalt or other important forms of county/municipal highway construction, or innovative ways employed to build through wet prairie and broken terrain conditions.

Part III: Construction history summarizes the physical evolution of each of the two selected public highways in Iowa and its story of development. This would include:

- an annotated chronology of its construction from unpaved road to paved highway
- identification of major subsequent changes along each route through discussing:
  - alterations in location and alignment of the route
  - alterations in width of right-of-way
  - alterations in profile (i.e., up-and-down movement without regard to left and right turns or horizontal curves)
  - evolution of the cross-section (i.e., composition from foundation base to the road surface) from, say, high modified railroad embankment type with deep ditches to a lower and flattened variety.
  - Successive engineering structures and design (bridges, culverts, grade separations, intersections, esplanades, roadside parks and structures, turnouts, scenic overlooks)
- summary of which segments reflect which era of each route's development (include map if possible).

Part IV: Significance of state arterial highways brings together for the reader the consultant's judgment and recommendations in the form of:

- guidelines for evaluating the significance and integrity of roads; and
- evaluations about where the greatest chance for National Register eligibility is to be found on the two selected routes. Taking into account considerations of integrity/authenticity and

significance, the author will provide an annotated ranking of highway stretches into those with high, low, and no potential to be listed under one or more criteria or in combination with other known transportation associated properties. Discuss as well any highway sections associated with important beginnings of new construction practices, design standards, or use of materials.

- Finally, the author will explain the two highways have or lack interpretive value to telling the state's transportation story. Photographs, illustrations, or site plan may be integrated into the narrative as needed to help convey what is significant.

Part IV: Reference Sources

It is expected that the Iowa DOT archives of past plans for each of the two routes will be consulted as will county and state atlases over time. A paragraph or two about the quality and quantity of information consulted, its location, noting any conflicts in source materials, their accuracy, biases or noteworthy historical perspectives. This would be followed by a bibliography of the reference source materials.

Part V: Appendices

The information here--if not placed elsewhere in the report--would include, but not be limited to, the following:

1. Map(s) showing the two highways
2. 5" X 7" enlargements of black and white views taken to illustrate one or another point of discussion, with each labeled on the back as to name of subject matter, location (if applicable), reference source (if applicable) with a No. 1 (soft) pencil, and placed in Print-File (57-4P), or equivalent, sleeve.
3. For field photos taken, a Photograph Catalog Field Sheet completed for each sleeve of black and white negatives and color slides, identified by roll number assigned by the SHPO inventory Coordinator.
4. For field photos taken, the negatives are to be placed in Print-File (35-7B), or equivalent, sleeves and slides properly labeled and placed in Print-File (2x2-20B), or equivalent, 20-slot sheets with number 4 (i.e., upper right hand corner left empty for inserting a sheet number). Each 20-slot sheet will be identified by a sheet number assigned by the SHPO Inventory Coordinator
5. A contact print sheet for each roll of black and white film placed in a Print-File (810-1B), or equivalent, sleeve.
6. Other relevant information (e.g., photocopy of advertisements or biographical information about a noteworthy highway designer, promoter, good roads organization or prominent road builder associated with construction of Iowa highways; other sketch plans and architectural drawings that were not integrated into the report).

Appendix B

JEFFERSON COUNTY EVENTS ASSOCIATED WITH EARLY AUTO TRANSPORTATION, THE BLUE GRASS ROAD, AND IOWA 8/HARDING HIGHWAY/U.S. 34 (1914–1959)

These news items were selected by Verda J. Baird from the Fairfield Ledger Fairfield, Iowa (Baird 1989). They were reprinted in *Highlights from "Out of the Past."* They help document both the route's progress and the concurrent social situation on the local level in Fairfield and Jefferson County. As well as discussing the study route's evolution and construction it also helped outline the general transportation activities and road condition within Jefferson County from 1914 to 1959.

1914

January 22: Three members of the Jefferson County Board of Supervisors left for Chicago to witness a demonstration of road graders.

April 21: The automobile institute opens tonight in library hall and much interest is being shown in the illustrated lectures on operation and care of cars.

May 13: Sales of cars have reached surprising figures. The Ford agency 22, Studebaker 11, Whites 2, Buicks 3, Overlands 17, Chalmers 2.

June 16: The governor of Iowa designated today as road drag day for Iowa, and in various places in the state, programs was given intended to encourage road dragging. It is expected that thousands of miles of roads will be dragged this week.

1919

October 14: Main automobile trails though the county will be marked so that they may be easily followed.

January 11: Jefferson County has been issued two more army trucks which will arrive in a few days. They will be used in road and bridge work.

1922

January 7: Many roads in Jefferson County are "lost" as far as accurate records in the engineer's office are concerned. The landmarks used to identify them are gone.

October 18: The Blue Grass Road is being worked again east of Batavia.

1923

March 25: The country roads are in a bad condition. Four horse teams are in evidence.

April 8: There were 21 concrete bridges built in Jefferson Co. on secondary roads during 1922 at a cost of $12,708.13.

April 13: The cost of grading the Blue Grass Road through Lockridge is to be paid for by the State.

June 5: Four Corners–The main route between Four Corners and Lockridge has been temporarily closed for a few weeks by the workmen on the Blue Grass Road.

October 13: Automobiles, not hogs, have the right-of-way on public highways, the Iowa Supreme Court has held.

1924

March 3: Bad roads, which have put the auto out of business in Jefferson Co., have led to a revival of the obsolete crime of horse stealing here.

March 7: East Pleasant Plain–Roads are terrible in this vicinity. The school wagons require four horses and have been getting stuck in the mud.

August 1: The Fairfield tourist camp is one of the finest in the state and is well known state-wide.

September 24: Pleasant Plain–The Woods Camp, which has been working the roads on Primary 8 here, has moved. They loaded the buildings Saturday preparatory to leaving on Monday.

1925

February 28: Plans for a new overhead wagon bridge to be constructed over the Burlington Railroad on the Ottumwa-Fairfield road have been received.

1926

June 19: The actual work of pouring cement on the 12 miles of Primary Roads No. 8 east of Fairfield will begin sometime the week of July 5.

July 23: The pouring of cement of Primary Roads No. 8 east of Lockridge was started today.

August 23: Work on the pavement is progressing nicely. Work was somewhat delayed on account of the rain, but the machinery is again in full swing.

October 18: The new federal road markers which turn State Primary Road No. 8 into Federal Highway No. 34 are now being placed in position.

1927

June 22: Today the Jefferson County paved highway was completed to the city limits of Fairfield to the east.

November 21: Plans to feed 5,000 people tomorrow at the formal exercises opening the paving on Highway 34 are being finished today.

1928
October 18: Highway 34 is now open and paved from Burlington to Chariton. It is called “The Harding Highway.” There is one small detour yet in Henry County.
November 3: Map: Showing only 1,000 miles of paved roads in the whole state of Iowa.
November 22: In southeast Iowa’s 12 counties there are 746 miles of Primary Roads, 237 of which are paved.
December 14: The bridge west of Mount Pleasant on Highway 34 which was considerably delayed by bad weather is now open. This is the very last connecting link between Burlington and Chariton.
1931
September 10: One of the most complete paint shops in the state of Iowa, for re-painting state road markers, was opened this week in Fairfield.
1933
March 27: J. A. Huglin tells of the history of his home east of Highway 34 when it was a famous brewery.
June 19: Jefferson Co. has more miles of Secondary roads than any other county its size in Iowa.
December 22: The new Jefferson County rock crusher will arrive in Fairfield on Monday, ready to be set up in whatever quarry the Board of Supervisors shall designate.
1937
December 22: Work on dismantling the old Coppock Bridge across the Skunk River will probably be done sometime this winter.
1939
May 19: Shrubs were planted on the new Highway 34 underpass on West Burlington to prevent washing. The structure is rated as one of our state’s finest.
August 14: Keith and Floyd Shafer counted 5,243 automobiles in 25 minutes that passed their home east of Fairfield, adding to an acute traffic problem. Five were hurt in a Burlington Railroad train wreck near Rome.
1940
March 12: Russell Keller is busy assessing Cedar township. The bad roads have interfered with his work and he has had to make the rounds horseback.
June 5: Taking action on the serious traffic problem that exists in Fairfield, the city council meeting added Harold Angstead to the city payroll as motorcycle traffic officer.
1941
Oct. 8: The average car on farms in the U.S. was seven years old and had an estimated value of not more than $100.
1947
April 27: The first carload of auto tires to be shipped into Fairfield since before the war, arrived yesterday.
May 22: A new ready-mix cement plant will open soon.
1948
August 6: Farmers north of Brookville have been moving back fences getting ready for the grading crew, which will widen that road for a state road.
October 6: The Dream Motel will open its doors to the public. Sixteen units–3 have twin beds and 13 double beds.
1955
April 28: Actual construction work has started on two highway improvement projects in and near the city. They include the widening project on N. Second street, and the widening project on Highway 34 immediately west of the city.
November 18: U.S. Highway 34 between Fairfield and the Jefferson-Wapello county line west of Batavia will be opened to traffic Saturday at 10 a.m., Carl Parker, resident engineer of the Iowa State Highway Commission announced today.
1956
November 21: Improvement of Highway 34 between Fairfield and the Henry county lines included in a 116 million dollar road program for 1957 announced today by the Iowa State Highway Commission.
1957
September 16: Old picture of the Fairfield square in 1903 when the city square was paved with brick. All grading work was done by horses.
1958
October 28: There will be a surfaced road to every farm house except two in Jefferson Co. by the end of 1959.
1959
February 4: The graveled road from Highway No. 1 east of Pleasant Plain will be surfaced with asphaltic concrete during the construction period this year.
April 3: Highway 34 east of Fairfield will probably be closed to through traffic the first of next week as work gets underway on the ten mile improvement project.
July 22: Most of the new right-of-way for Highway 34 east from Parsonsville to the Ross Shuppy farm has been brought to rough grade.
November 18: Local traffic will be permitted to use the new pavement on Highway 34 east of Fairfield beginning tomorrow.

Appendix C

SELECTED CORREPONDENCE OF ROBERT N. CARSON CONCERNING PROBLEMS ON THE RED BALL ROUTE

This correspondence is included to provide an idea of the workings between Robert Carson of Iowa City, head of the Red Ball and River to River Road associations, auto club head, and important businessman and several well known Iowa State Highway Commission officials during the end of the Registered Road Era and the beginning of the Iowa Primary Road Era. It especially important in understanding the relationships, competition, and enmity between the two organizations over issues concerning the Red Ball Road such as sign painting, route moving, road grading, transportation conditions, and local, county, and state governments.

Robert N. Carson, president of The Red Ball Route association wrote a number of letters to Fred White (White 1919, Chief Engineer, and others of the ISHC complaining about state signage crews wiping out, painting over, or in some manner adversely affecting the registered route symbols. In a series of letters from 1920 to 1922 to both the ISHC and Linn and Washington county engineers he relates,

> You are hereby notified that you have covered and otherwise defaced the markers of the Red Ball Route in Washington County, contrary to the law…This act was violated when you painted over and practically obscured the markers of this route, to place your Primary Roads markers…you will see the advisability of sending your men out…without any delay and restoring each and every Red Ball marker…and use the Heath and Milligan "perma-red" paint (Carson 1920b).

In September, the ISHC's Road Maintenance Engineer, Cy Morrison, apologizes in a letter to Carson for any signs painted out and gives instructions for the Washington County Engineer, W. P. Rawn to see to the Red Ball markers. To Carson he responded that,

> The only ones covered were those at points that afforded the only post on which to place a marker, and in…That the Highway Commission has the power to determine the priority of markers, we determined that the Primary Marker should have preference over the Red Ball marker…But that we are getting most awfully tired of having to read the large amount of unsolicited information that is…Coming from the said Robt. N. Carson (Board of Supervisors, Washington Co. 1920, Rawn 1920).

Mr. Carson replies that "…unless this matter is taken care of promptly…(the association) will start suit to recover damages" (parenthetical remark added). On Sept. 7, J. S. Morison, the District Engineer replied,

> …that he had ridden the route and that the Red Ball Route has been well marked…I find that six or seven Red Ball Markers have been painted over between Ainsworth and the North County line. And though not proper…that there are plenty of markers remaining…and…In talking this over with the County Engineer and one of the Supervisors…That they have a bitter feeling against Mr. Carson…and believe that very little or no damage has been done…(ISHC 1920h).

In Linn County Ralph W. Gearhart the county engineer replied,

> …that his men covered the Red Ball markers on each third pole between Cedar Rapids and the South line of Linn County. Every third Red Ball marker in Linn County was painted by Linn County men at our own expense two years ago…Therefore, we were simply replacing our own markers with the numbers…of the Primary Roads system…(Gearhart 1920).

Carson replied,

> …that there is no consistency in your claim because your county happened to paint the markers, you can not now cover the same…if there were not other poles upon which to paint your Primary Roads markers…but there are any number of poles with no markers…and every pole between the Johnson Co. line and Cedar Rapids offers space for your 3 inch yellow band so you are…not "shut out" for space (Carson 1920h).

By October 9th Carson further replies,

> I do not think it is a question for you to determine as to the number of markings…on the Red Ball Route or in fact any marked and registered highway. Neither is it right to favor the county engineers or others…In summing up…it is very apparent you did not inform these counties with regard to not covering the markers…we will bring suit immediately unless Linn Co. and Washington Co. replace the markers covered and destroyed without further delay. They have had due notice…(Carson 1920g).

The Linn County engineer replies, "We believe…that it would be much better of you to endeavor to cooperate with the county engineers of Linn and Washington counties as well as the County engineers of the other counties thru which the Red Ball runs" (ISHC 1915a:15, Letters–1920). On October 23, 1920, W. H. Root tells Fred R. White, Chief Engineer, that he has attached a file and that "Mr. Carson…does not wish to correspond with me further." On Oct. 19th, Carson replies that,

> I motored over this highway…with some friends including Judge R. P. Howell and they were all of the opinion that the primary markings should have been located on other poles…or above or below the space used by the Red Ball makers…The marked highways in this and other states have done as much to promote the sentiment for better highways as any other movement of its kind. Before Mr. MacDonald went to Washington, he so expressed himself (in a letter)…which I have on file (Carson 1920h) (parenthetical remark added).

In reply the Chief Engineer related,

> That it is our desire that important registered routes, such as the Red Ball Route, the Lincoln Highway etc, retain their markings and their identity. We wish to lend out support and encouragement to such registered routes. We do not wish to do anything that could in any way be construed as disfiguring or destroying the name or prestige that such routes enjoy (ISHC 1920, Oct. 26).

In another letter in Aug. of 1922, Robert N. Carson to Fred R. White related,

> …that the roads are not properly dragged in parts of Linn and Benton Counties. This has to do with the Red Ball Route west over to Atkins and Newhall, thence north and joining route No. 40 south of Vinton...That this routing is county road in Linn and Benton counties, and that Route No. 40…does not touch a town between Cedar Rapids and Vinton, a distance of thirty miles. It is my desire to have at least two towns on the route…and I feel the route needs the towns and the towns need this route…Your suggestions will be appreciated…(Carson 1922a).

In reply Fred White relates,

> …The Red Ball Route between Cedar Rapids and Vinton follows a county road. Such being the case, it is the duty of the county boards of supervisors to keep this route in the best practical condition…The Benton County Board has practically ignored…the maintenance of the Primary Roads, where ample funds are available, and which funds do not come from tax levies…We have hounded the Board until we have exhausted our resources…Finally, upon threat of taking the matter to the Attorney General, we have succeeded in getting the Lincoln Highway dragged…I feel that very little results will be secured in attempting to get the Benton county board to expend tax money on the country road…You may possibly know that the situation in Benton county this year is rather difficult one. Shortly after the first of the year, a large group of taxpayers got together and started an investigation of the county board. State checkers were put

> on the job, and…some irregularities were shown up, although there have been no steps taken…to remove anyone from office (Fred White 1922).

In 1923, another incident came up involving local businessmen in Cedar Rapids moving the route signs to run past their businesses. In a letter to the editor of the Cedar Rapids Republican, July 1924, Carson relates,

> …how the markers had been removed from the official routes…that the City officials were not charged with this underhanded work…and it has been done by some group of men...who hope to commercialize the opening of this new road. This is not the first time the Red Ball Route has experienced like trouble in Linn County and in the city of Cedar Rapids…a year ago a garage on the west side of Cedar Rapids, decided it would locate the Red Ball Route along First Ave. west and south to ”J” street. This was done without any authority…and a group of men attempted to “stand pat,” but the markers were later removed. Now comes this recent unauthorized change…We are quite willing to change the Red Ball route to the new road when that road is properly graded, paved…It is…record that several serious accidents have occurred on this new road, due to a heavy grade and abrupt turns…That at the foot of this hill the property owner left his gate open, so that if motorists could not make the turn, they could drive through this gate and into a vacant lot…(Carson 1924).

In the letter to the editor Carson refers to the Benton County road dragging incidents and Primary Route 40 alignment problems of 1920. In the article he relates,

> Located in 1913 the Red Ball Route…never favored passing up the original towns and thereby not affording tourists the proper service by these towns. Therefore the Red Ball does not follow Primary Roads No. 40 which is also No. 6, west of Cedar Rapids and then north along No. 40 to Vinton. There is not a town or village along this routing...about 30 miles. The Linn County Board through its engineer placed large sign boards at the southern and western county line approaches telling tourists to stay off the Red Ball Route. The Red Ball Route even along the Primary Roads in Linn county does not compare with the road conditions along this highway in Johnson and many other counties. During the winter of 1922–1923, traffic was using the Red Ball Route west of Cedar Rapids because Primary Road No. 6 (Lincoln Highway) and Primary Road No. 40 were impassable (Carson 1924).

Appendix D

TRANSPORTATION MILESTONES IN IOWA

Events considered transportation milestones by the Iowa DOT (1999) and related to the overall study contexts.

1880–1899	Good Roads Movement
1900–1913	Good Roads Train
	First concrete paved street in Iowa (1904 LeMars) (2 blocks of concrete squares)
	1905–799 cars in Iowa
1913	Tourist Road Routes
	Three man State Highway Commission
	First bus transport (1911 Red Ball Transportation Company/Charles City to Waverly)
	Three highway engineers have review control over all county and township officials
1915	Iowa 1st in nation in cars per capita
1916–1917	"Gravel Bees" for roads
1916	First Federal Aid
	First paving project, 4½ mi of 16 ft Portland cement Mason City to Clear Lake (1916)
1917–1918	WWI surplus equipment for Iowa
1919	First official Iowa road map
	Iowa's Primary Roads System–6,400 mile inter-county federal aid road system
	10,000 mile county system
	88,000 mile township system
	Prior to this time the "Blue Book" used.
	Political boost as Primary Roads system links all county seats of 1,000 or more
	Establishment of Primary Roads fund to finance construction and maintenance, and complete\compile plan to improve entire system
	Authorized counties to vote on issuance of bonds (Black Hawk County first in 1919)
	The counties and not federal government were going into debt for Primary Roads system
1920s	"Out of the Mud" surfacing push by Highway Commission. Provided jobs for Depression Era farmers for grading and hauling. This push lasted until 1940.
1922	Federally mandated 18 ft highway width.
1924	First Primary Roads Law turned over Primary Roads maintenance to Highway Commission
1925	Iowans Thomas McDonald and Fred White play major role in formulating U.S. numbering system
1926	Iowa Primary Roads numbering system replaced Registered Route systems
	Black center lines started, ended 1954
1927	Primary and Secondary Road Act
	Primary–main market roads to county seat towns and main market centers
	Secondary–public highways except Primary Roads and state roads and highways within cities and towns
	Five man Highway Commission
1928	First asphalt paving (royalty fee decision left asphalt unused by Iowa DOT until 1950s)
1929	First traffic load regulation (seasonal)
	Mud-Jack mentioned (John Poulfer)
1940–1947	Slip-form paver introduced (James Johnson)
	National Highway development (National Highway Resource Board)

Appendix E

IOWA ROAD RELATED IDENTIFICATION, RECORDATION, AND EVALUATION

As outlined in the MOA this simple list is provided for the gathering of basic information during survey. It is divided into contexts, segment lengths, locational and geographical information, identification, recordation, and significant individuals. They may be used to construct a survey check list.

Basic Iowa Road Related Historic Contexts

Engineering Periods:
1. early pre-1900–1904
2. middle 1904–1919
3. late 1920–1939
4. WWII and post-war 1940–1948

Political:
1. Good Roads era
2. Formation of Iowa State Highway Commission (1904)
3. 1913 design review
4. Registered Highways
5. Primary and/or Secondary Road
6. Federal and State transportation acts
7. local, stub, trunk, arterial

R.O.W. Engineering. What does the segment's engineering consist of:
1. design
2. testing
3. materials–quarries, sources, pours
4. construction–grading, surfacing, drainage, filling (contractors)
5. signage, fences, markers
6. completed roads and bridges
7. machinery and technology employed
8. sophistication of design and execution

What is cut-off, who cut it, and who maintains it now:
1. by Iowa DOT
2. by county
3. township
4. municipal
5. private

Segment types:
1. ruinous
2. abandoned
3. in-place
4. through-farm

5. decommissioned
6. in use

Segment lengths:

1. short segments under ¼ mile
2. segments one mile or under
3. segments over one mile but less than three miles
4. segments over three miles
5. multiple segments, each over two miles, spaced along a multi-mile corridor
6. multiple segments in corridors stretching over 12 miles
7. multiple segments, of various lengths, that together form a historic corridor

Degree of preservation/integrity:

1. completely original or high integrity of cross-section, pavement, and engineered structures
2. original except for partial resurfacing: high integrity of engineered cross-section and structures but altered pavement surface
3. original pavement but some structures modified or replaced
4. original pavement with most structures modified or replaced
5. pavement only totally replaced
6. pavement original but widened and resurfaced with original cross-section but more than 40 percent of structures replaced or significantly modified
7. pavement remains but cross-section altered
8. original cross-section obliterated
9. original route parallels present route
10. original route parallels present route–is abandoned but visible
11. original route obliterated by subsequent and present routes
12. cross section, pavement, and route altered or obliterated

Locational Information

1. Legal Locations (minimum of three ¼ sections with section, township, range, and county)
2. UTMs
3. GPS
4. Verbal description
5. U.S.G.S. maps
6. Oral histories
7. Historic maps and atlases

Identification

1. period:
    a. planning
    b. width (see below)
    c. State Highway Commission (1st era)–1904 to 1913
    d. State Highway Commission (2nd era)–post 1913 to 1928
    e. State and Federal Partnership (3rd era)–1928 to 1948
    f. Good Roads era–(1880 to 1904)
2. material types and their sources:
    a. fills
    b. concrete and mortar

        c. gravel and sand
        d. brick
        e. rock
        f. type/other
3. engineering:
        a. experimental
        b. standard
        c. location of experimental sections
        d. pre or post-1913
        e. pre or post-1922
        f. pre or post-1940
        g. local, township, county
        h. Iowa State Highway Commission (later Iowa DOT)
        i. railroad
4. firsts:
        a. nearby examples (LeMars, Mason City/Clear Lake, Fredonia/Columbus Junction, Coleman)
        b. bridges, culverts, curbs, drains (pre or post 1913–1917)
        c. fills and grades
        d. surface material
        e. material type and use related to period
5. widths: bridges and pavements
        a. 1900–1915 (12, 14–14½, 16)
        b. 1916–1922 (18, 20, 22)
        c. 1922–1940 (22+)
        d. 1940–1948 (22+)
6. construction:
        a. handwork
        b. horse-drawn equipment
        c. mechanized (steam vs. gasoline/diesel)
        d. slip form paver (after 1940)
        e. local, large in-state contractor, out of state contractor
        f. builder
7. structural elements/details
        a. curb form and height
                1. integral
                2. added
                3. removed
                4. covered
        b. aggregate materials
                1. quarry rock
                2. river rock
                3. bank rock
                4. quarry location (local, state)
                5. quarry material type (soil/clay, sand, gravel, stone)
                6. hauled by
                7. crushed and/or sorted
        c. structures
                1. culverts (type, material, construction method, period)

- a. hand or machine excavated footings
- b. length, width, depth
- c. closed or open bottom
- d. under or overpass
  - 1. stock crossing
  - 2. drainage
  - 3. dates or names
- e. county, contractor, or state crew, designer, plans
- f. approach type and alterations

2. bridges (type, material, construction method, period)
   - a. Warren Truss
   - b. Deck Truss
   - c. Pratt Truss
   - d. Pony truss
   - e. plans available (Iowa DOT/County/Municipal)
   - f. manufacturer, builder, erector (County Supervisor's Meetings)
   - g. approach type, guardrails, deck material, and alterations
3. berms
   - a. cut and fill
   - b. fill only
   - c. side dredge (wetlands)
   - d. date (alterations)
   - e. borrow pits
4. drains
   - a. concrete, metal, or ceramic
   - b. original (or to what period of replacement)
   - c. size, shape, and disposition
   - d. manufacturer (local, known, period)
   - e. builder
   - f. inlet cover types
   - g. date
5. fences, posts, and signage
   - a. wood or metal
   - b. purpose (culverts, driveway, curves, r.o.w. markers)
   - c. informative, warning, paint scheme
   - d. reflector and/or reflective
   - e. painted on concrete or stone
   - f. date
6. stream drainage
   - a. natural or channallized
   - b. primary, secondary, tertiary
   - c. names
   - d. rock exposures
   - e. bottom (sand, gravel, rock, other)
   - f. drainage pattern (related to landform)
7. other

d. iron, stone, concrete, wood, other, combination

e. expansion joints

1. iron
2. asphalt
3. rubber
4. Baker

f. rebar

1. twist
2. square
3. corrugated
4. round (modern)
5. other (buggy axels, beds, scrap, wire, hubs, etc.)
6. from dated structure

g. alterations and replacements

1. curb removal (some or all segments)
2. culvert and bridge replacement
3. pavement replacement
4. pavement resurface
5. cross-section alteration or replacement

Geographical Information–Landform Regions

1. Southern Iowa Drift Plain
2. Iowan Surface
3. Paleozoic Plateau–Silurian Escarpment
4. Northwest Iowa Plains
5. Loess Hills
6. Missouri Alluvial Plain
7. Mississippi Alluvial Plain
8. Des Moines Lobe
9. Other: General
   a. elevation
   b. soil type(s)
   c. drainage (principal, secondary, tertiary)
   d. base map used

Recordation

1. Photographs
   a. 35mm (black and white/color) (digital photos should follow NR and SHPO requirements)
   b. video (standard, Hi 8, digital)
   c. photolog (time/place, landowner, photographer, direction, subject, conditions)
2. Base map used
3. Map showing directions photos taken from (when possible, for NR nomination)

Significant individuals

1. local, regional, state, or national significance
2. master builder, designer, inventor, researcher, writer, philanthropist, hobbyist
3. socio-political influence, landowner or associates, individual associated with routeways or structure
4. period of their influence or significance
5. Criterion B National Register eligibility and related contexts
6. settlement pattern, migration, period(s) of use related to individual

Historic Road Survey

Provenience Information

Your Name:

Today's Date:

Name of Road:

County:

Closest Town:

UTM's (in field)
N:
E:

UTM's (corrected)
N:
E:

Road Features Information

Pavement type(s) (please circle)

Gravel
Blacktop
Cement
Dirt
Other

Width of pavement (in feet)

A
B
C
D

Are curbs present? Yes No

7.5' Quad ________________

Is there evidence that curbs had been present? Yes No

Can you see evidence of re-pavement of roadway? Yes No

Are there any bridges? Yes No

List the bridges, include what they transverse i.e railroad tracks, another road or drive, waterway. Then include type such as steel span(include no. of spans) steel truss, cement, wood, or combination. If the bridge appears more than fifty years old, please mark it with +at the end of the line. Also include any identification number or name. Also include any other feature(s) of roadway here.

Add. Comments on back?

Yes No

Data Management Information Were pictures taken? Yes No If pictures were taken, please list in order and indicate what type of camera was used. If using digital, include time picture was taken and card no. in camera. If print include roll and frame #

1	7
2	8
3	9
4	10
5	11
6	12

Appendix F

GLOSSARY

Abandoned To have been given up completely as a state owned arterial or property. For the purpose of this report there can be considered to be various levels of abandonment. Some "abandoned" arterial period segments may still be in use in various roles as local roads, driveways, or field accesses. Other cut-off segments may have been completely abandoned and either forgotten, returned to cultivation, or obliterated. Roads, especially cut-off segments, may be in the process of abandonment. Many have been abandoned as a federal highway, state highway, or Registered Route but not as a local road.

Aesthetic Routes Roadways designed for a specific interaction with the natural or built environment. These routes incorporate the surrounding scenery into their design.

Abutment A substructure supporting the end of a single span or the extreme end of a multi-span superstructure and, in general, retaining or supporting the approach embankment.

Alignment The vertical and horizontal layout of a highway make up the alignment. The design of the alignment depends on the design speed selected for the highway. The least costly alignment is one that takes the form of the natural topography. It is important that both the horizontal and vertical alignments be designed to complement each other. The width of a roadway as defined by both the right-of-way limits and its path over the landscape.

Anchorage The complete assemblage of members and parts designed to hold in correct position the anchor span of a cantilever bridge, the end suspension span cable, or a suspension span backstay; the end of a restrained beam, girder, or truss span; a retaining wall, bulkhead, or other portion or part of a structure.

Anchor Span The span that counterbalances and holds in equilibrium the fully cantilevered portion of an adjacent span; see Cantilever Beam, Girder, or Truss.

Angle A rolled member of steel or iron forming an "L" shape. Also "angle-iron."

Apron A broadened hard-surfaced area, often paved, as part of an automobile driveway, as where it joins the road.

Arch A curved structural element primarily in compression, producing at its supports reactions having both vertical and horizontal components.

Arch Barrel A single arch member that extends the width of the structure.

Arch Culvert A culvert whose deck is supported by a concrete arch beneath.

Arch Rib The main support element used in open-spandrel arch construction; also known as arch ring.

Arterial A road providing the principal high-volume and high-speed linkages within a community and between communities.

Asphalt A mixture of bitumen, a tar like substance, with sand, gravel, or other material for cementing, paving, roofing, etc. Also know as Tarvia, a trade name.

At Grade Crossing A road crossing that approaches another transportation feature, such as a railroad line or other road, at the same level as the grade of the crossed feature, such as railroad tracks.

Backwall The topmost portion of an abutment above the elevation of the bridge seat, functioning primarily as a retaining wall with a live-load surcharge; it may serve also as a support for the extreme end of the bridge deck and the approach slab.

Baffle Wall An obstructing device such as a wall or screen used to hold back or turn aside the flow of water.

Batten A narrow strip of metal used to fasten other pieces together in a built-up member.

Batter The inclination of a surface in relation to a horizontal or vertical plane, the angle is commonly designated on bridge detail plans as a number of feet to 1 foot.

Beam A linear structural member designed to span from one support to another.

Bearing A support element transferring loads from superstructure to substructure, capable of permitting limited movement.

Bent A substructure unit made up of two or more columns or column-like members connected at their top most ends by a cap, strut, or other member holding them in their correct positions.

Blue Grass Road Also known as the Blue Grass Route. The name of the historic path of old U.S. 34 (a.k.a. Iowa 8 and The Harding Highway) prior to and during the Registered Highway Era (1914–1925). The name was established in 1913 prior to the adoption of the state and federal highway numbering systems and related to a portion of south central Iowa that originally had large areas of native bluegrass present. The route was marked and partially maintained by the Blue Grass Route Association until 1926. Its symbol was a wide horizontal blue line centered in a white field.

Borrow (a.k.a. Borrow Pit) An excavation made to provide materials such as clay, gravel, or dirt for fill.

Box Beam A hollow structural beam with a square, rectangular, or trapezoid cross-section.

Box Culvert A square or rectangular shaped masonry structure designed for drainage under a road.

Bracing A system of tension or compression members, or a combination of these, that maintains the geometric configuration of the primary member, It transfers wind, dynamic, impact, and vibratory stresses and gives rigidity throughout the complete assembly.

Breastwall The portion of an abutment between the wings and beneath the bridge seat; the breastwall supports the superstructure loads and retains the approach fill.

Bridge A structure spanning and providing passage over a river, creek, or railroad.

Brought-to-Grade The process by which a wagon road or topographic roadway is brought to an engineered and surveyed grade by the dredging, cutting, filling, bridging, draining, and surfacing of the routeway.

Built-Up Forming a bridge member (such as a chord or a vertical) from smaller pieces (such as angles or channels) by riveting or welding them together.

Built-Up Member A column or beam composed of plates and angles or other structural shapes united by bolting, riveting, or welding.

Bulkhead A retaining wall-like structure commonly composed of driven piles supporting a wall or a barrier of wooden timbers or reinforced concrete members.

Buttress A breast-like wall, or full or partial height, projecting from another wall; the buttress strengthens and stiffens the wall against overturning forces; all parts of a buttress act in compression.

Buttressed Wall A retaining wall designed with projecting buttresses to provide strength and stability.

Camber The slightly arched form or convex curvature provided in beams to compensate for dead-load deflection; in general, a structure built with perfectly straight lines appears slightly sagged.

Cantilever A structural member that has a free end projecting beyond its supporting wall or column; length of span overhanging the support.

Cantilever Abutment An abutment that resists the lateral thrust of earth pressure through the opposing cantilever action of a vertical stem and horizontal footing.

Cap The topmost piece of a pier or of a pile bent serving to distribute the loads upon the columns or piles and to hold them in their proper relative positions.

Capacity The maximum rate of flow in vehicles per hour that can be reasonably expected to traverse a point or uniform segment of a lane or roadway during a specified time period under prevailing roadway, traffic and control conditions, usually expressed as vehicles per hour.

Capstone The topmost stone of a masonry pillar, column, or other structure requiring the use of a single capping element.

Cast-in-Place (Poured-in-Place) The act of placing and curing concrete within formwork to construct a concrete element in its final position.

Cast Iron Relatively pure iron, smelted from iron ore, containing 1.89 to 4.5 percent free carbon, and cast to shape.

Cement A powder that hardens when mixed with water; an ingredient use in concrete.

Centerline The painted line dividing the two lanes of a roadway. The painting of centerlines in Iowa was initiated in 1929.

CCC (Civilian Conservation Corps) A New Deal work program established by the Federal government during the Great Depression existing from 1933 to 1942. The CCC built roads, bridges, and structures and completed many conservation projects throughout the United States and Iowa. Many CCC constructed structures are historically significant (Alleger and Alleger ca. 1980; Anonymous ca. 1980).

Cement Mortar A mixture of four parts sand to one part cement with enough water added to make it formable.

Channel A rolled member of steel or iron forming a square "C" shape. The bed of a running stream.

Channeled A stream or river bed that has been straightened or channallized.

Chord The upper and lower horizontal components of the truss, forming the top and bottom of the truss webbing. The upper chord is in compression, the lower chord, in tension.

Clear Span The unobstructed space or distance between support elements of a bridge or bridge member.

Coating A material that provides a continuous film over surface; a film formed by the material.

Component A general term reserved to define a deck, superstructure, or substructure.

Concrete A mixture of aggregate, water, and a binder, usually Portland cement, that hardens to a stone-like mass.

Context Refers to the setting, or surrounding area, that influences a resource such as a roadway.

Continuous Beam A general term applied to a beam that spans uninterrupted over one or more intermediate supports.

Copin*g* A course of stone laid with a projection beyond the general surface of the masonry below it and forming the topmost portion of a wall; a course of stone capping the curved or V-shaped extremity of a pier, providing a transition to the pier head proper.

Corbel A piece constructed to project from the surface of a wall, column, or other portion of a structure to serve as a support for another member, or as a decorative element.

Core Cylindrical plug-shaped sample drilled from concrete pavement. Cores were used to test various engineering and structural elements of concrete roadways, bridges, abutments, and other structures.

Crack A break or split in concrete or other masonry, usually without complete separation of parts. Also a defect or flaw.

Concretion A naturally occurring mineral primarily composed of iron sulphates frequently found in river gravel used in concrete aggregate. Also known as an "ironstone" concretion. A solidified mass or an inclusion in sedimentary rock, usually rounded and harder than the surrounding rock, resulting from the formation of succeeding layers of mineral matter accreting about some nucleus.

Cross Girders Girders that supply transverse support for longitudinal beams or girders.

Cross-section The profile of a roadway's right-of-way width, generally from fence line to fence line.

Crown of the Roadway The vertical dimension describing the total amount of the surface that is convex or raised from gutter to centerline; this is sometimes termed the cross fall of the roadway.

Cultural Routes Roads that have evolved over time. Roads for which there is no recognized date of beginning.

Culvert A conduit, especially a drain, as a construction of brick, stone, or concrete, that passes under a road, railroad track, footpath, or through an embankment. See box culvert, drop culvert.

Curb A short barrier paralleling the outside edge of the roadway to guide the movement of vehicle wheels and safeguard constructions and pedestrian traffic existing outside the roadway limit from collision with vehicles and their loads.

Current Route The route of a highway that is in use at the present time.

Cut Back The side of a natural ground feature such as a hill or a slope that results from the removal of materials to prevent slumping and to help establish a grade through a promontory.

Cut-Off Segment A length of highway, roadway, trail, road bed, or other engineered or built pathway, often abandoned, that has been cut through by subsequent construction.

Cut and Fill The process of cutting through high areas in order to fill lower areas to establish a consistent road grade.

Deck The portion off a bridge that provides direct support for vehicular and pedestrian traffic.

Deck Bridge A bridge in which the supporting members are all beneath the roadway.

Density The number of vehicles occupying a given length of lane or roadway averaged over time, usually expressed vehicles per mile or vehicles per mile per lane.

Design Speed Design speed is defined as the maximum safe speed that can be maintained over a specified section of highway when conditions are favorable. Design speed depends on the type of highway, the topography of the area in which the highway is located, and the land use of the adjacent area.

Ditch The cuts on either side of a road bed designed to direct runoff away from the roadway.

Dolomite A hard, sedimentary, limestone-like rock found in Iowa frequently quarried and used in concrete aggregate and road surfacing due to its durability.

Drag A heavy object such as logs used to grade and crown dirt roads. The "King Drag" was a late 19^{th} century implement used to grade roads.

Drain A channel or pipe for carrying off water.

Drainage The act or process of draining. A system of drains; arrangement of pipes for carrying off waste water. A region or area drained, as by a river or stream.

Drain Pipe A hollow tube with a flared end used singly or joined to provide or aid water flow from a structure, ditch, or low area frequently made of tile, concrete, and cast or galvanized sheet iron.

Drop Culvert A drainage structure along a road bed that contains a drop or fall for water to pass into a horizontal outlet beneath the road. See culvert.

Embankment A bank of earth constructed above the natural ground surface to carry a road or to prevent water form passing beyond desirable limits: also known as bank.

Expansion Joint A joint designed to provide means for expansion and contraction movements produced by temperature changes, load, or other forces.

Extant Still existing. Not lost or destroyed.

Farmstead The land and buildings of a farm. In Iowa, usually comprising a five acre area consisting of the main building complex containing the house, outbuildings, pens, feedlots, and often enclosed by a shelter belt of trees.

Fence A barrier, as of wooden or metal posts, rails, wire mesh used as a boundary or means of protection or confinement.

Fence Line The barrier established along the edge of, and parallel with, the right-of-way or road margin used to both establish the boundary of the construction's property and to keep animals and materials away from the road.

Fill Various materials used to level or elevate low areas, road beds, or other sunken or empty natural features or constructions.

Float(ed*)* A flat tool for spreading or smoothing concrete, and the process used to bring the smaller particles of the concrete aggregate to the surface.

Footing The enlarged, lower portion of a substructure that distributes the structure load either to the earth or to supporting piles; the most common footing is the concrete slab; footer is a local term for footing.

Form A form is a structure used to give shape to something else. In concrete construction it is a structure of boards or metal into which concrete is poured and allowed to set.

Foundation The supporting material upon which the substructure portion of a bridge is placed.

Gauge The distance between parallel lines of rails, rivet holes, etc; a measure of thickness of sheet metal, or wire; also known as gage.

Girder A flexural member that is the main or primary support or the structure and usually receives loads from floor beams and stringer; and large beam, especially if built up.

Girder Bridge A bridge whose superstructure consists of two or more girders supporting a separate floor system, as differentiated from a multi-beam or a slab bridge.

Good Roads Movement A late nineteenth and early twentieth century road advocacy movement.

Grade The degree of rise or descent of a sloping surface. The ground level around a building or structure.

Grader An implement or machine used to establish or maintain a grade.

Grading The process of maintaining a grade. In construction the sorting of materials for size, hardness, or usability.

Grout A mortar having a sufficient water content to render it a free-flowing mass, used for filling (grouting) the joints in masonry, for fixing anchor bolts, and for filling cored spaces where water may accumulate.

Guardrail A structural element designed to redirect an errant vehicle onto the roadway (Guide Rail).

Gutter A narrow channel along the side of a road or street to carry off rain water, as to a culvert or sewer.

Handrail A sidewalk, bridge, or culvert railing having a latticed, barred, balustered, or other open web construction.

Hematite A reddish or black iron ore (anhydrous ferric oxide) frequently found in Iowa river gravels.

Heritage Corridor A celebrated historic route. For example, Natchez Trace or Route 66 Heritage Corridor. Such routes may have a management plan to aid in their presentation and interpretation.

Historic Context A historical overview of a road or route relating to its location, inception, use, events, and people. A document that takes into account its evolution over time and its elements of significance such as migrations, engineering, and political and social events and conditions.

Horizontal Curve An at-grade curve with no or minimal banking that is common on rural roads.

I-Beam A structural member with a cross-sectional shape similar to the capital letter “I”.

Impress(ed) To mark by using pressure; stamp; imprint.

Inlet An entrance, opening, or passage, as to a culvert.

Jacksonian Relating to Andrew Jackson or his policies.

Joint In stone masonry, the space between individual stones; in concrete, a division in continuity of the concrete; in a truss, the point at which members of a truss frame are joined.

Keystone The symmetrically shaped, wedge-like stone located in the head ring of the crown of an arch; the final stone placed, thereby closing the arch.

Lichenometry The study of lichen growth to determine the relative age of stones or structures.

Lip-Curb A curb that is poured integral to the pavement.

Livestock Crossing A bridge, culvert, or passage over, under, or atop a transportation feature such as a road bed, railroad track, or bridge.

Macadam Uniformly sized stones combined with a binder and rolled to form a road. Sometimes mixed with oil or tar before application.

Masonry The portion of a structure composed of stone, brick, or concrete block placed in layers and in some cases cemented with mortar.

Master Builder A person notably proficient in the art of building: one who has attained proficiency in one of the building crafts and is qualified to supervise building construction.

Materials The elements (wood, brick, stone, concrete, metals) originally combined to make the structure.

Median A central space with divided opposite travel lanes.

Member An individual angle, beam, plate, or built piece intended to become an integral part of an assembled frame or structure.

Monolithic A single mass formed without joints.

Mortar A paste of cement, sand , and water laid between bricks, stones, or blocks.

Old District System Based on the township system for road construction and maintenance.

Overpas*s* A bridge structure where the major thoroughfare is the upper roadway.

Parapet A low wall along the outmost top edge of a bridge or culvert to protect vehicles and pedestrians.

Parge To apply a thin coat of mortar or plaster to masonry to seal the surface.

Paver A hardened brick designed specifically for use as a road surfacing or paving material.

Pier A substructure unit that supports the spans of a multi-span superstructure at an intermediate location between its abutments.

Pier Cap The topmost portion of a pier that distributes the concentrated loads from the bridge uniformly over the pier.

Pile A shaft-like linear member that carries loads through weak layers of soil to those which are capable of supporting such loads.

Pile Bent A row of driven or placed piles with a pile cap to hold them in their correct positions; see Bent.

Pile Bridge A bridge resting on piles or pile bents.

Pile Cap The uppermost portion of a pile that acts to secure the piles in position and provides a bridge seat to receive and distribute superstructure loads.

Plain Concrete Concrete with no structural reinforcement except light steel to reduce shrinkage and temperature-related cracking.

Pony Truss A through truss having insufficient height to use a top chord system of lateral bracing.

Post Road Early and major state roads on which the mail was carried.

Portal The clear, unobstructed space of a through-truss bridge forming the entrance to the structure.

Precast Concrete Concrete members which are cast and cured before being placed into their final position on a construction site.

Precursor Route (a.k.a. Proto Route) A trail, road, route, or highway that preceded and served as the basis for the current route, and along whose historic pathway subsequent alignments were built.

Primary Roads State controlled roads and highways.

Quarry A place where construction materials (rock, stone, sand, clay, earth, gravel) are excavated.

Quarry Faced Blocks of quarried stone whose surfaces are undressed or minimally dressed (flattened and squared), as they came from the quarry.

Quartzite A very hard, metamorphic sandstone so firmly cemented that breakage occurs through the grains rather than between them. A hard, durable, silicate mineral frequently found in river gravel and quarries. A distinctive and important variant or type is “Sioux City” quartzite, which is found in the far western part of Iowa, and identifiable by its reddish color, granular surface, and angular fracture. Frequently used in concrete aggregate, stone constructions, railroad ballast, and as road surfacing material (gravel) when crushed.

Railing A fence-like construction built at the outermost edge of the roadway or the sidewalk portion of a culvert or bridge to protect pedestrians and vehicles (see handrail).

Realignment The repositioning of a road.

Red Ball Route Also known as the Red Ball Road. The name of the historic path of old U.S 218 (a.k.a. U.S. 161, Iowa 965) prior to and during the Registered Highway Era (1914–1925). The name was established before the adoption of the state and federal highway numbering systems The route was marked and partially maintained by the Red Ball Route Association. Its symbol was a large red ball in a white field.

Registered Highway A highways whose route was registered with the Iowa State Highway Commission between 1914 and 1925. Often established prior to the establishment of the state and federal Primary Roads system they were marked and partially maintained by a dedicated highway association.

Reinforced Concrete Concrete with steel reinforcing bars bonded within it to supply increased tensile strength and durability.

Reinforcement Rods or mesh embedded in concrete to strengthen it.

Retaining Wall A structure designed to restrain and hold back a mass of earth.

Right-of-Way The total land area acquired for construction of a transportation facility. Land over which a public road passes.

Rip-Rap Stones, blocks of concrete, or other protective covering material deposited upon river and stream beds and banks, lake, tidal, or other shores to prevent erosion and scour by water flow, wave, or other movement.

Rivet A metal fastener used in pre-1970 construction; made with a rounded preformed head to one end and installed hot into a predrilled or punched hole; the other end was hammered into a similar shaped head, thereby clamping the adjoining parts together.

Roadway The portion of the road intended for the use of vehicular traffic.

Routeway The path that a route takes at a given time. The path that a roadway may run.

Sanded The process of covering the surface of a concrete structure with fine sand (or marble dust) to improve its appearance or help release it from a mold. Also called “sugaring” due to the frosty or “sugar coating” effect achieved.

Scraper An implement or machine designed to maintain or dress dirt roadways or to provide fill materials.

Scupper The opening in the floor portion of a bridge to provide means for rain or other water accumulated upon the roadway surface to drain through it into the space beneath the structure.

Seat The base on which an object or member is placed.

Segmental Constructed of individual pieces or segments that are collectively jointed to form the whole.

Shoulder A stabilized level area adjacent and parallel to the road. Shoulders provided a recovery space for an errant vehicle or a safe space for a disabled vehicle.

Siderail A sidewalk, bridge, or culvert railing made of solid construction with no openings.

Simple Span The span of a bridge or element that begins at one support and ends at an adjacent support.

Slab Bridge A bridge having a superstructure composed of a glue-laminated timber slab or a reinforced concrete slab constructed whether as a single unit or as a series of narrow slabs placed parallel to the roadway and spanning the space between the supporting abutments.

Slake To add water to or hydrate a dry mortar in order to make it plastic and to start the setting/curing process.

Slip Form Paver A machine that lays and forms concrete road beds as it travels forward.

Sorted To differentiate materials by size, color, hardness or other factor.

Spall The breakage or chipping of stone, brick, or concrete due to either weathering action on materials or through heavy pressure.

Span The distance between piers, towers, or abutments.

Standards The legally adopted policies directing the design and construction of roads.

State Quarry A gravel or stone quarry owned and/or operated by the state to supply raw materials for construction projects.

Steel An alloy of iron, carbon, and various other elements and metals.

Stone Masonry The portion of a structure composed of stone.

Stub Abutment A short abutment often supported upon piles or on gravel fill, the embankment, or natural ground.

Stringer A longitudinal beam supporting the bridge deck.

Structural Member An individual piece, such as a beam or strut, which is an integral part of a structure.

Structure Manner of building, constructing, or organizing. A construction such as a culvert or bridge that is built and designed to sustain a load.

Sugared To apply a coating of fine sand, colored gravel, or marble dust to the surface of concrete (see Sanded).

Surfaced To treat the surface so as to make it smooth or level or to give a surface to, as in paving.

Super elevation The difference in elevation between the inside and outside of edges of a roadway on a horizontal curve; required to counteract the effect of centrifugal force.

Superstructure The entire portion of a bridge structure that primarily receives and supports traffic loads and in turn transfers these loads to the bridge substructure.

Supra elevation Curves built with the outside edge lower than the inside. The opposite of super elevation.

Terrain Land especially considered with regard to its topography and natural features. For transportation design, topography is generally classified into three groups; level terrain, rolling terrain, and mountainous terrain:

Level Terrain- Is relatively flat and horizontal and vertical sight distances are generally long or can be achieved without much construction difficulty or major expense.

Rolling Terrain- Has natural slopes that often rise above and fall below the grade, with occasional steep slopes that restrict the normal vertical and horizontal alignments.

Mountainous Terrain- Has sudden changes in ground elevation in both the longitudinal and transverse directions, thereby, requiring frequent hillside excavations to achieve acceptable horizontal and vertical alignments.

Textured The arrangement of the particles or the constituent parts of any material as it affects the appearance or feel of the surface; structure, composition, grain, etc.; see Sugared.

Timber Wood suitable for building purposes.

Traction Engine An early steam powered tractor used for construction or agricultural work.

Travel Way The roadway. Sometimes informally used to describe the surface or road bed of a route.

Trestle A bridge structure consisting of spans supported upon frame bents.

Truss A joined structure made up of individual members arranged and connected, usually in a triangular pattern, so as to support longer spans.

Tunnel An underground passage open to daylight at both ends.

Turned Turtle The vehicle had turned up side down.

Underpass A bridge structure where the principal, or subject, transportation facility is the lower roadway.

Vertical A member resisting compressive stresses located vertical to the bottom chord of a truss and common to two-truss panels, sometimes used synonymously with vertical column.

Vertical Alignment The vertical alignment of a highway consists of straight sections of the highways known as grades, or tangents connected by vertical curves. The topography of an area through which the road traverses has significant influence on the design of the vertical alignment.

Vertical Curve See vertical alignment.

Viaduct A series of spans carried on piers at short intervals.

Volume The number of persons or vehicles passing a point on lane, roadway, or other traffic way during some time interval (often one hour).

Voussoir One of the truncated wedge-shaped stones of which a stone arch is built; also known as a ring stone.

Voussoir Arch An arrangement of wedge-shaped blocks set to form an arched bridge.

Waterway The available width for the passage of water beneath a bridge.

Wearing Surface The topmost layer of material applied upon a roadway to receive traffic loads and to resist the resulting disintegrating action; also known as wearing course.

Wheel Guard A raised curb along the outside edge of traffic lanes to safeguard constructions outside the roadway limit from collision with vehicles.

Wingwall The retaining wall extension of an abutment intended to restrain and hold in place the side-slope material of an approach roadway embankment.

(Primary sources for definitions– The Iowa Department of Transportation, AASHTO, FHWA, Colorado State Roads and Highways: Multiple Property Listings, and Webster's New World Dictionary)

Appendix G

IOWA DOT OVERVIEW OF TEXTS REGARDED AS SIGNIFICANT FOR EVALUATING ROADS

These works were noted by Iowa DOT engineers in 1984 (Iowa DOT Library) as necessary to the understanding of historic highway construction in the state.

1. Wilson G. Harger and Edmund A. Bonney, *Handbook for Highway Engineers*. 3rd Edition, New York, McGraw-Hill, Inc., 1919.
2. Wilson G. Harger, *Location, Grading and Drainage of Highways*, 1st Edition, New York, McGraw-Hill Book Company, 1921.
3. Wilson G. Harger and Edmund A Bonney, *Handbook for Highway Engineers*, 4th Edition, New York, McGraw-Hill, 1927.
4. Arthur G. Bruce, *Highway Design and Construction*, 1st Edition, Scranton, Pennsylvania, International Textbook Company, 1934.
5. Arthur G. Bruce, *Highway Design and Construction*, 1st Edition, Scranton, Pennsylvania, International Textbook Company, 1937.
6. Thomas Radford Agg, *The Construction of Roads and Pavements*, 5th Edition, New York, McGraw-Hill, 1940.
7. Laurence Ilsley Hewes, *American Highway Practice*, 1st Edition, New York, John Wiley and Sons, 1942, Vols. I and II.
8. *A Policy on Sight Distance for Highways*, A.A.S.H.O., Washington, D.C., 1940.
9. *A Policy on Design Standards – Interstate, Primary and Secondary*, A.A.S.H.T.O., Washington, D.C., 1941 and 1945.
10. *A Policy on Intersections at Grade*, A.A.S.H.O., Washington, D.C., 1940.


PRIMARY
2
ROAD