Iowa's Renewable Energy and Infrastructure Impacts

Center for Transportation Research and Education

Final Report
April 2010

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16. Abstract

The federal government is aggressively promoting biofuels as an answer to global climate change and dependence on imported sources of energy. Iowa has quickly become a leader in the bioeconomy and wind energy production, but meeting the United States Department of Energy's goal having 20% of U.S. transportation fuels come from biologically based sources by 2030 will require a dramatic increase in ethanol and biodiesel production and distribution. At the same time, much of Iowa's rural transportation infrastructure is near or beyond its original design life. As Iowa's rural roadway structures, pavements, and unpaved roadways become structurally deficient or functionally obsolete, public sector maintenance and rehabilitation costs rapidly increase. More importantly, costs to move all farm products will rapidly increase if infrastructure components are allowed to fail; longer hauls, slower turnaround times, and smaller loads result. When these results occur on a large scale, Iowa will start to lose its economic competitive edge in the rapidly developing bioeconomy.

The primary objective of this study was to document the current physical and fiscal impacts of Iowa's existing biofuels and wind power industries. A four-county cluster in north-central Iowa and a two-county cluster in southeast Iowa were identified through a local agency survey as having a large number of diverse facilities and were selected for the traffic and physical impact analysis. The research team investigated the large truck traffic patterns on Iowa's secondary and local roads from 2002 to 2008 and associated those with the pavement condition and county maintenance expenditures. The impacts were quantified to the extent possible and visualized using geographic information system (GIS) tools. In addition, a traffic and fiscal assessment tool was developed to understand the impact of the development of the biofuels on Iowa's secondary road system.

Recommended changes in public policies relating to the local government and to the administration of those policies included standardizing the reporting and format of all county expenditures, conducting regular pavement evaluations on a county's system, cooperating and communicating with cities (adjacent to a plant site), considering utilization of tax increment financing (TIF) districts as a short-term tool to produce revenues, and considering alternative ways to tax the industry.

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IOWA'S RENEWABLE ENERGY AND INFRASTRUCTURE IMPACTS

Final Report
April 2010

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EXECUTIVE SUMMARY

The federal government is aggressively promoting biofuels as an answer to global climate change and dependence on imported energy sources. Iowa has quickly become a leader in the bioeconomy and wind energy production, but meeting the United States Department of Energy's goal of having 20% of U.S. transportation fuels come from biologically based sources by 2030 will require a dramatic increase in ethanol and biodiesel production and distribution. At the same time, much of Iowa's rural transportation infrastructure is near or beyond its original design life. As Iowa's rural roadway structures, pavements, and unpaved roadways become structurally deficient or functionally obsolete, public sector maintenance and rehabilitation costs rapidly increase. More importantly, costs to move all farm products will rapidly increase if infrastructure components are allowed to fail; longer hauls, slower turnaround times, and smaller loads will result. When this happens on a large scale, Iowa will start to lose its economic competitive edge in the rapidly developing bioeconomy.

The primary objective of this study was to document the current physical and fiscal impacts of Iowa's existing biofuels and wind power industries. In order to identify counties with existing biofuels production plants, wind energy turbine facilities, and infrastructure financial data related to these facilities for the traffic and physical impact analysis, a statewide survey was distributed to all county engineers. This survey provided researchers with the latest information about the ongoing planning, construction, and operations of biofuels production plants and wind energy farms. A four-county cluster (Worth, Mitchell, Cerro Gordo, and Floyd) was selected in north-central Iowa. In order to see if cost trends identified by the research team applied to other areas of the state, a two-county cluster (Des Moines and Lee) in southeastern Iowa was selected for further analysis. More detailed, site-specific data and cost information was then acquired through face-to-face interviews with the county engineers of the selected counties.

The research team investigated the large-truck traffic patterns on Iowa's secondary and local roads in the selected counties from 2002 to 2008 and associated those patterns with pavement condition and county maintenance expenditures. In addition, the engineering characteristics of the subgrade were evaluated to gain a better understanding of the impacts of the growing renewable energy industry on Iowa's transportation infrastructure. The impacts were quantified and visualized using geographic information system (GIS) tools. The investigation of the large-truck traffic trends suggested that there was an increase in truck traffic accompanying the construction of an ethanol/biodiesel plant and that, even though this traffic decreased following the plant opening, it is still higher than the statewide average and remains a concern for county and local engineers. The analysis of maintenance expenditures showed increased expenditures accompanying plant construction and an increasing trend afterwards. In general, the wind farm industry assumed the maintenance cost during construction and restored the roadways at the end of the project. The cost data reviewed by the research team did not identify specific costs associated with the wind farm's construction and ongoing operations.

In addition, a traffic and fiscal assessment tool was developed to understand the impact of the development of the biofuels on Iowa's secondary road system. The tool is a small area model as opposed to a network model of an entire county. It is designed to systematically estimate additional truck trips as a result of the presence of a biofuels plant. It allows the estimated truck traffic to be assigned to the major road leading out of the proposed or existing plant. The impact calculator is designed to calculate the incremental maintenance costs by pavement type (rigid or flexible) of new traffic generated as a result of the biofuels plant. If the total equivalent single-axle loads (ESALs) resulting from the plant are greater than the number of ESALs for which the road was designed, the pavement will deteriorate faster than its design life, and a new design is proposed. Several pavement design simulations were conducted using the 1993 American Association of State Highway and Transportation Officials (AASHTO) *Pavement Design Guide for New and Rehabilitated Pavements* to develop pavement thickness designs.

During this work, it became evident that accessible and accurate information is vital to any detailed analysis of the full economic impacts to local jurisdictions. Several items could be addressed by changes in public policies relating to the local government and the administration of those policies. The following policies should be considered:

- Standardize the reporting and format of all expenditures by all entities involved.
- Establish cooperation and communication with cities (adjacent to a plant site) regarding possible annexations that need to take place early in the process so that future tax revenues (or loss thereof) may be considered in any economic analysis.
- Consider utilizing Tax Increment Financing (TIF) districts as a short-term tool to produce revenues within a local jurisdiction.
- Consider developing policies or regulations as to where these types of plants may locate, based on the proximity of a paved road system.
- Conduct regular pavement evaluations on a county’s system to help facilitate the comparison of pavement condition before and after a plant’s opening.
- Consider the implications of providing tax reductions or abatements. The advantages and disadvantages of implementing a statewide policy on tax abatements and potential tax reductions should be also considered.
- Consider more effective ways to tax (or assess) the industry for appropriate additional costs to the local jurisdiction, such as a tax or fee per bushel of corn, gallon of product, kilowatt-hour, or per axle-weight-mile.

CHAPTER 1. INTRODUCTION

1.1 Problem Statement and Background Summary

Iowa has quickly become a leader in the bioeconomy and sustainable energy production and is a production center for biofuels such as grain-based ethanol and soy bio-diesel. Iowa has also become a leader in wind energy generation. A large number of wind turbines have been installed throughout Iowa, particularly in the northwest and north-central parts of the state, where prevailing winds are most favorable for generating electricity by using wind energy. Several wind generation equipment manufacturing facilities have opened in Iowa during the past three years. A new economy—the "bioeconomy" is rapidly evolving in Iowa.

The federal government is aggressively promoting biofuels as an answer to problems, including global climate change, rapidly escalating prices of conventional petroleum energy, and dependence on imported energy sources. The United States Department of Energy has set a goal of having 20% of U.S. transportation fuels come from biologically based sources by 2030. This goal cannot be accomplished through the use of crop-based biofuels, such as grain-based ethanol and soy biodiesel; the supply is simply not great enough to accomplish the goal. Meeting this goal will require developing a second generation of biofuels production—one based on cellulosic feedstock.

While accommodating the first generation of ethanol and biodiesel, production has not come without issues in terms of infrastructure. This industry has essentially changed the pattern of shipping commodities and freight in and around the state of Iowa. For instance, grain that was once shipped out of the state for export by barges and unit trains is more likely to be trucked to ethanol and biodiesel plants to be turned into biofuels and co-products, such as distillers dried grain (DDG), which can be used as a livestock feed product. Biofuels are then either trucked or shipped by train to blending points, mainly in the upper Midwest, but sometimes as far away as California. The market for biofuels is still rather limited and is concentrated in the Midwest. It is fundamentally a regional market product today (with the notable exception of California, where ethanol is mandated as a transportation fuel oxygenator for air quality considerations.)

The next generation of biofuels—cellulosic biofuels—will dramatically change the patterns of commodity shipping for two reasons. One reason is that in order for the federal government's 20% goal to be met, biofuels will have to find a national market. This national market means that longer outbound movements of biofuels will occur, which could change the pattern of outbound logistics from one based on relatively small shipments by semi-truck and even fewer shipments by trainload rail to some other shipment and modal pattern. More importantly, the sheer scale of biofuels production will need to increase dramatically. At present, biofuels are really only a niche product nationally and globally; today, approximately 2% of worldwide transportation fuels are biofuels, mainly used in Brazil and the United States. The 20% goal appears to be attainable, but it will require a very rapid and dramatic ramp-up of biofuels production based on cellulosic feedstocks. In the United States, cellulosic feedstocks will mainly include crop wastes (e.g., corn stover; the leaves, stalks, and cobs from corn), forestry wastes and residue, and specialty grass crops (e.g., switchgrass). Other sources of cellulosic/biomass feedstock under investigation are wheat straw, rice straw, bagasse (sugar cane waste), other crop residues, municipal solid wastes, and poplar and willow trees. Iowa is very well-suited for producing corn (hence corn stover) as well as specialty grass crops. It appears that Iowa will become one of the leading biomass production states in the next 10 to 20 years, similar to how it has become a leading state for ethanol, biodiesel, and wind energy production in the past decade.

Cellulose production on such a massive scale would dramatically increase the amount of commodities being shipped on Iowa's transportation system. It would not be unreasonable to forecast an increase of four or more times the freight shipping that occurs today on Iowa's secondary road system as cellulosic biofuels production ramps up. How the impacts play out depends to a large extent on how cellulose is harvested, stored, and transported from the farm to the production plant.

The technology for cellulose/biomass farming is currently undergoing research and development. If cellulose were transported from the farm in a raw state, the implications would be that a large number of relatively light but massive vehicle loads would have to be accommodated; on the other hand, if cellulose were to be pelletized on or near the farm, a somewhat smaller number of heavier vehicle loads would have to be accommodated. Whatever the distribution system, the impact on transportation infrastructure—especially Iowa's secondary roads and bridges—could be profound.

The infrastructure issues associated with the rapid increase of the wind energy industry in Iowa are likely less profound but still problematic. These issues relate to the size (mainly length) of wind turbines that are shipped from the manufacturing plants to farm fields and other locations for final assembly and installation. Iowa's primary highway system, farm-to-market roadways, and local secondary roadway systems were not designed to handle such massive vehicles. The problem is essentially a truck size issue.

For both the cellulosic biofuels and the wind power industries in Iowa, the need to support the transportation infrastructure should be understood. Even more, it is necessary to ensure that the transportation infrastructure support needs of these industries are addressed in a fiscally sustainable manner. Otherwise, these industries will not be able to compete in the long run.

The following section discusses the major research objectives and the anticipated benefits of this study.

1.2 Research Objectives and Benefits

The plan for this research project includes ten tasks, which are listed and accompanied by a discussion on anticipated benefits.

Task 1: Establish a Technical Advisory Committee

Representatives from counties, cities, and the Iowa Department of Transportation (Iowa DOT) were identified to serve on the Technical Advisory Committee (TAC). TAC meetings were scheduled quarterly and in consultation with the project manager.

Task 2: Prepare a Detailed Literature Review and Trends Analysis

A literature review was prepared on the potential development trends of biofuels and wind energy production on the transportation infrastructure. The literature review discusses current and likely development trends and locations for biofuels production (both crop-based and cellulose-based ethanol and biodiesel) and wind energy power in Iowa. This trend and location analysis covers the time period of the next 15 to 20 years.

Task 3: Conduct a Local Agency Survey

The research team developed a survey questionnaire to be distributed to county engineers. The survey included questions relating to the types of biofuel production plants or wind energy farms that were in place, under construction, or in the planning stage. This survey provided researchers with the latest update on biofuels production plants and wind energy farms. More detailed, site-specific data were then acquired through face-to-face interviews with the county engineers from counties that were selected for further analysis.

Task 4: Estimate Traffic Growth and Pavement Deterioration in a Multi-County Area

A four-county cluster in north-central Iowa and a two-county cluster in southeast Iowa were identified as having a large number of varied facilities. Some of these facilities had been in operation for an extended period of time. In addition, the size and locations of these plants indicated that some of them probably influenced the traffic patterns of adjoining county roads. The research team investigated the large truck traffic patterns on Iowa's secondary and local roads and correlated those patterns with the pavement condition. In addition, the engineering characteristics of the subgrade were evaluated to gain a better understanding of the impacts of the growing renewable energy industry on the transportation infrastructure in Iowa. These impacts were quantified to the extent possible and visualized using geographic information system (GIS) tools.

Task 5: Develop a Traffic and Fiscal Impact Model for the Bioeconomy

A transportation (traffic and additional transportation cost) model and local government fiscal impact model was prepared to help assess the impact of additional biofuels plants on Iowa's highway transportation system. Several pavement design simulations were also conducted to estimate flexible and rigid pavement thickness designs for different levels of equivalent single axle loads (ESALs).

Task 6: Analyze Truck Size/Configuration and Weight Issues Related to the Bioeconomy

This task generated an understanding of trucks, trailers, and other vehicles that are currently being used or will likely be used in support of the conventional biofuels industry, the wind power industry, and the cellulosic biofuels industry. Size (e.g., turning radius) and weight/axle loadings were examined for a variety of vehicles. The truck, trailer, and vehicle characteristics have implications in terms of roadway geometrics, unpaved roadway structure designs, pavement designs, structural designs, and roadway maintenance practices and costs.

Task 7: Develop a Brief Set of Public Policy Recommendations

This task involved briefly summarizing the implications of the transportation impacts analysis results from Tasks 4 and 5 as well as the truck size and weight results from Task 6. The focus was on suggesting public policy changes that local governments could consider given the need to provide adequate roadway and bridge infrastructure to support the biofuels and wind power industries during the next 15 to 20 years in Iowa.

Task 8: Prepare a Draft Final Report

A draft final report was prepared for the TAC to review.

Task 9: Prepare a Detailed Technology Transfer "Road Map"

A plan was developed to transfer the findings of this research to practitioners at the state and local levels in Iowa, as well as other agricultural states that are facing similar issues. Various means of dissemination and outreach activities were considered, including conference presentations, articles, and newsletters (such as the Iowa Local Technical Assistance Program [LTAP] newsletter, *Technology News*). Actual implementation of the technology transfer plan was beyond the scope of this research project.

Task 10: Prepare the Final Project Report

The final report was prepared following revisions suggested by the TAC.

Figure 1.1 shows the relationships between select tasks.

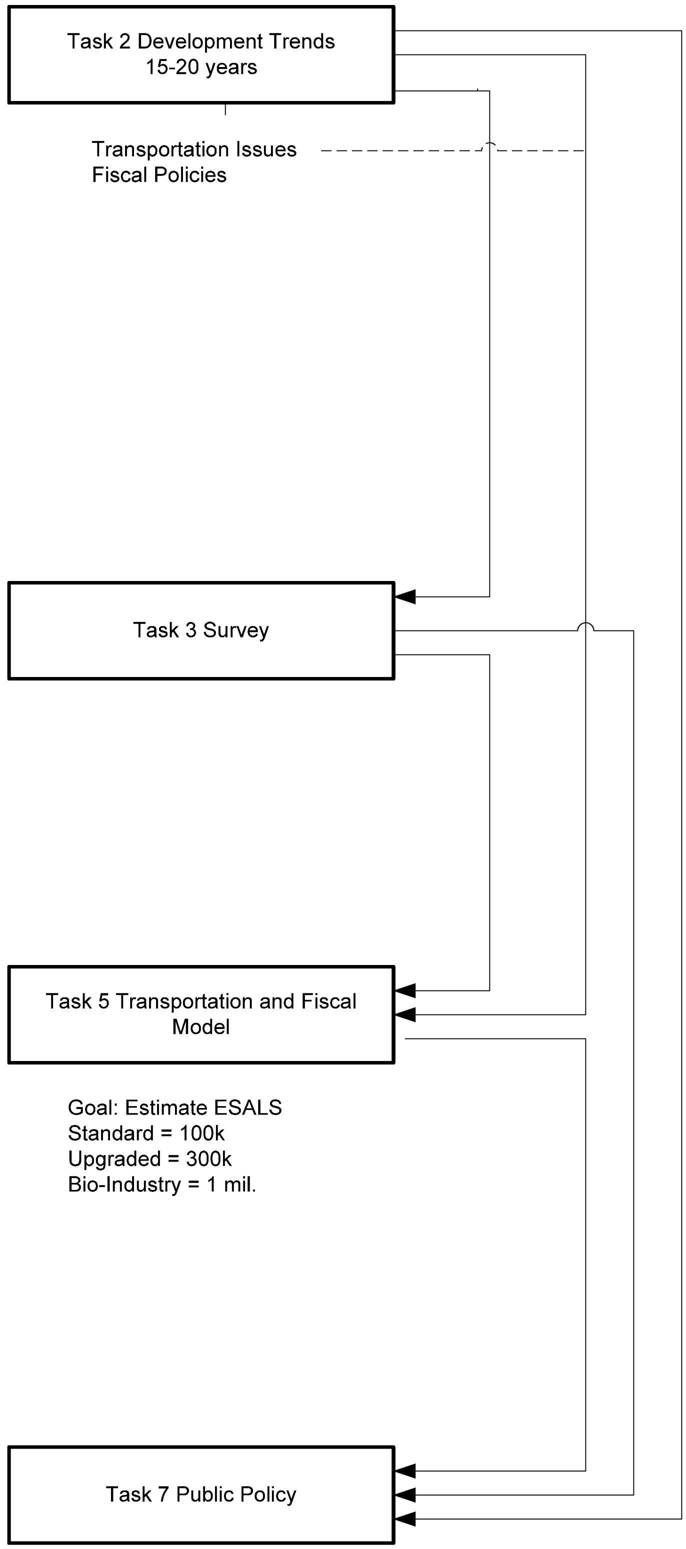


Figure 1.1. Research flow process

1.3 Report Organization

Table 1.1 lists the tasks and corresponding chapters.

Table 1.1. Tasks and corresponding chapters

Task	Corresponding Chapter
1. Establish Technical Advisory Committee	1. Introduction
2. Prepare a Detailed Literature Review and Trends Analysis	2. Literature Review
3. Conduct a Local Agency Survey	3. County Maintenance Costs
4. Estimate Traffic Growth and Pavement Deterioration in a Multi-County Area	4. Estimation of Traffic Growth and Pavement Deterioration
5. Develop a Traffic and Fiscal Impact Model for the Bioeconomy	5. Traffic Impact Model and Pavement Thickness Design
6. Analyze Truck Size/Configuration and Weight Issues Related to the Bioeconomy	6. Truck Size, Configuration, and Weight Issues
7. Develop a Brief Set of Public Policy Recommendations	7. Public Policy Implications
8. Prepare a Draft Final Report	
9. Prepare a Detailed Technology Transfer "Road Map"	8. Technology Transfer Road Map
10. Prepare the Final Project Report	

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

A literature review was conducted that focused on the potential development trends of ethanol and biofuels production and wind energy power and their impact on Iowa's transportation infrastructure. The literature review includes sections that explore current and likely development trends and locations for biofuels production (both crop-based and cellulose-based ethanol and biodiesel) and wind energy power in Iowa. This trend and location analysis will cover the time period of the next 15 to 20 years.

2.2 Ethanol and Biodiesel

2.2.1 Current Trends for Ethanol and Biodiesel

Ethanol can be extracted from the starches and sugars contained in corn and be produced from cellulose, which is the fiber of the plants. Some examples of cellulose are wheat and rice straw, switchgrass, paper pulp, and agricultural by-products, such as corn cobs and stover.

Cellulosic ethanol production requires more biomass than corn ethanol production. Producing ethanol from cellulose materials has the potential to produce roughly twice as much fuel from the same area of land currently producing corn for ethanol production. As shown in Figure 2.1, producing ethanol from corn is more energy intensive than producing ethanol from cellulose materials. A great deal of the energy (78%) is lost from producing ethanol from corn while only 10% of energy is lost from producing cellulose ethanol.

Figure 2.1. Ethanol from corn vs. cellulose (ByTheBoxes)

From an environmental point of view, materials like switchgrass have important benefits in addition to being cellulosic feedstock. They stabilize the soil to help prevent erosion, and the decaying materials help make the soil fertile.

Whether or not using ethanol in place of gasoline helps reduce carbon dioxide emission is still debatable. Liska et al. (2008) found that corn-based ethanol reduces direct greenhouse gas (GHG) emissions between 48% and 59% compared to the GHG emissions from gasoline. In 2007, ethanol use in the U.S. reduced CO_2-eqivalent GHG emissions by approximately 10.1 million tons. This amount equals removing more than 1.5 million cars from America's roadways. Figure 2.2 shows CO_2-equivalent emissions per kilowatt-hour generated by different materials. As shown in Figure 2.3, on average, corn ethanol can reduce 19% of GHG emissions, while cellulosic ethanol can reduce GHG emissions by 86%.

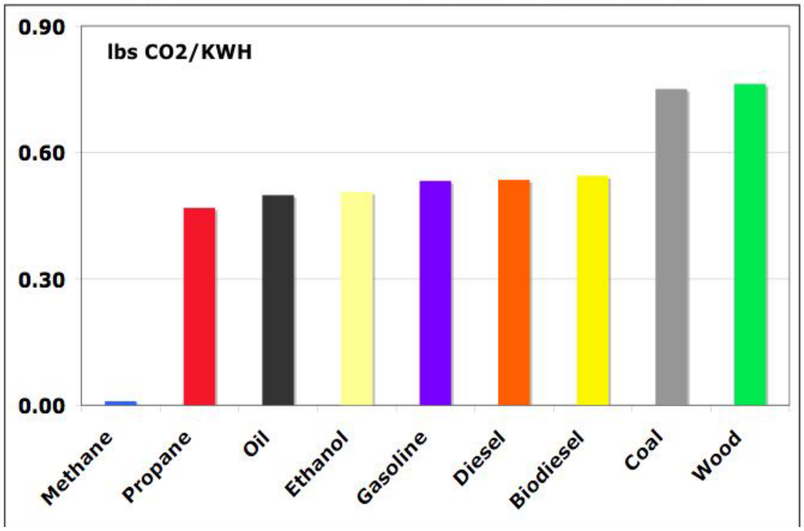


Figure 2.2. CO_2 emissions generated by different transportation fuel materials (U.S. Department of Energy, Argonne National Laboratory 1991)

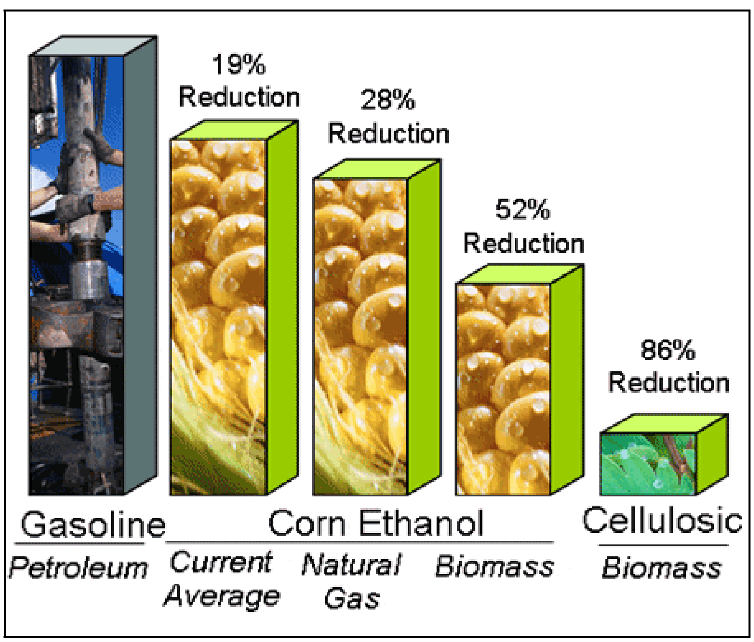


Figure 2.3. GHG emissions of transportation fuels by type of energy used in processing (Wang et al. 2007)

However, other studies show different results. Searchinger et al. (2008) found that corn-based ethanol would double greenhouse emissions over 30 years and increase greenhouse gases for 167 years instead of leading to an anticipated 20% reduction. The authors stated that earlier studies did not account for one hard-to-measure factor: forests and grasslands are being converted to land to grow feedstock for the biofuels. According to this study, if grown in U.S. corn lands, biofuels from switchgrass will increase emissions by 50%.

From an economic viewpoint, the limit of total production of corn-ethanol is about 15 billion gallons of fuel annually. This limit is based on competing demand for corn-based food. On the other hand, the next generation biofuels production of cellulose ethanol is about to begin and has the potential to replace the corn-based ethanol. As shown in Figure 2.4, under the most aggressive technology development scenario, cellulosic ethanol would become commercialized and contribute to the alternative fuels pool, supplying 30% (70 billion gallons per year) of the nation's gasoline by the year 2030.

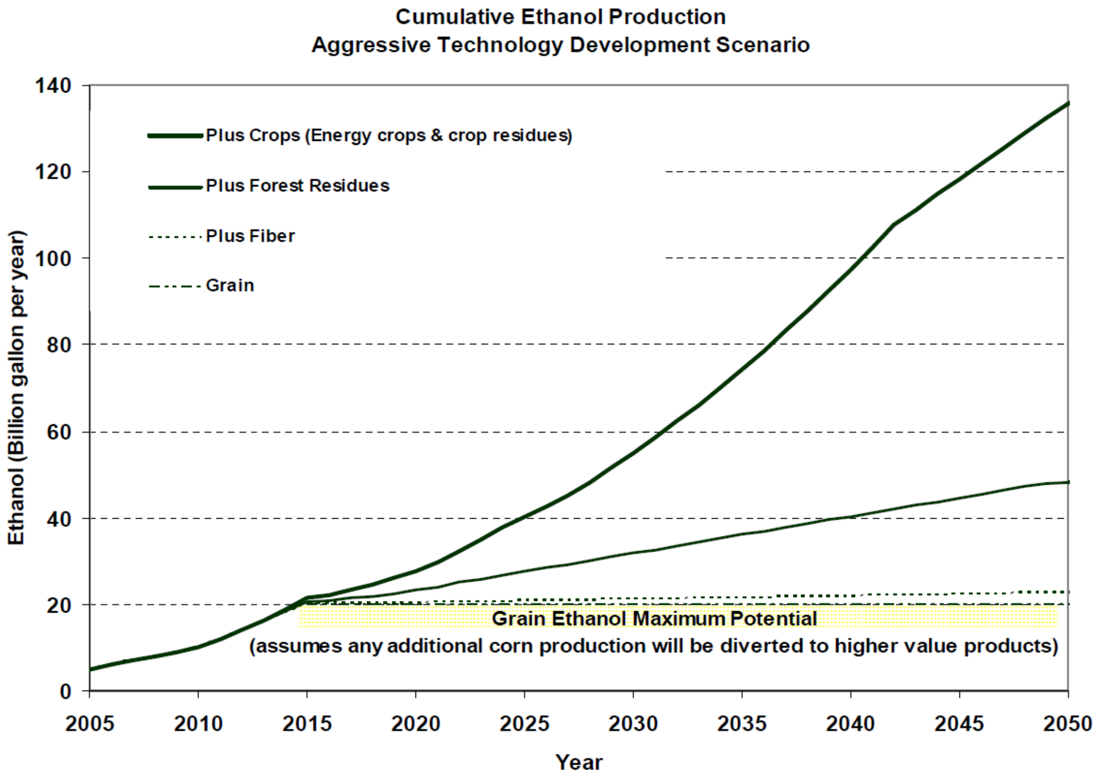


Figure 2.4. Required growth of cellulosic ethanol to supply 30% of U.S. gasoline demand by 2030 (National Renewable Energy Laboratory 2006)

Iowa is a leader in renewable energy in the U.S. and ranks first in ethanol production, as shown in Table 2.1. Every year Iowa produces nearly 3.5 billion gallons of fuel, which accounts for over 25% of the U.S. ethanol production.

Table 2.1. Ethanol production capacity ranked by state as of 2008 (Renewable Fuels Association 2008)

Rank	State	Ethanol Production Capacity (Million Gallons Per Year)
1	Iowa	3,534.0
2	Nebraska	1,665.5
3	Illinois	1223.0
4	Minnesota	1102.1
5	Indiana	1162.0
6	South Dakota	892.0
7	Kansas	507.5
8	Ohio	529.0
9	Wisconsin	498.0
10	Texas	355.0
11	North Dakota	333.0
12	Michigan	264.0
13	Missouri	241.0
13.751 14	California	234.5
15	Tennessee	205.0
16	New York	164.0
17	Oregon	148.0
18	Colorado	125.0
19	Georgia	120.4
20	Pennsylvania	110.0
21	Arizona	55.0
22	Washington	55.0
23	Idaho	54.0
24	Kentucky	35.4
25	New Mexico	30.0
26	Wyoming	6.5
27	Louisiana	1.5
	United States Total	13,751.4

Given the recent financial crisis and the resulting negative effect on ethanol plant operations, the list of operating plants in Iowa could potentially change.

2.2.2 Locations in Iowa

Figures 2.5 to 2.7 show the distribution of ethanol and biofuels plants in Iowa. Ethanol plants are mostly concentrated in the northwest and central sections of Iowa, while biodiesel plants are primarily located in northwest and southeast sections of Iowa.

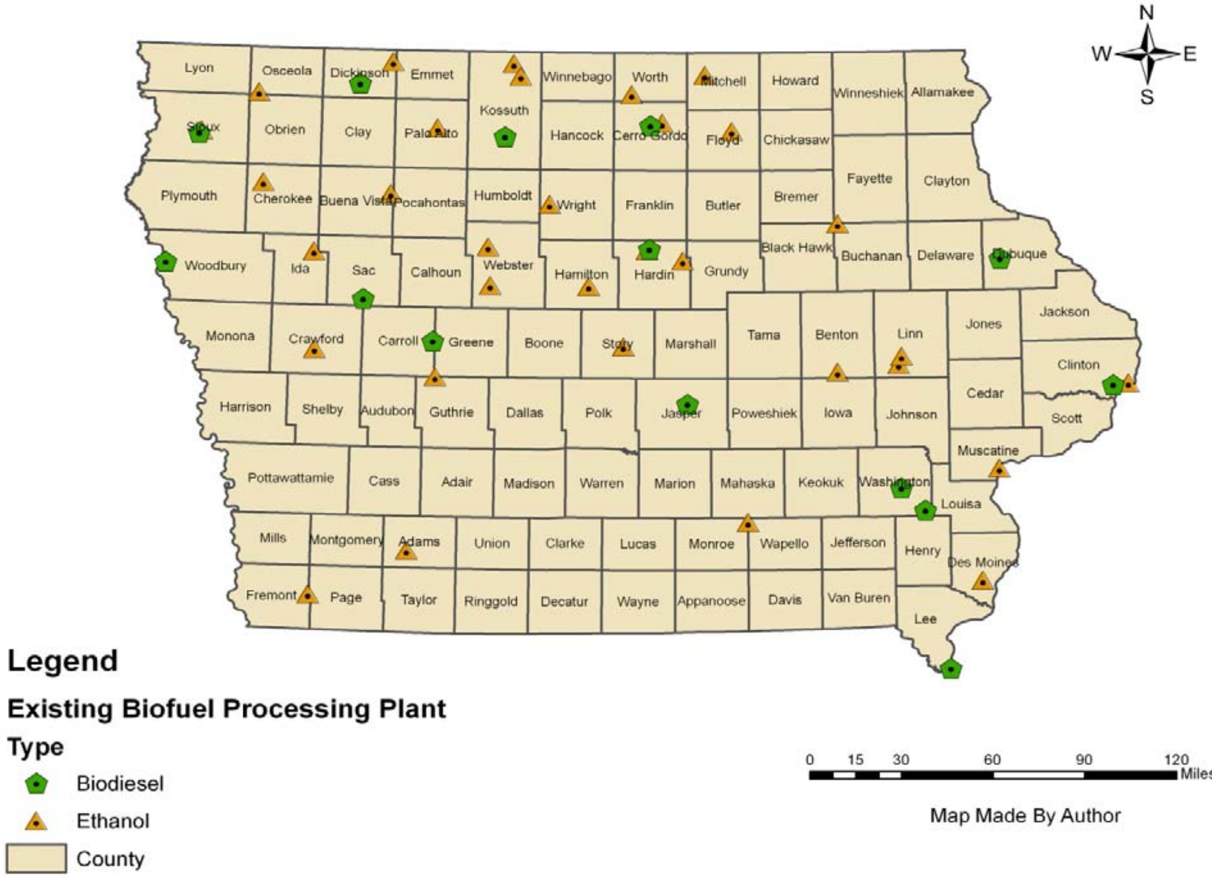


Figure 2.5. Biodiesel and ethanol processing plants as of 12/01/2008

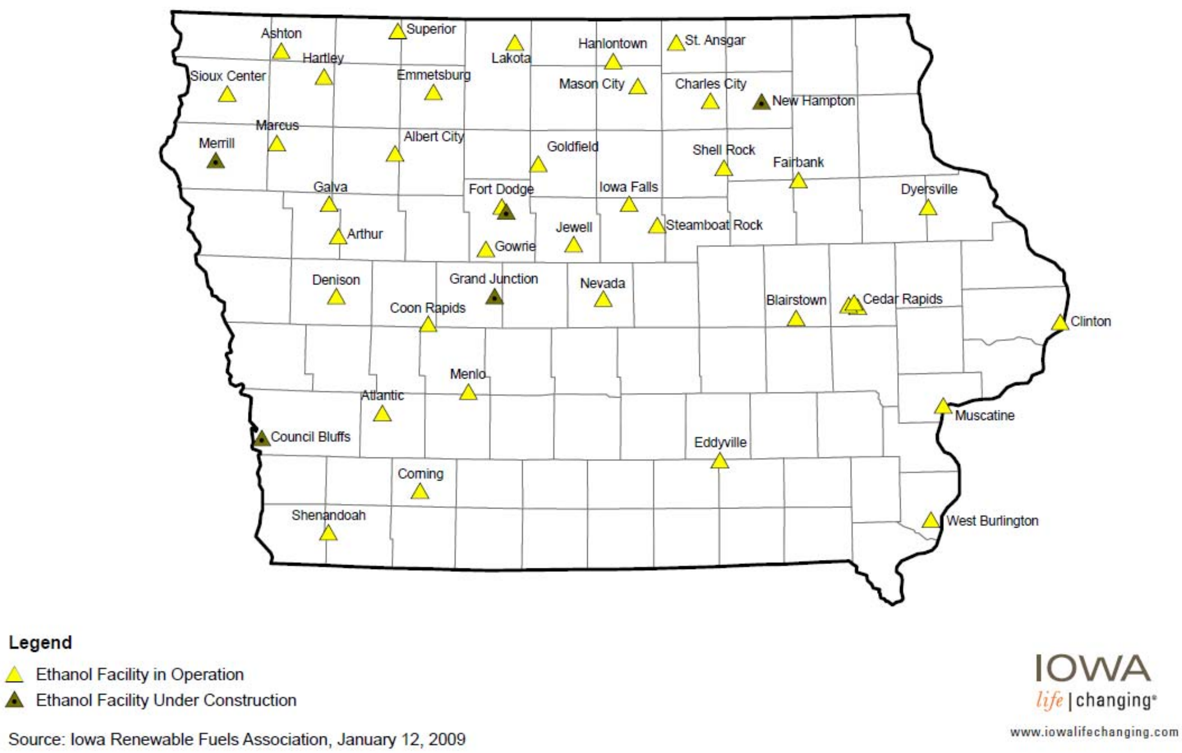


Figure 2.6. Map of ethanol plants in Iowa as of 01/12/2009 (Iowa Department of Economic Development)

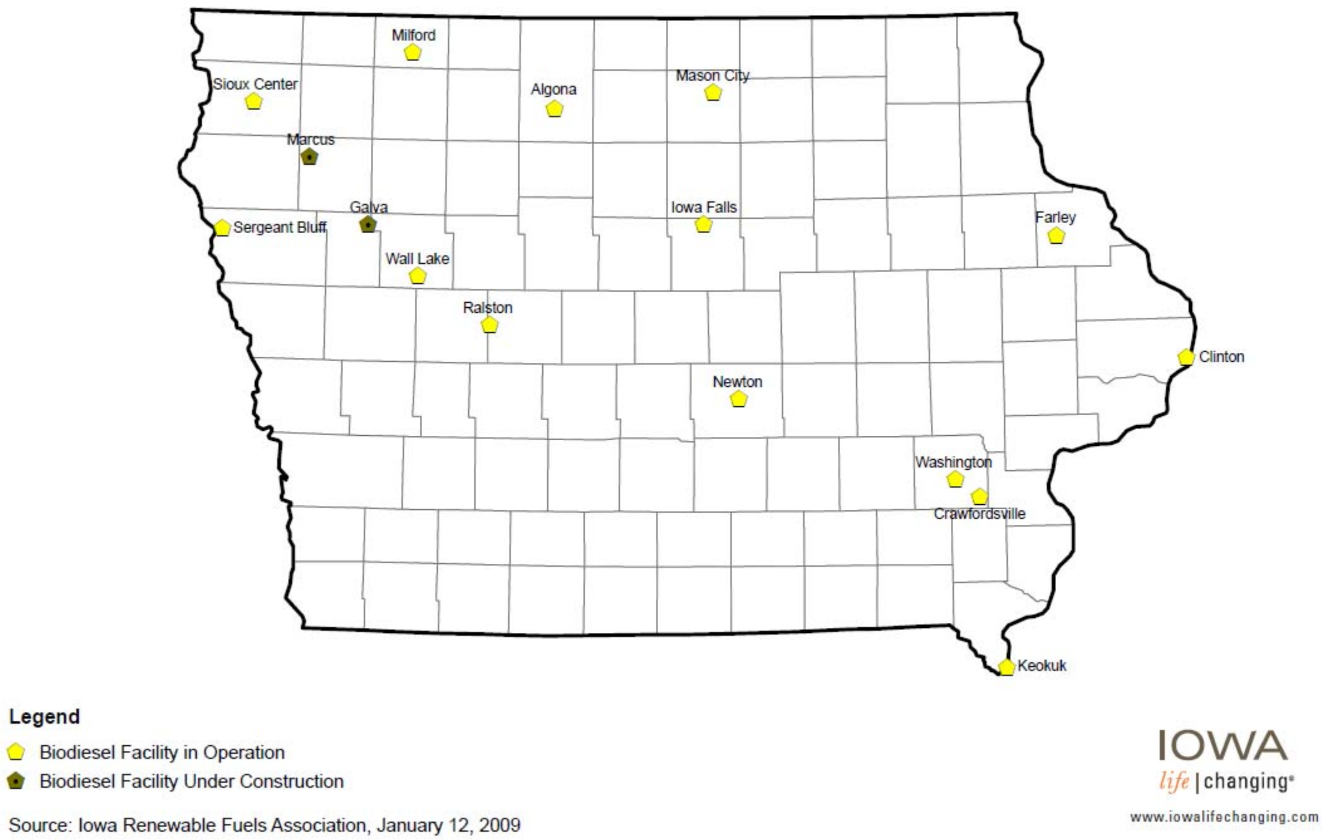


Figure 2.7. Map of biodiesel producers in Iowa as of 01/12/2009 (Iowa Department of Economic Development)

2.2.3 Future Trends for Ethanol and BioDiesel

In 2008, the rising cost of corn and other factors has caused some plants to shut down or to reduce the amount of ethanol being generated. During July and August 2008, a plan for a new biodiesel plant near Hardy, Iowa, was suspended. According to a Humboldt County supervisor, the costs of construction and corn were too high to make the facility financially feasible.

In November 2008, the *Des Moines Register* reported that Iowa's largest ethanol producer, VeraSun Energy Corporation of Sioux Falls, South Dakota announced bankruptcy. After filing for bankruptcy, VeraSun stopped production at the Pine Lake facility. The plant was 50 miles west of Waterloo and produced 30 million gallons of ethanol annually.

In Iowa, VeraSun had a total annual ethanol capacity of 550 million gallons. This amount accounted for more than 20% of the 2.5 billion gallons of ethanol produced annually in Iowa. At the time (November 2008), the price of corn reached record highs of almost $8 per bushel compared to $4 per bushel in the past. According to a *Chicago Tribune* article dated March 19, 2009, Valero Energy was going to buy seven ethanol plants from VeraSun, four of which were located in Iowa. The plants Valero Energy bought are located in Aurora, South Dakota; Charles City, Fort Dodge, Hartley, and Dyersville, Iowa.

In 2007, the U.S. Department of Energy (DOE) announced that it would invest up to $385 million over the following four years for six cellulosic ethanol plant projects. When fully constructed, the plants are expected to produce more than 130 million gallons of cellulosic ethanol per year. This expansion of the raw material base for ethanol will play a critical role in providing cellulosic ethanol to market. The production will help make ethanol cost-competitive with gasoline. Cellulosic ethanol along with trend toward increased automobile fuel efficiency has the potential to reduce America's gasoline consumption by 20% over the next ten years.

Two facilities are proposed to be built in the Midwest. One location is in Emmetsburg, Iowa (Palo Alto County), as shown in Figure 2.8. This cellulosic ethanol facility will expand the existing corn-based ethanol plant. The Emmetsburg plant is projected to produce 125 million gallons of ethanol per year, 25% of which will be cellulosic ethanol. For feedstock, the Emmetsburg plant expects to use 842 tons per day of corn fiber, cobs, and stalks. The potential impact to the transport infrastructure could be significant.

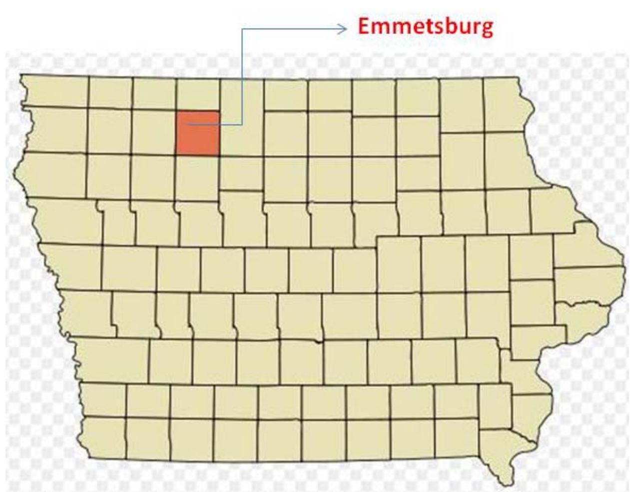


Figure 2.8. Emmetsburg plant in Iowa

With improved technologies and modern agricultural practices, farmers may achieve higher yields per acre, which would result in more grain being hauled to market. The future estimated average corn stover production in Iowa is 35.9 million metric tons per year, or 18.3% of the U.S. total production. This equates to about 2 tons per acre and represents a 40% to 50% increase in tonnage that would be harvested, stored, and transported on Iowa's roads.

Table 2.2 indicates the Iowa farm size changing trend from 2002 to 2007. It shows that the number and land of different sized farms have not changed equivalently. In terms of number, except for farms with 1 to 99 acres and over 2,000 acres, other farm sizes have decreased in number. It may be inferred that medium- and large-size farms above 100 acres were more likely to decrease in number than small-size farms during that period. Similarly, the land for farms smaller than 100 acres and larger than 2,000 acres has increased. On the other hand, mediumand large-size farms, which refer to farm sizes ranging from 100 to 2,000 acres, have all decreased in size. Overall, the average land per farm has remained steady during that period.

Table 2.2. Iowa farm size changing trend from 2002 to 2007 (U.S. Department of Agriculture 2007)

All Farms	Farms		Land in farms (acres)		Land per farm (acres)	
	2002	2007	2002	2007	2002	2007
Total acres	90,655	92,856	31,729,490	30,747,550	350	331
1 to 9	4,811	8,709	25,779	39,686	5	5
10 to 49	16,278	17,824	414,842	456,783	25	26
50 to 69	3,843	4,428	224,086	258,754	58	58
70 to 99	6,821	7,253	556,342	592,231	82	82
100 to 139	6,300	6,280	736,158	736,483	117	117
140 to 179	7,286	6,731	1,147,324	1,059,126	157	157
180 to 219	4,621	4,364	913,565	861,308	198	197
220 to 259	4,506	3,943	1,071,679	937,864	238	238
260 to 499	15,592	14,047	5,665,052	5,104,492	363	363
500 to 999	13,063	11,862	9,083,537	8,248,050	695	695
1,000 to 1,999	6,213	5,898	8,189,394	7,866,091	1,318	1,334
2,000 or more	1,321	1,553	3,701,732	4,586,682	2,943	2,953

Most ethanol is currently produced in the Midwest, and 80% of the demand comes from the nation’s coastlines. In Iowa, 2 billion gallons of ethanol were produced, 52% of which were sold to markets outside the state. The average corn shipping distance is 32 miles. The average ethanol shipping distance by truck is 98 miles and 955 miles by rail. An increasing concern is the capacity of nation’s transportation system to move ethanol to markets, feedstock to ethanol plants, and co-products produced from the ethanol production process as well as the continued availability of corn near corn-based ethanol plants. In addition, long-term growth in overall freight volumes is expected. According to the U.S. Department of Transportation Freight Analysis Framework, it is estimated that the demand for total intercity freight by all modes will grow significantly from 19.3 billion tons to 37.2 billion tons in 2035, an increase of approximately 93%. All of these trends will impact Iowa’s transportation infrastructure.

Increasing ethanol production may also affect where corn is transported and by which transportation mode. Ethanol is a solvent that picks up residues of other materials that have passed through the pipelines, resulting in cleaner pipes but dirtier fuels, which damages vehicle engines. As a result, ethanol is generally transported by truck, train, or barge and not by pipelines.

Childs and Bradley (2007) indicated that the corn used for ethanol production is generally delivered by truck from the farm (or elevator) to the nearby storage or processing plant within 50 miles. The infrastructure requirement for this expanded biofuels industry can be grouped into three phases: (1) storage and delivery of feedstock from point of production to plant, (2) transport of fuels from plant to fuel blender and then to retail outlet, and (3) distribution of fuel from retailer to consumer.

According a survey conducted by Iowa State University (Yu and Hart 2008), almost 66% of corn was transported from country elevators by trucks, while rail transportation accounted for only 30% of corn movements by grain handlers. Figures 2.9 and 2.10 show the transportation modes used to transport corn and soybean in different parts of the state. For transporting ethanol, the northwest, northeast, east-central, and southeast parts of Iowa mostly rely on trucks; for transporting biodiesel, except for the east-central and southeast parts of the state, all parts of Iowa are highly depend on truck transportation.

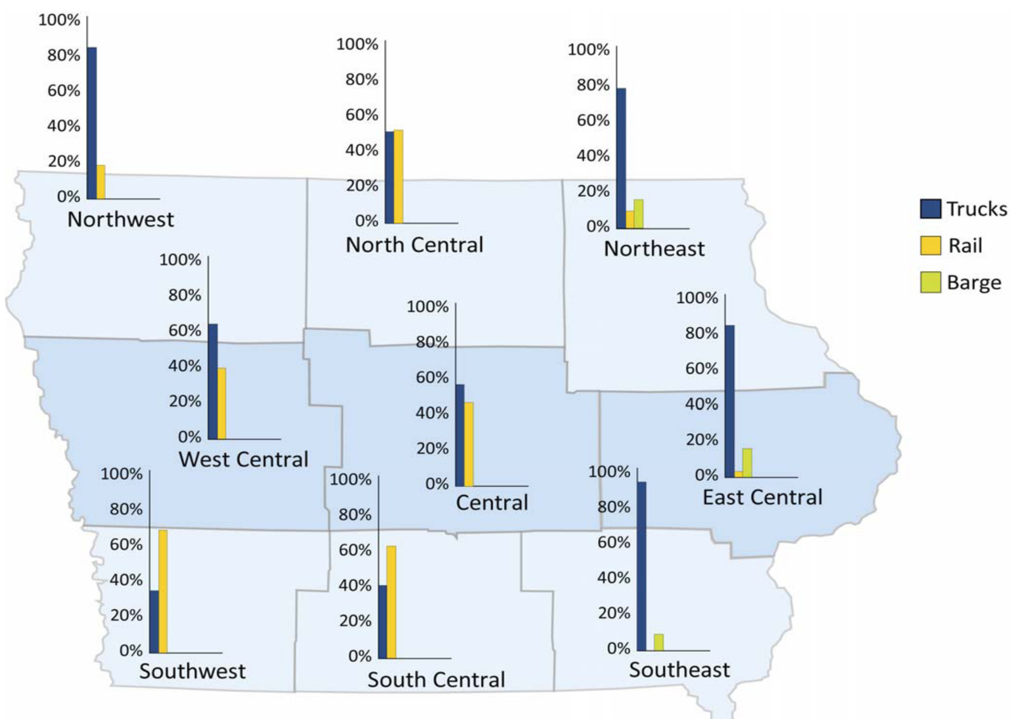


Figure 2.9. Corn transportation by grain handlers in state of Iowa (Yu and Hart 2008)

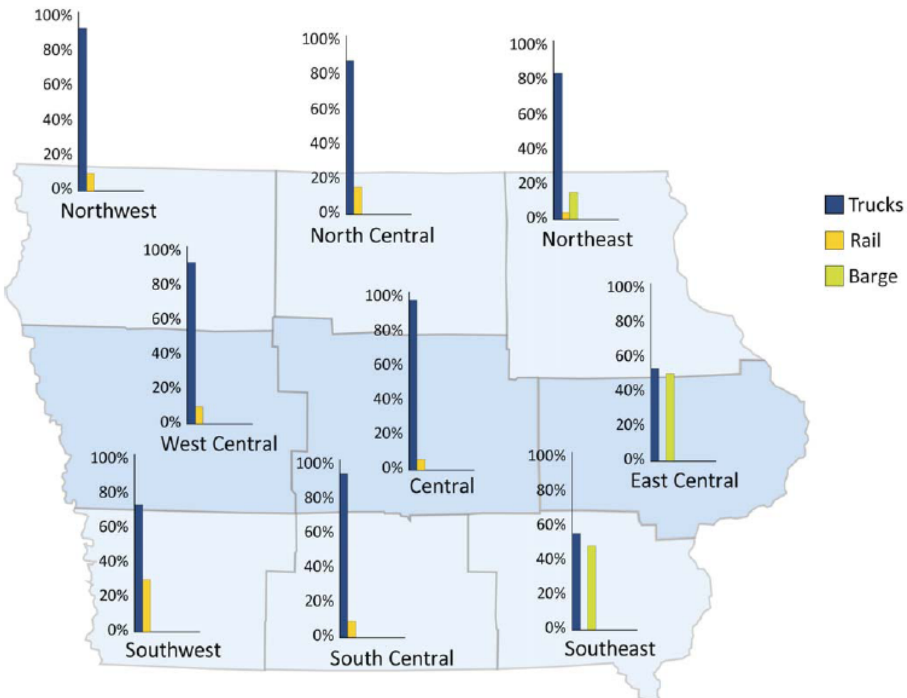


Figure 2.10. Soybean transportation by grain handlers in state of Iowa (Yu and Hart 2008)

Note that 200,000 barrels of grain per day carried by truck (which is only 2% of 9 million barrels of motor gasoline per day consumed in the U.S. in 2005) would require 2,000 additional large tanker truck trips on an already loaded Iowa road network.

After feedstock and energy costs, transportation costs become the third-highest expense to an ethanol producer. Balancing transportation expenses with fixed infrastructure costs is critical to sustained profitability for each ethanol plant. A research study (Brechbill et al. 2008) has developed a set of costs for various farm sizes and travel distances. Table 2.3 outlines these average costs for both corn stover and switchgrass by farm size and distance. The distance from field to plant range from 5 to 50 miles and was calculated for intervals of 5 miles. This research also shows that the distance of field to plant will increase by the proximity to a large metropolitan city and by the large size of the plant.

Table 2.3. Average product and transportation cost per ton by farm size (Brechbill et al. 2008)

	Corn Stover					
	Custom	500 acres	1,000 acres	1,500 acres	2,000 acres	Average
5 miles	$36.49	$42.80	$38.48	$37.04	$36.32	$38.22
10 miles	$37.87	$43.47	$39.15	$37.71	$36.99	$39.04
15 miles	$39.26	$44.14	$39.82	$38.38	$37.66	$39.85
20 miles	$40.64	$44.81	$40.49	$39.05	$38.33	$40.66
25 miles	$42.03	$45.48	$41.16	$39.72	$39.00	$41.47
30 miles	$43.41	$46.15	$41.83	$40.39	$39.67	$42.29
35 miles	$44.80	$46.82	$42.50	$41.06	$40.34	$43.10
40 miles	$46.18	$47.49	$43.17	$41.73	$41.01	$43.91
45 miles	$47.57	$48.16	$43.84	$42.40	$41.68	$44.73
50 miles	$48.95	$48.83	$44.51	$43.07	$42.35	$45.54
	Switchgrass					
	Custom	500 acres	1,000 acres	1,500 acres	2,000 acres	Average
5 miles	$58.45	$60.52	$57.84	$56.94	$56.50	$58.05
10 miles	$59.84	$61.19	$58.51	$57.61	$57.17	$58.86
15 miles	$61.22	$61.86	$59.18	$58.28	$57.84	$59.68
20 miles	$62.61	$62.53	$59.85	$58.95	$58.51	$60.49
25 miles	$63.99	$63.20	$60.52	$59.62	$59.18	$61.30
30 miles	$65.38	$63.87	$61.19	$60.29	$59.85	$62.12
35 miles	$66.76	$64.54	$61.86	$60.96	$60.52	$62.93
40 miles	$68.15	$65.21	$62.53	$61.63	$61.19	$63.74
45 miles	$69.53	$65.88	$63.20	$62.31	$61.86	$64.55
50 miles	$70.92	$66.55	$63.87	$62.98	$62.53	$65.37

Over time cellulose production is likely to shift toward more economical, genetically modified perennial grasses, such as switchgrass and miscanthus. Yields of 13 tons per acre have already been achieved in Illinois and Wisconsin, which is four times the tonnage produced per acre of a corn crop. There is a possibility of moving several times more agricultural products on Iowa's roadway and bridge systems by the year 2030. Cellulose (no matter if it comes from wheat and rice straw, switchgrass, paper pulp, or agricultural waste products like corn cobs or stover) is a new agricultural product that also needs to be harvested, transported, and stored. Figures 2.11 to 2.13 provide an overview of the harvest, storage, and transportation options available for the production of cellulosic ethanol.

Figure 2.11. Switchgrass harvest (University of Wisconsin–Madison 2006)

Figure 2.12. Switchgrass bales loaded on flatbed (Chariton Valley A)

Figure 2.13. Stacking bales for storage (Chariton Valley B)

Cellulose products are bulky materials that require large-sized but not heavy vehicles for transportation to markets. Another example of a possible transportation option is pelletizing corn cobs close to the farm field, resulting in fewer but heavier vehicles. Both options have issues, including a functionally obsolete infrastructure (such as narrow bridges and roads) that prohibits the movement of large-sized vehicles and heavy vehicles that could be restricted on structurally deficient transportation infrastructure sections.

In conclusion, the improving agriculture technologies, the increasing demand of ethanol, and the raising corn price all result in higher corn yield and production. The production expansion will increase the demand for transportation no matter if it is ethanol from a Midwest plant farm to the coastline or corn from corn farms to the closest ethanol plant. Trucks are the dominant transportation mode of corn to ethanol plants, traveling mostly on the secondary road system. Therefore, the increased traffic volume could deteriorate the infrastructure.

2.2.4 Summary

2.2.4.1 Corn Ethanol

- Technology aspect: 78% of the energy is lost in production of ethanol from corn
- Environmental aspect: 19% to 52% reduction of greenhouse emissions from corn ethanol
- Economic aspect: limited total production of 15 billion gallons because of fewer corn supplies and competing uses
- Due to rising costs and the economic crisis in 2008, two companies declared bankruptcy, one plant suspended operations
- Corn ethanol production will peak between 2015 and 2030 and is less likely to be sustainable in the future than cellulosic ethanol production

2.2.4.2 Cellulosic Ethanol

- Technology aspect: only 10% energy is lost in production—ethanol extracted from cellulose is less energy-intensive than ethanol from corn
- Environmental aspect: reduction of GHG emissions up to 86% is possible
- Economic aspect: U.S. production of 150 billion gallons of ethanol by 2050 (two-thirds of the current U.S. gasoline consumption) means less dependence on foreign oil and a potential overall fuel cost savings
- DOE announced in 2007 an investment of up to $385 million over four years for six cellulosic ethanol plants
- The cellulosic plant in Emmetsburg may produce 125 million gallons of ethanol, with 25% being cellulosic ethanol; expected to use 842 tons per day of corn fiber, cobs, and stalks

2.3 Wind Energy in Iowa

2.3.1 Current Trends

In addition to corn and cellulose ethanol production, Iowa is a major center for wind energy generation. Iowa is uniquely positioned in the heart of the nation’s wind generation corridor and at the gateway to the demand of renewable energy. As of December 31, 2008, Iowa surpassed California, becoming the second state with the most current installed wind power capacity (see Figure 2.14). With 47 wind farms running 1,100 working turbines, Iowa has an annual wind energy capacity of 3,035.28 MW (National Wind 2009).

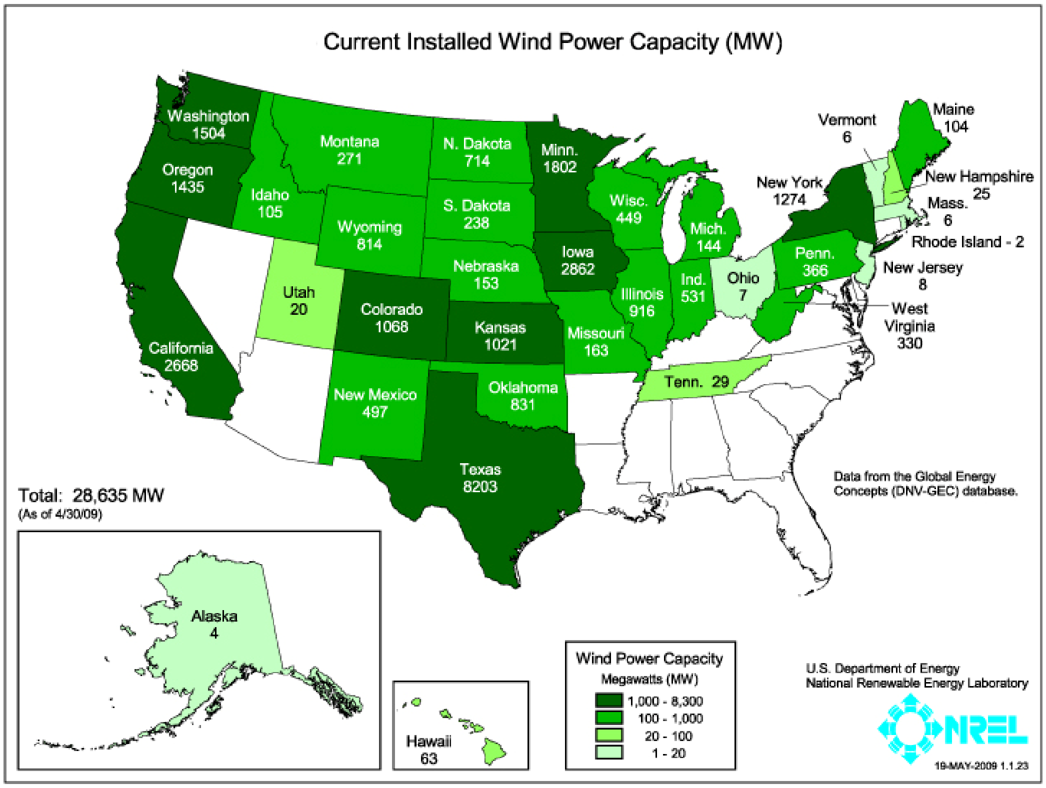


Figure 2.14. National wind power capacities (MW) as of 04/30/2009 (National Renewable Energy Laboratory 2009)

2.3.2 Future Trends

Public policy initiatives are the first factor driving wind generation installation. Iowa has extensive legislation in place to provide incentives for production.

The decline in the cost of wind power is also a driving factor. In Iowa, wind power costs for new wind generation projects have dropped by about one-third since the first large wind farms were installed in 1999.

Future carbon emission regulations could be the most powerful long-term driving factor for more wind generation. Because wind generation reduces GHG emissions, it represents a great opportunity for the wind industry. Figure 2.15 shows the DOE projections that cumulative wind installation should reach 300 GW annually by 2030 in order to achieve the 20% wind-penetration goal.

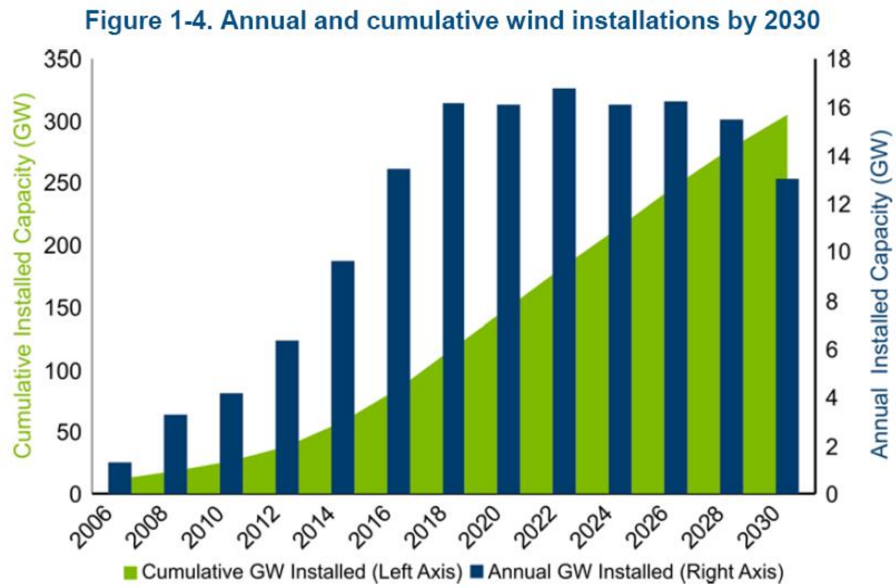


Figure 2.15. Annual and cumulative wind installations by 2030 (U.S. Department of Energy)

Because wind generation tends to be developed first where the average wind speeds are the highest, it is helpful to compare Iowa's relative wind speed to the entire United States. Figure 2.16 shows a U.S. wind resource map developed by the National Renewable Energy Laboratory. Areas in orange or purple generally have sufficient wind resources to be economically developable. The map illustrates the significant wind generation potential in Iowa.

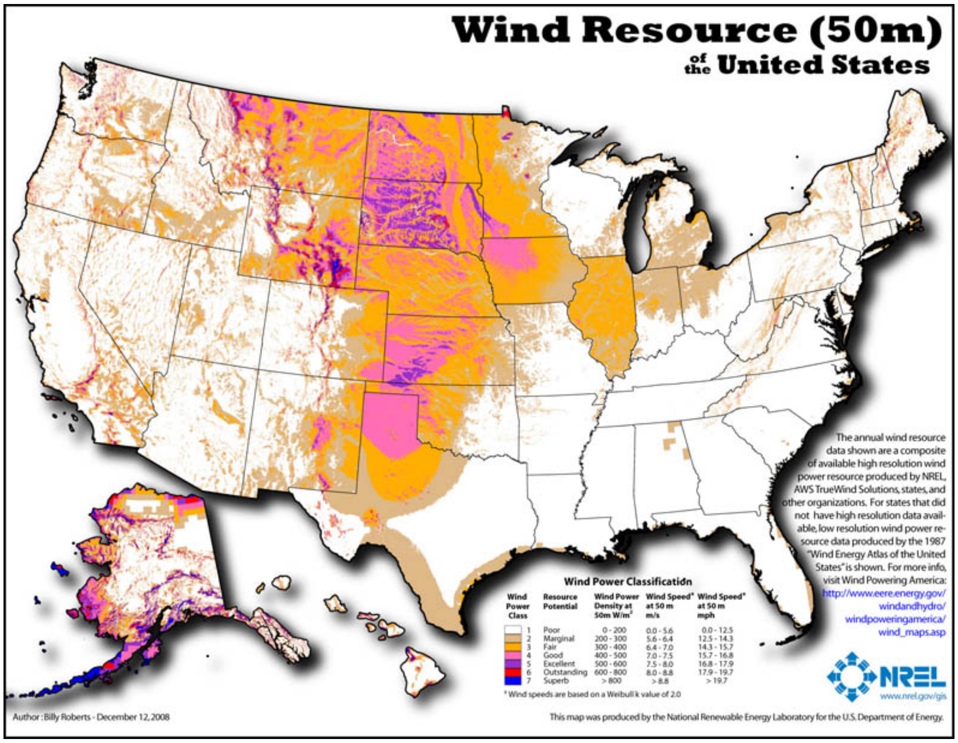


Figure 2.16. U.S. wind resource map (National Renewable Energy Laboratory 1987)

Based on individual company plans, Wind Utility Consulting, PC, and Wind Management, LLC, project a significant growth of 5,025 MW in Iowa by 2014, which accounts for 30% of electricity, as shown in Figure 2.17.

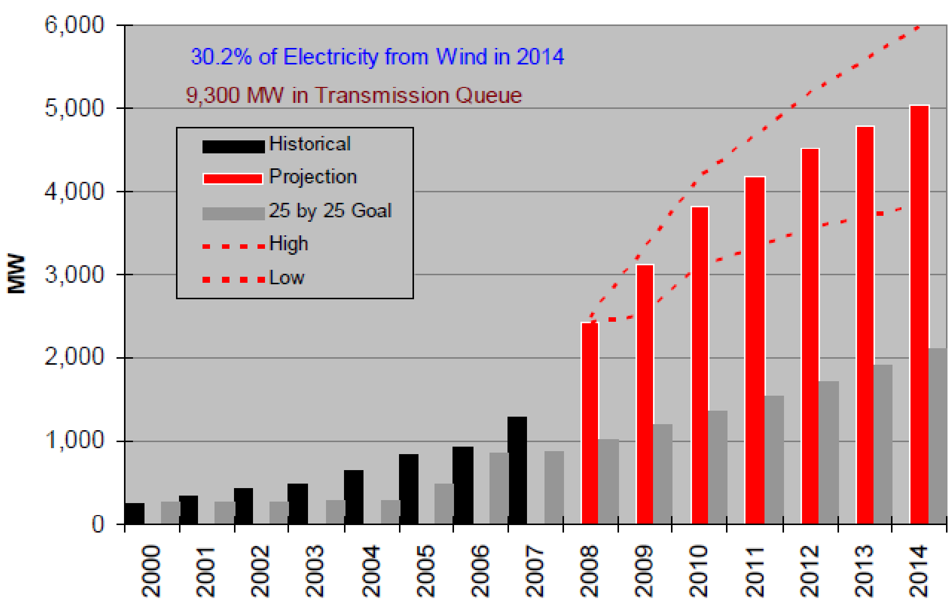


Figure 2.17. Historical and projected total wind generation by year (Wind Utility Consulting, PC, and Wind Management, LLC 2008)

Figure 2.18 shows the map of wind energy turbines in Iowa by operational year. The lighter blue cluster shows relatively old wind turbines, and the darker blue cluster shows wind turbines that were recently installed. Wind Utility Consulting, PC, and Wind Management, LLC, (2008) indicate that although large areas of Iowa have adequate electric load, transmission lines, and good wind resources that can accommodate large wind farms, the lack of transmission lines in northwest Iowa will push development southeastward, where transmission is less constrained.

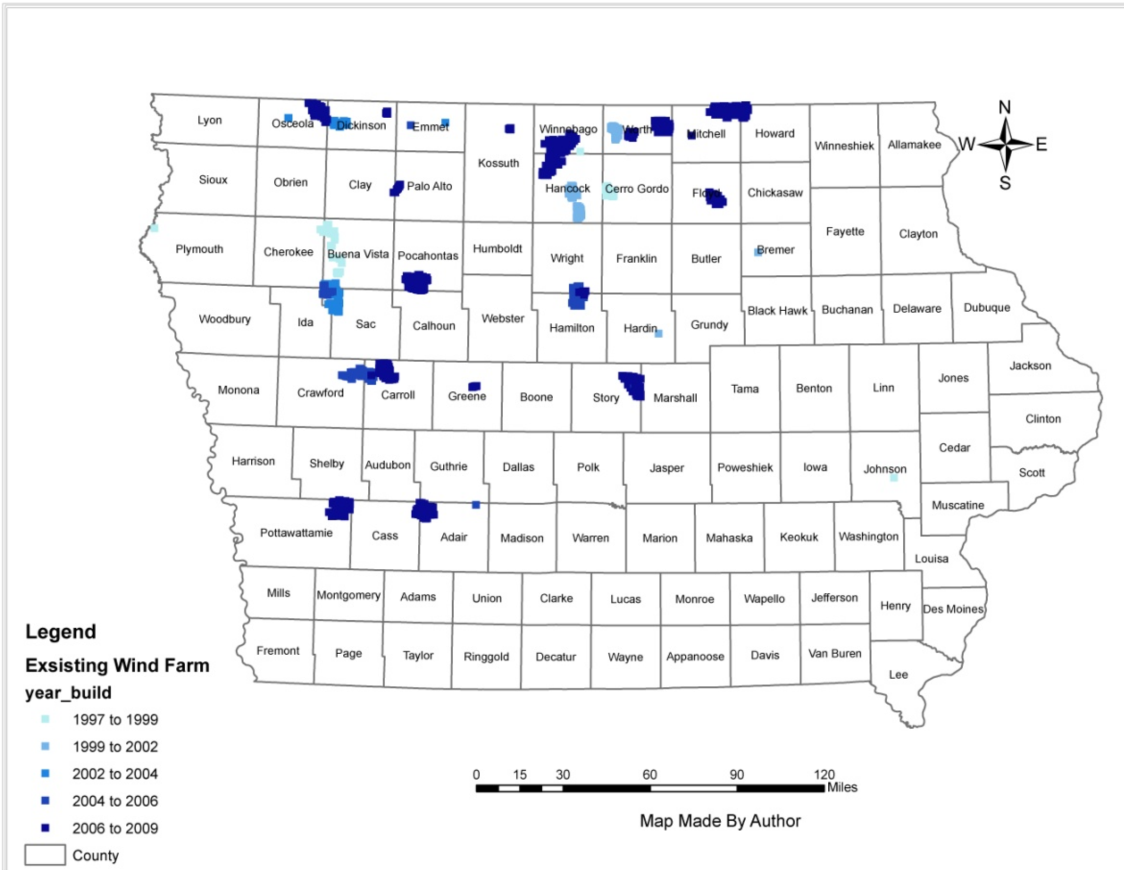


Figure 2.18. Map of wind energy turbines in Iowa by operational year as of 2008

A typical wind turbine sits atop a tower that ranges from 170 to 320 feet high. The blade diameter is 75 to 100 feet and weighs between 8,000 and 10,000 pounds (see Figure 2.19). As wind turbines blades become longer, the weight of the blade increases. Transporting blades from the manufacturing sites to the wind farms fields is becoming problematic because of the length and weight.

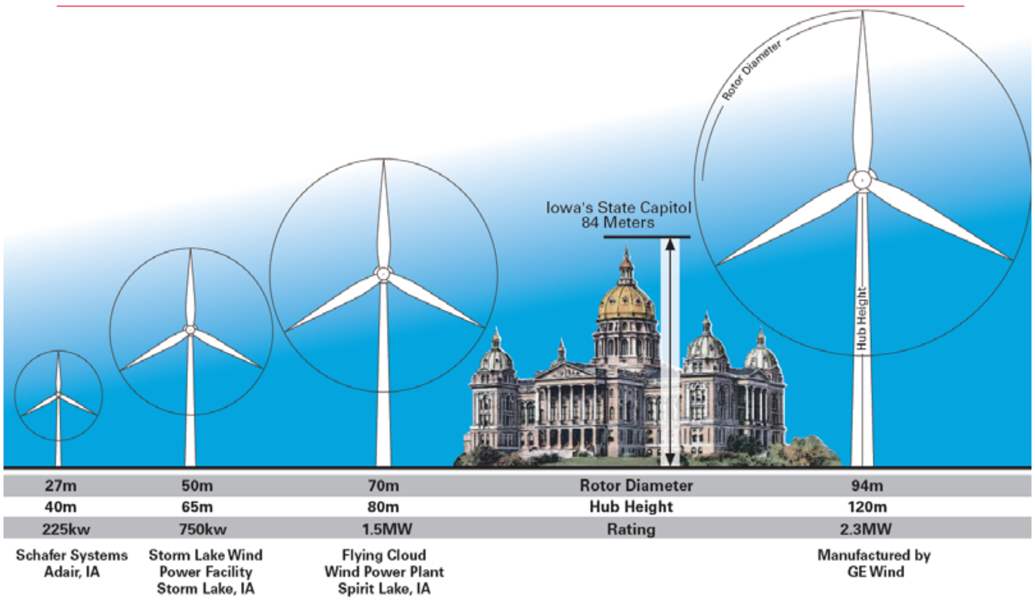


Figure 2.19. Wind turbine heights in Iowa (Iowa Energy Center)

In summary, Iowa was ranked second for current installed wind capacity in 2009. A typical wind turbine ranges from 170 to 320 feet in height, 74 to 100 feet in blade diameter, and 8,000 to 10,000 pounds in weight. As the turbine radii become larger and larger (Figure 2.19 showed that the largest turbine in 2006 was nearly 328 feet tall), the issue of transporting these turbines begins to emerge. In Iowa, although the height of turbines is between 200 to 250 feet with three blades (up to 90 feet in blade diameter) transporting the blades on the secondary road system will be problematic. County secondary roads and structures were not designed to accommodate vehicle configurations being used today to transport major wind turbine components (see Figure 2.20). A similar issue arises for transporting the equipment used to erect turbines and towers.

Figure 2.20. Transporting large wind turbines (Treehugger 2008)

2.3.3 Locations in Iowa

Figure 2.21 shows the distribution of wind turbine manufacturing, suppliers, financing, and farms in Iowa as of 2008.

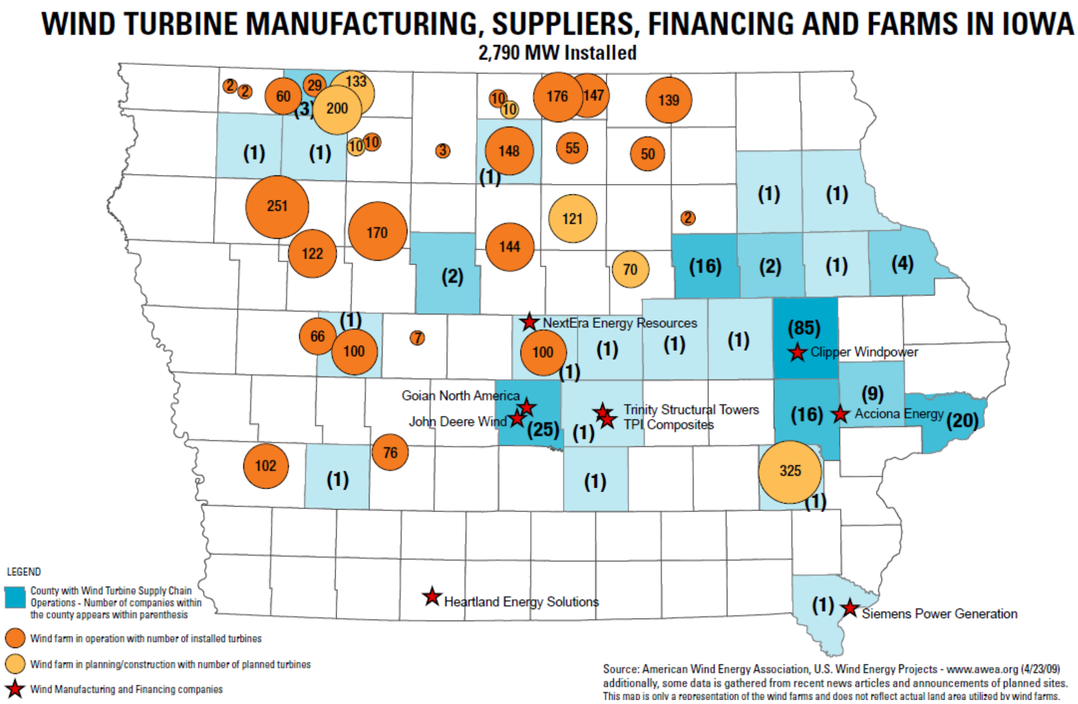


Figure 2.21. Map of turbine component manufacturing and wind farms in Iowa as of 10/20/2008 (Iowa Department of Economic Development)

2.3.4 Summary

- Wind turbines are becoming a common sight in Iowa, with a number of turbines and wind farms in the northwest part of the state.
- A typical wind turbine ranges from 170 to 320 feet in height and has a 74 to 100 feet blade diameter that weighs 8,000 to 10,000 lbs.
- Iowa has the second largest installed capacity of wind energy in the U.S. behind Texas.
- The DOE projects that cumulative wind installations should reach 300 GW by 2030 to achieve the 20% wind penetration goal.
- Iowa is projected to have a significant growth of 5,025 MW by 2014.
- Iowa wind energy turbine development is projected to move from the northwest part of Iowa towards the southeast.

CHAPTER 3. COUNTY MAINTENANCE COSTS

3.1 Introduction

The research task and objective was to develop, implement, and summarize a survey of Iowa counties that documents the physical and fiscal impacts of Iowa's existing biofuels and wind power industries. If this were accomplished, the future infrastructure impacts could be projected based on growth scenarios for the next 15 to 20 years. The approach was to utilize a multi-county case study approach so that the research team could quantify and visualize the impacts. The process used can be graphically represented by the chart in Figure 3.1.

1. Survey counties to locate facilities and establish cost data
2. Identify clusters of counties with renewable energy facilities
3. Interview selected counties, summarizing maintenance cost data
4. Observe patterns and similarities between counties' cost experiences; develop conclusions to be tested
5. Repeat steps 2–4 with second cluster with geographical differences
6. Derive findings for report from responses of individual counties and county clusters

Figure 3.1. Graphical representation of task

In order to identify those counties with existing biofuels production plants and wind energy turbine facilities and the infrastructure financial data related to these facilities, a statewide survey was distributed to all county engineers. This survey provided researchers with the latest information about the ongoing planning, construction, and operations of biofuel production plants and wind energy farms. More detailed, site-specific data were then acquired by face-to-face interviews with the county engineers of counties that were selected because of their experiences and willingness and ability to provide informational data.

It was hoped that the information from these interviews could provide the basis of this report's findings and document the fiscal impacts the biofuels industry and wind energy facilities have had on the county transportation infrastructure. The research team looked at the selected counties' cost histories and reviewed the data as a group. If a trend was identified in one county, the research team wanted to see if it could identify the same trend in adjacent counties. The intention was to show that the renewable fuels plants impacts are not constrained by jurisdictional boundaries and will impact counties adjacent to their location. A four-county cluster (Worth, Mitchell, Cerro Gordo, and Floyd) was selected in north-central Iowa. In order to see if cost trends identified by the research team applied to other areas of the state, a two-county cluster from southeastern Iowa was selected for county engineer interviews. The counties were Lee and Des Moines.

3.2 County Engineer Survey Results

Early in October of 2008, the research team developed a survey questionnaire to be distributed to county engineers. The survey included questions relating to the types of biofuels production plants or wind energy farms that were in place, under construction, or in the planning stage. The survey asked if the county had specific cost information relative to these facilities either during construction or as on-going roadway maintenance activities. At the November 2008 meeting, the TAC was given a draft of the survey for its review. A revised survey questionnaire (see Appendix A) was sent to all 99 Iowa counties.

Initially, 42 responses were recorded for a 42% response rate. A second survey was distributed to the remaining 58 counties at the 2008 Iowa County Engineer's Association (ICEA) conference. In mid-December, a final request was sent to counties with bioenergy plants or wind energy farms identified by Iowa DOT references but who had not yet responded to the survey. The last two efforts resulted in 54 responses (54% response rate), for a total response rate of 96%. The data was tabulated and made available for use in the project, as shown in Table 3.1.

Table 3.1. Biofuels and wind energy survey responses (by county)

			Biofuels County Survey							
			1	2	3	4	5			
County No.	Name	Date Rec'd	Any Involvement	Ethanol Plant?	Biodiesel Plant?	Wind Turbine Farm?	CoGeneration Facility?	Info Avail?	Info Share?	Comments or Contact Info
1	Adair	11/18/2008	Y	N	N	Y	N	Y	Y	85% complete - Online 12/31?
2	Adams	11/26/2008		O - 4/2007	N	N	N	N		
3	Allamakee	11/21/2008	Y	P	N	P	N	N	Y	
4	Appanoose									
5	Audubon	11/21/2008	N							
6	Benton	1/29/2009	Y	Y	N	N	N	N	n	Small (50 mil gallons) ~ 15 years ago; 4th? Owner
7	Black Hawk									
8	Boone									
9	Bremer	11/17/2008	N							
10	Buchanan	17-Nov-08	Y	O - 5/2007	N	N	N	Y	Y	Art Gourley
11	Buena Vista	11/17/2008	Y	P+O - 2006	P	3O-2-'99,1-'05	N	N	N/A	
12	Butler	11/17/2008	Y	O - fall 2008	N	N	N	N	N/A	
13	Calhoun	11/20/2008	N							
14	Carroll	11/17/2008	Y	N	O ~2002	O - 2007	N	Y	Y	
15	Cass									
16	Cedar									
17	Cerro Gordo	12/18/2008	Y	O -2003	O- 2004/2005	O - 1998	N	Y	Y	Ethanol & Biodiesel Plants both in Mason City
18	Cherokee	11/20/2008	Y	O	N	O -2003	UC	N	Y	Not yet built- currently idle
19	Chickasaw									
20	Clarke	11/17/2008	Y	N	P	N	N			
21	Clay									
22	Clayton									
23	Clinton									
24	Crawford	11/17/2008	Y	O - Sep 2005	N	O - Mar-2007	N	Y	Y	
25	Dallas	17-Nov-08	N							
26	Davis	20-Nov-08	N							Animal Confinement prob. Pulling fee trucks w/ dozer
27	Decatur									
28	Delaware	11/20/2008	Y	2O- < '00& '08	N	N	N	Y	Y	
29	Des Moines	11/28/2008	Y	O - 2004	N	N	N	Y	Y	
30	Dickinson	11/17/2008	Y	O - 2007	O - 2002	O - 1993	N	N	Y	Shut down in 2005 - economics
31	Dubuque	17-Nov-08	N							Biodiesel in City of Farley
32	Emmet	11/17/2008	Y	N	C - Rendering	P+O ~ 2006	P+O	N	Y	
33	Fayette									
34	Floyd	12/3/2008	Y	O	N	P	N	?	Y	Verbal Info @ ICEA CONF
35	Franklin									
36	Fremont	12/22/2008	Y	O	N	N	N	N	N	Plant is just west of Page county line into Fremont
37	Greene	17-Nov-08	Y	C & O 2005	N	Op - 2007	N	N	N	
38	Grundy									
39	Guthrie									
40	Hamilton									
41	Hancock	11/17/2008	Y	P	N	2 O - 2002 & '08	N	N		General knowledge only
42	Hardin	12/18/2008	Y	O-2002?	O - 2003 ?	P-2009	N	N		
43	Harrison									
44	Henry									
45	Howard									
46	Humboldt	11/18/2008	N							
47	Ida	12/18/2008	Y	O-2006 +2008	C	P	N	Y	Y	
48	Iowa									
49	Jackson									
50	Jasper	11/17/2008	Y	N	O - 2006	O-2007	N	Y	Y	Blades and towers built in Newton
51	Jefferson	11/17/2008	N							

			Biofuels County Survey							
			1	2	3	4	5			
County No.	Name	Date Rec'd	Any Involvement	Ethanol Plant?	Biodiesel Plant?	Wind Turbine Farm?	CoGeneration Facility?	Info Avail?	Info Share?	Comments or Contact Info
52	Johnson									
53	Jones	17-Nov-08	N							
54	Keokuk	11/17/2008	N							
55	Kossuth	17-Nov	Y	P&O 2005	O 2007	P	N	Y	Y	Doug Miller - Asst Engr
56	Lee									
57	Linn	17-Nov-08	Y	O - 1980	N	N	N	N	Y	Steve Gannon
58	Louisa									
59	Lucas									
60	Lyon									
61	Madison									
62	Mahaska									
63	Marion	17-Nov-08	N	P						Plans on Hold
64	Marshall	11/17/2008	Y	N	N	N	P	Y	Y	
65	Mills									
66	Mitchell	11/18/2008	Y	O - 2008	N	O-2008	N	Y	Y	
67	Monona									
68	Monroe	11/17/2008	Y	O - 1992	N	N	N	N	N/A	
69	Montgomery	11/25/2008	N							
70	Muscatine									
71	O'Brien									
72	Osceola	11/17/2008	Y	O-2005	N	O-2008	N	N	Y	
73	Page	11/25/2008	N							Plant is just west - In Fremont County
74	Palo Alto	11/20/2008	Y	O-2005	N	O -2007	N	N	Y	10 Turbine farm; Lots of deteriorating roads-hard to s
75	Plymouth	11/17/2008	Y	P + O -2008	N	N	N	N	Y	
76	Pocahontas	16-Nov-08	Y	N	N	Op - 2007	N	N	Y	Jack Moellering
77	Polk									
78	Pottawattamie									
79	Poweshiek									
80	Ringgold									
81	Sac	11/20/2008	Y	N	O-2006	O - 2004	N	N		
82	Scott									
83	Shelby	11/21/2008								
84	Sioux									
85	Story	11/17/2008	Y	O - 2006	N	O - 2008	N	Y	Y	
86	Tama									
87	Taylor	11/26/2008	N							
88	Union									
89	Van Buren									
90	Wapello									
91	Warren	11/17/2008	N							
92	Washington	11/24/2008	Y	N	2O- '07	P	N	N	N	Planning 30 unit turbine farm
93	Wayne									
94	Webster	11/17/2008	Y	C+2O -'05&'06	N	N	N	Y	Y	Jamie Johll - Ast Engineer
95	Winnebago									
96	Winneshiek									
97	Woodbury	12/19/2008								In city?? Survey to Economic Development Director
98	Worth	11/18/2008	Y	O - 2003	N	O - 2003	N	Y	Y	
99	Wright	12/3/2008	Y	O-??	N	N	N	??	Y	Verbal Info @ ICEA CONF

Following the survey, data tabulation maps were developed to show the current facilities in each county (see Figures 3.2 through 3.5).

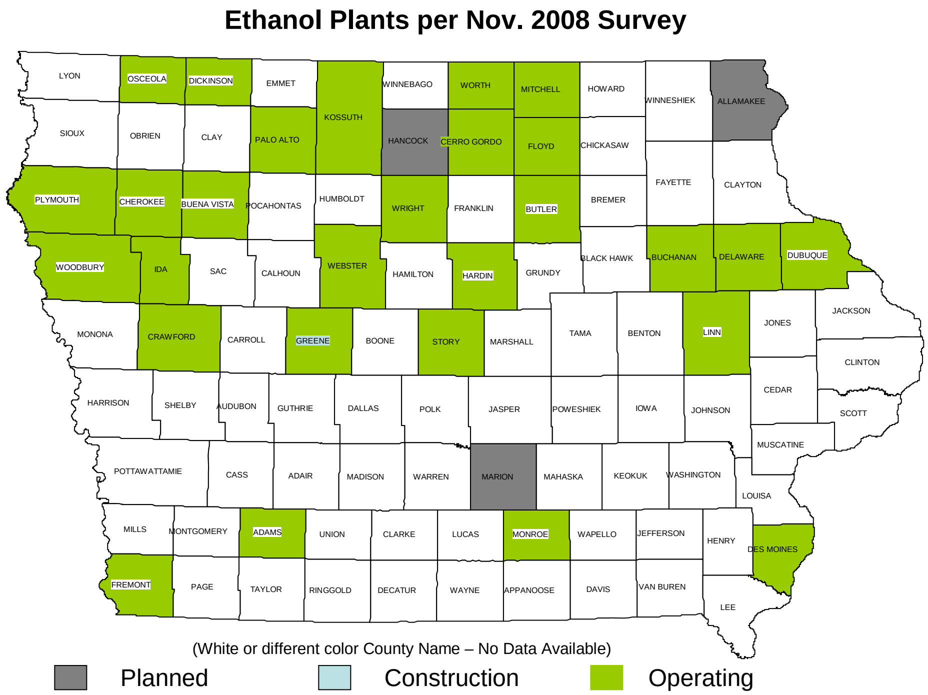


Figure 3.2. Counties with ethanol plants

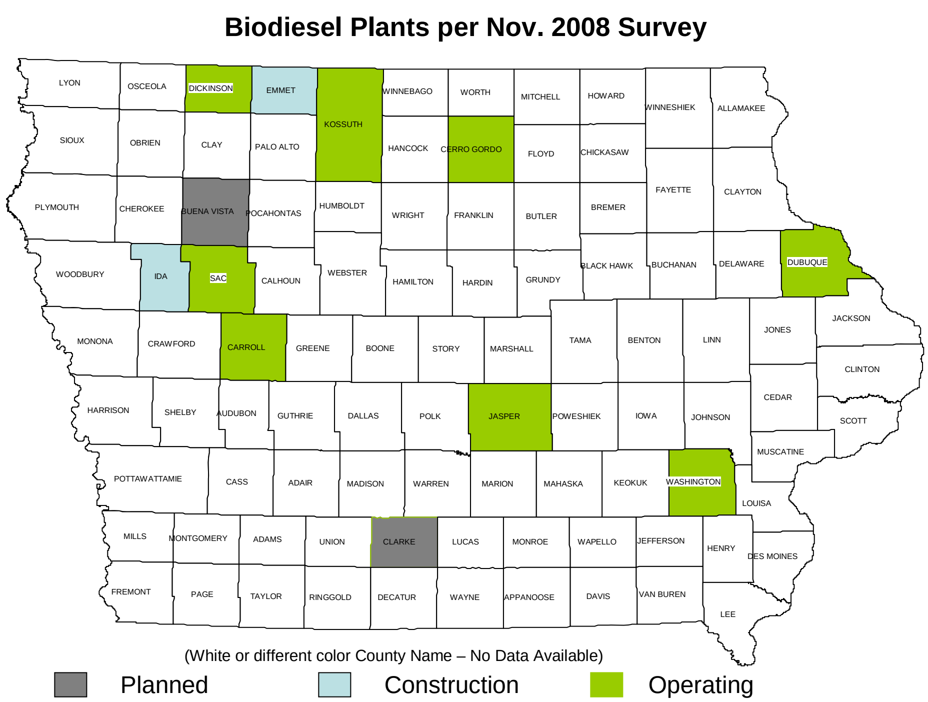


Figure 3.3. Counties with biodiesel plants

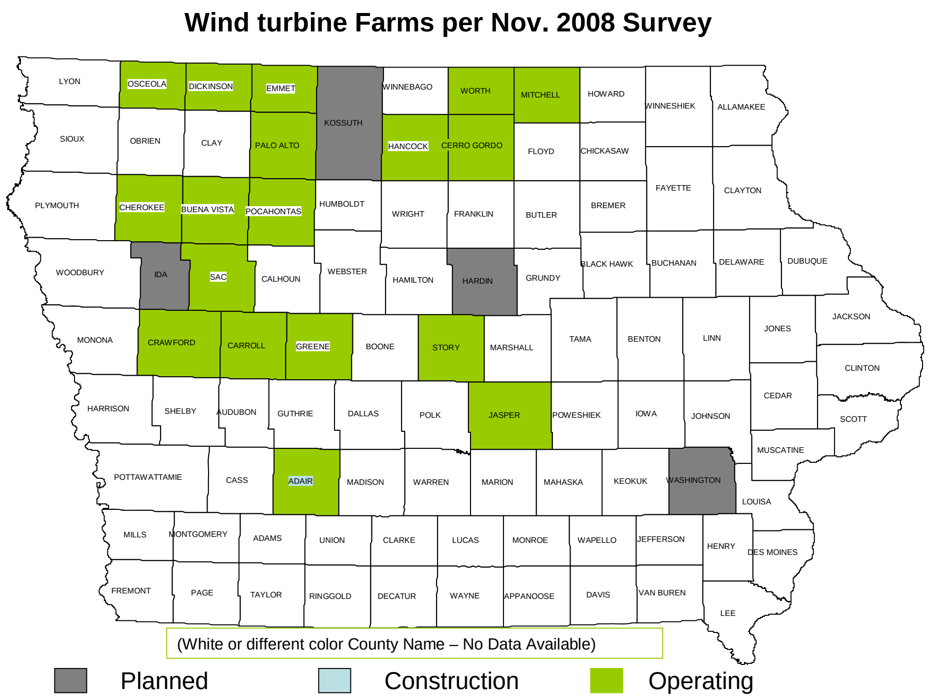


Figure 3.4. Counties with wind energy farms

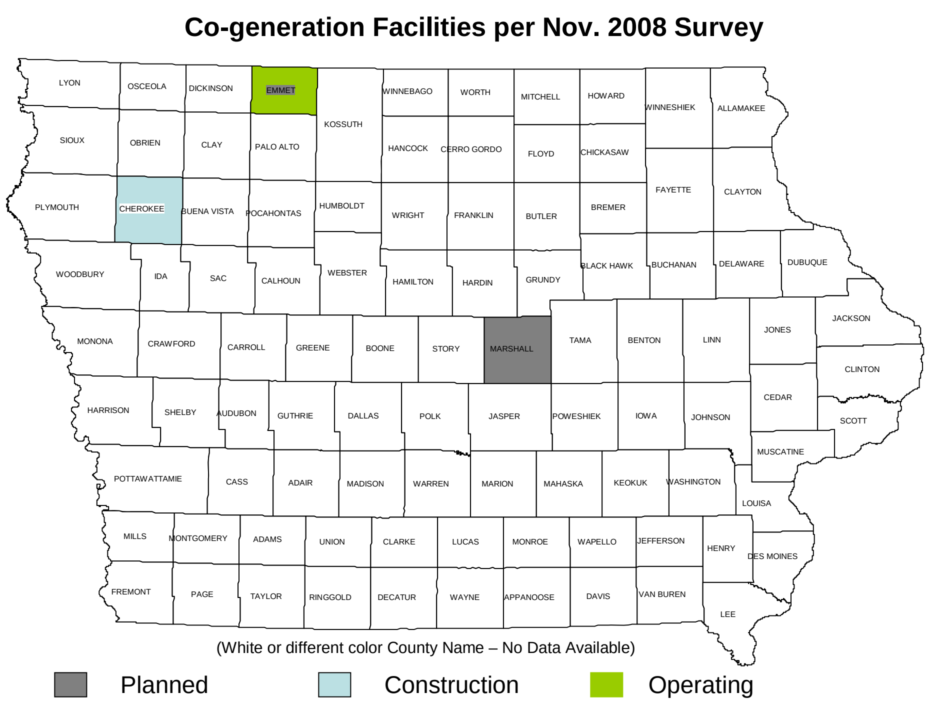


Figure 3.5. Counties with co-generation facilities

Researchers were able to use these maps and the corresponding data initially collected (shown in Table 3.1) to visually locate potential counties for further examination and detailed personal interviews. A four-county cluster in north-central Iowa (see Figure 3.6) was identified as having a large number of varied facilities. Some facilities had been in operation for an extended period. In addition, the size and locations of these plants indicated that some of them probably influenced the traffic patterns of adjoining county roads. Financial and maintenance information was available for Worth, Mitchell, Cerro Gordo, and Floyd Counties, and these counties were selected for further analysis.

Figure 3.6. Four-county cluster in north-central Iowa

3.3 Maintenance Cost Analysis: North-Central Counties

Historical maintenance cost data was provided by the Iowa County Engineer's Service Bureau for the four counties of Worth, Mitchell, Cerro Gordo, and Floyd. The data source was the Iowa's county engineers' annual report which is prepared by the county engineer and filed annually with the Iowa DOT. These reports utilize a standard accounting system for all road department expenses. The expenses are subdivided into maintenance expense categories that are coded by three-digit numbers. A full listing of all potential expense categories is shown on the Iowa DOT website:
http://www.iowadot.gov/local_systems/publications/county_im/im_2_071.pdf.

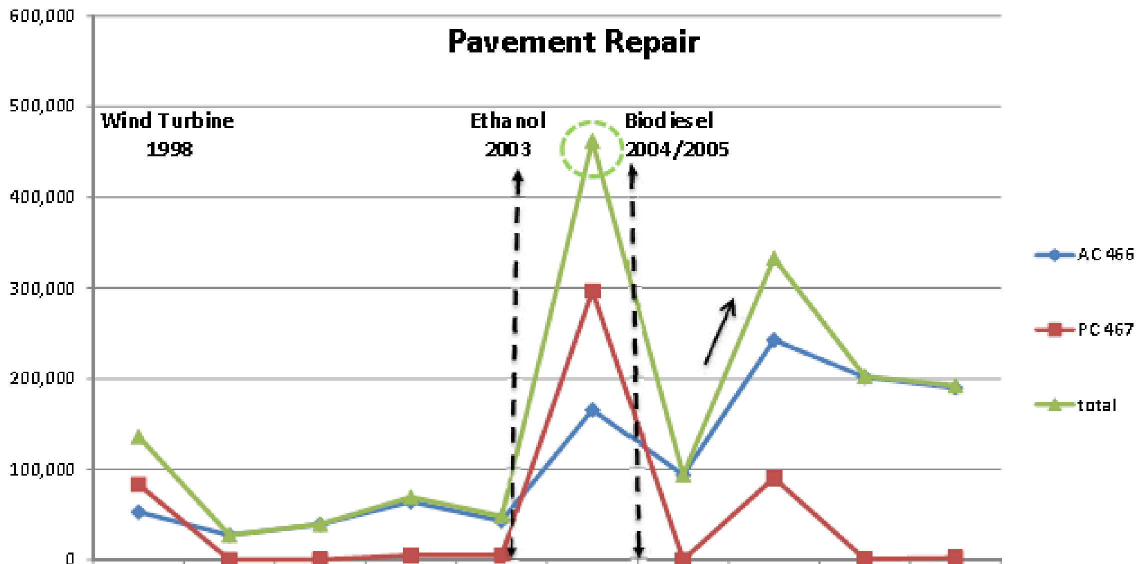
The cost categories selected for this review included only the following (along with combinations of all of the following categories):

420—Bridge repairs (materials and county or contract labor expenses for maintenance)
461—Granular (surfacing and hauling labor)
451—Blading (road maintenance labor)
466—Asphalt pavement repairs
467—Portland cement concrete (PCC) pavement repairs
521—Snow & ice control (labor for pavements)
522—Snow plowing (labor for gravel roads)

These categories were selected because they are the most representative of where maintenance expenses would increase if there were a fiscal impact to the transportation system due to renewable energy facility construction or operations.

Road maintenance costs for the period 1999 through 2008 were graphed and reviewed. The research team expected to find that the heavy usage of the roads around a biofuels plant or a wind energy farm when these facilities were built would create a visible “spike,” or increased cost. If there were “spikes,” the conclusion would be that the additional costs were associated with the renewable energy facilities. If this were true, all of the counties in the cluster would show the same trend or “spike” after the construction of renewable energy facilities.

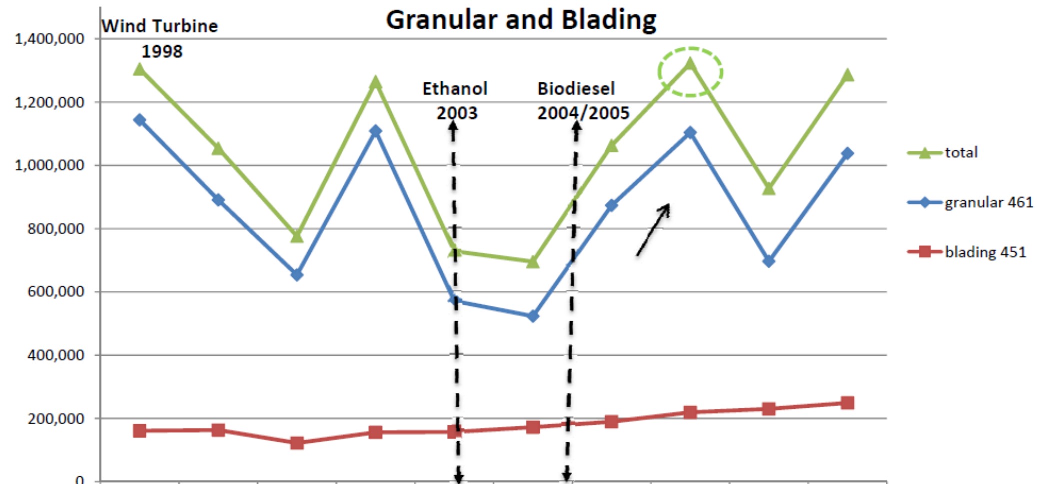
Graphs of the data for each of the four counties were prepared, showing recorded annual expenditures by category and noting the year the facility was constructed. A sample graph for Cerro Gordo County is shown in Figures 3.7 through 3.10. The trends shown in the graphs are discussed after each figure. A full set of the trends in the maintenance costs for each of the selected counties is shown in Appendix B.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AC 466	52,716	27,276	38,985	64,099	42,929	165,435	93,618	242,526	201,403	189,854
PC 467	83,200	168	229	5,105	5,209	296,711	61	90,332	892	2,121
total	135,916	27,444	39,214	69,204	48,138	462,146	93,679	332,858	202,295	191,975

Figure 3.7. Cerro Gordo County annual expenses for pavement repair

Figure 3.7 revealed the anticipated spikes in both asphalt concrete (AC) and portland cement (PC) concrete pavement repairs in the year following the start of operations of the ethanol plant in 2003 and again two years after the start of operations at the biodiesel facility. Verifying these results and searching for the tie to the new plants was one of the detailed questions for the county engineer.



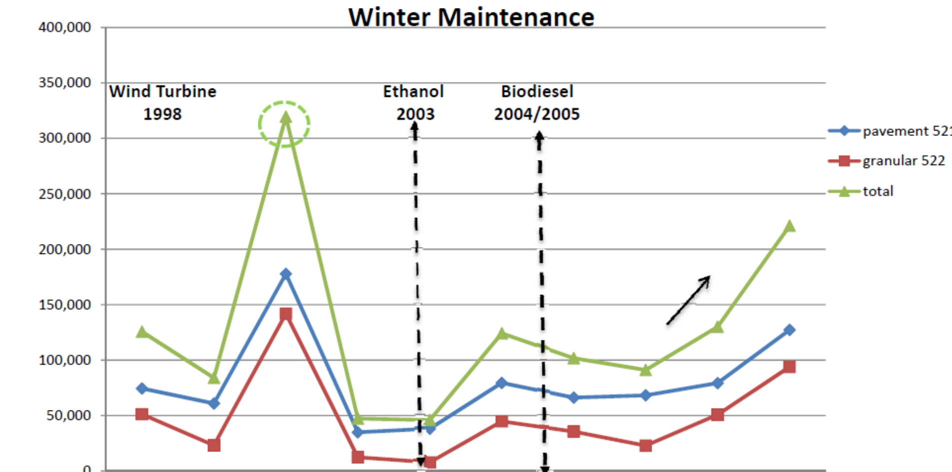
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total	1,304,53	1,053,80	775,706	1,264,45	728,479	695,431	1,062,79	1,322,85	926,858	1,286,60
granular 461	1,143,58	890,673	653,492	1,108,51	571,408	523,190	873,257	1,103,78	696,667	1,037,81
blading 451	160,948	163,134	122,214	155,937	157,071	172,241	189,534	219,068	230,191	248,797

Figure 3.8. Cerro Gordo County annual expenses for granular and blading

Figure 3.8 revealed several spikes in granular surfacing, including the year the wind turbine farm began operation, the year before the ethanol plant began operating (which may be weather-related), and two years after operations began at the biodiesel facility.

The blading labor costs rose steadily from $157,071 in 2003 to $248,797 in 2008. This could indicate not only additional effort required to maintain the overall road conditions but also a potential shift in the level of maintenance provided to a new group of roads (those that were bringing loads to the plant).

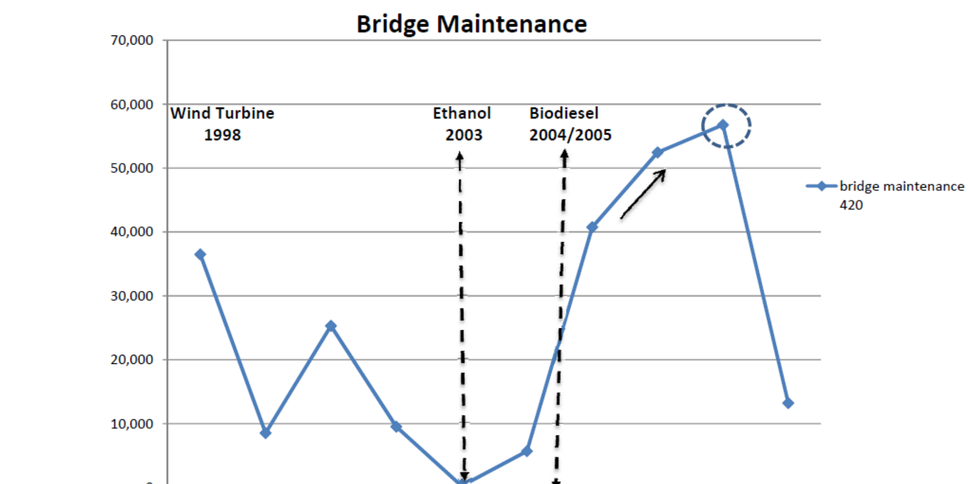
More questions were generated for the engineer.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
pavement 521	74,402	60,883	177,793	34,863	38,125	79,430	66,164	68,222	79,282	127,236
granular 522	51,202	23,067	141,756	12,389	7,790	44,720	35,545	22,829	50,752	93,846
total	125,604	83,950	319,549	47,252	45,915	124,150	101,709	91,051	130,034	221,082

Figure 3.9. Cerro Gordo County annual expense for winter maintenance

Figure 3.9 revealed several spikes in the snow removal category in 2001, 2004, and again in 2008. Further review showed very similar spikes in 2001 in all four north-central counties. Upon investigation, history revealed that Iowa experienced a very severe winter season in 2008 The remaining two spikes still appeared to indicate that there was increased use of the roads for delivering grain to the facilities during the winter season.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
bridge maintenance 420	36,501	8,530	25,309	9,530	250	5,693	40,753	52,445	56,764	13,227

Figure 3.10. Cerro Gordo County annual expenses for bridge maintenance

The bridge maintenance expenses shown in Figure 3.10 reveal definite spikes in both 1999 and 2007. Bridge damage could have been caused by heavy loads associated with the wind farm construction. Following the bio-facilities openings, bridge damage could possibly have been caused by extreme stresses due to heavy and repeated loadings of grain carts and trucks.

Nearly each set of county graphs appeared to contain some unique spikes, and the authors believed they had substantive evidence of increased costs from the renewable energy facilities. Based on the annual report information and the graphs created with that information, the research team developed questions in preparation for interviews with the county engineers. Each county's graphs and the research team's preliminary thoughts were forwarded in advance to the four north-central county engineers for their review.

3.4 County Engineer Interviews

The north-central Iowa counties (and the engineers) that were chosen for interviews were

Mary Kelly, PE, Cerro Gordo County
Dusten Rolando, PE (also engineer for Chickasaw), Floyd County
James Hyde, PE, Mitchell County and Worth County

The interview was held jointly with all three of the county engineers for the four counties on February 24, 2009 in Mason City, IA. Copies of all notes and cost data received from them at that meeting are included in Appendix C. The many instances in the graphs where spikes or increasing cost conditions occurred soon after the renewable energy facilities were constructed were noted. However, during the interviews, the research team was repeatedly told that most of the spikes and increasing costs trends were coincidental expenses under the "normal" varying maintenance conditions. The following notes are examples of the explanations given by the engineers for the variations:

- Buying additional road rock for next year's stockpile during a fiscal year when funds were available
- Combining bridge repair funds from two or more years into one bridge repair contract to encourage lower bid prices
- Spending additional funds from the Federal Emergency Management Agency (FEMA) a year or two after a local disaster

The only positive correlation made from the county maintenance cost graphs was that all of the counties' costs were unusually high in winter snow removal and gravel road maintenance for 2001. This common increased expenditure spike assured the research team that the maintenance cost data was relevant and detailed to the extent that trends can be identified.

All the county engineers interviewed did agree on several issues:

- Bioenergy plants or wind energy farms had initially cost the counties a substantial amount of money.
- The damage (and subsequent repair costs) to county roads was a result of the following:
    - For wind energy farms, the major damage occurs during construction activities and on granular roads. In addition to routine maintenance repairs, additional damage becomes evident in 1-1½ years after construction. The

roads impacted were used as haul roads for heavy transformers, other turbine parts, and multiple loads of construction materials.
    - For biofuels plants, the road damage that occurs is not during plant construction. The damage is on-going and due to the continual hauling of raw product to the plant and finished products to market.
- The delivery patterns of corn to the ethanol plants changed since the plants began operating. Originally, the corn came directly from the fields as it was harvested. Now, the corn most often goes to a farm cooperative for temporary storage and is later hauled to the ethanol plant. This process often results in concentrated haul routes and heavy loads on fewer roads.
- The engineers recognize the political popularity and benefits of the biofuels plants and wind energy farms, as well as the potential for road damage and increasing maintenance costs. In order to compensate, they have adjusted pavement design standards to a higher level (at an additional cost) to provide for the increased heavy loads.
- Local county and city leaders still feel that the additional costs associated with these operations are a positive for the county/city in terms of economic growth and local employment. Many counties promote the construction of biofuels plants. They may have enticed the renewable energy industry with cash, infrastructure matches, tax abatements, Revitalize Iowa's Sound Economy (RISE) projects, etc. The trend of enticing renewable energy companies to construct in the county will probably continue in the future.

3.4.1 Biofuels Plants Impacts

All four north-central Iowa county engineers stated that they had incurred increased maintenance costs on many of their county roads due to the biofuels plants. Initially, these increased costs were on the gravel roads in the fall and spring when most corn is hauled from farms to the plants. Maintenance activities were adjusted to reduce the maintenance on other roads in the county in order to balance their annual budgets. Many of the counties have now found that the paved roads leading to biofuels plants are showing distress. Because of the restricted maintenance budgets, none were surprised that the cost history data didn't reflect the impacts. The county engineers spent the same amount on total maintenance, but the portion on roads adjacent to biofuels plants increased. Typically, an increased amount of grading is done on the more heavily traveled roads and a reduced amount is done on the rest of the system.

The paved road (S10) north of Joice in Worth County has experienced subsequent damage. The damage is associated with the increased corn hauling to this plant. The road is asphalt and was resurfaced only four years ago (in approximately 2004). Heavy truck traffic has already created two- to three-inch ruts in the pavement surface. The ruts are a hazard that tends to make vehicles lurch unexpectedly when one drives in and out of them. They also hold water, causing a hydroplaning in warm weather and slick spots in cold weather. The county engineers feel that they have been left with a liability exposure until this road can be repaired or rebuilt. Today, Worth County estimates that 65% of the corn for the ethanol plant at Hanlontown is coming from the north and uses County Road S10.

Floyd County has experienced changes in delivery patterns. Corn deliveries from adjoining Chickasaw County have increased substantially. Most of the corn appears to be coming from cooperatives. Corn is moved from the farm to the cooperative at harvest time. Then, depending on market value and the demand for corn, the corn is moved from the cooperative to the ethanol plants. As mentioned earlier, the research team expected to see corn delivery from a homogenous radius around ethanol plants. Both of these examples show that corn supplies are not homogenous and that the renewable fuels plants impacts are not constrained by jurisdictional boundaries. They will impact transportation facilities in adjacent counties.

3.4.2 Wind Energy Farms Impacts

Construction of wind energy farms requires a large number of heavy vehicles. The concrete base for each of the 130 wind towers in Mitchell County contains 550 cubic yards (55 to 60 loads on 7 cubic yard trucks) of concrete. Transport equipment used to move the cranes used to set in the towers to a site are very heavy. See Figure 3.11.

Figure 3.11. Crane being readied for tower erection work (photo courtesy of Mitchell County)

While most of the heavy lifting done by the heavy cranes during the tower erection process is off the public road right-of-way, moving the cranes from site to site can easily cause extensive road damage. Transporting heavy electrical transformers to the towers may be extremely damaging to the roads when there is wet weather or frost on the roadway in the spring. The transformers weigh about 1½ million pounds each and must be permitted for overweight travel. They are transported on very long, multi-axle trailers. The effects of the overweight vehicle are evident by the road rutting shown in Figure 3.12.

Figure 3.12. Electrical transformer en route to power station (photo courtesy of Mitchell County)

Because these large hauling units require many axles and are very long, turns at intersections are especially challenging (see Figure 3.13). Some haulers use trailer units with rear axle steering to reduce the turning radius. Hook and ladder fire trucks use the same concept on their trailers. These rear steering trailers are often used for the much longer but lighter loads of wind turbine blades. Turning radii for all of these long units require additional roadway width at intersections and driveways along the route. More details about requirements and design standards for these radii are presented in Chapter 6 of this report.

Figure 3.13. Heavy hauler maneuvering a turn (photo courtesy of Mitchell County)

Transportation infrastructure damages and associated costs relating to wind farms have been difficult to quantify.

1. In Mitchell County, the construction company crushed and hauled all of the aggregate necessary to maintain and repair the granular roads. No cost records are available for this expenditure. The county engineer does know that a considerable amount of surfacing material was placed on county roads during the construction phase.

2. Floyd County experienced very little road damage because most of their wind farm was constructed during the winter months when the roads were frozen.
3. Cerro Gordo County had few records from their initial 1998 wind farm construction. The board of supervisors' resolution on file noted that the applicant was responsible for maintaining the roads and repairing all road damage. Surfacing materials for the 2006 wind farm expansion were hauled primarily on U.S. 65 and thus did not impact county maintenance costs.
4. In Worth County, the county performed the required maintenance work. The construction company was billed $38,650 for that work. After moving of one of the heavy transformers, a road paved with 8½ inches of asphalt was left with ruts over 1 inch deep. These ruts were filled with slurry but could not be repaired effectively.

3.4.3 Pavement Designs

The heavy truckloads that county roads are being subjected to during renewable energy site construction may be devastating. The resulting costs to the counties for repair or reconstruction are considerable. Normal county pavement design would involve trying to predict the total traffic volume at the end of the pavement's design life and then applying a percentage of trucks based on anticipated industry growth in the area. This estimate would provide the number of ESALs (the basis of pavement thickness design formulas) that the road would carry during its life cycle. However, the operations of area bioplants in north-central Iowa have altered several of these formula components, yielding poor predictive results. If a plant is developed and constructed during the life of an improved roadway segment, the roadway's life is substantially shortened. In an effort to prevent this, the pavement design standards in three of the four north-central counties have been artificially upgraded in order to better accommodate the heavier truck traffic loads in any area of anticipated growth. Mitchell and Worth Counties now design their pavements for 10 million ESALs for roads that connect cooperatives to biofuels plants. Floyd County has raised the pavement design standard from 100,000 to 300,000 ESALs for the same anticipated roadway usage. A more accurate estimate of future traffic patterns for these facilities would certainly help reach some standard of need.

Despite the increased pavement design standards for new roadways, the older roads often need maintenance work before new facilities are constructed. All four county engineers agreed that their Boards of Supervisors are aware of this fact and recognize the associated impacts to the roads. Many times the supervisors feel that the need for economic growth and jobs in their county overrides the negative points and increased transportation infrastructure maintenance costs associated with the plants.

In some of Iowa's first biofuels plant locations, the plant/farm developer had a considerable amount of bargaining power when many competing sites were available. Cerro Gordo County made an agreement for infrastructure improvements through expanding a biofuels plant, knowing that the property was going to be annexed by the city. Some division of cost was made in anticipation of future tax revenues. Additional consideration of the "common good" or "balancing the scales" has begun to take place in Mitchell and Worth Counties, where they have formed Tax Increment Financing (TIF) districts for wind energy farms. The TIF raises revenue for future road repair and construction work associated with the wind energy farms. These two counties have over $15 million of TIF-funded work budgeted for pavement overlays (pavement strengthening) over the next two years. In addition, Mitchell County has passed a "Road Preservation Ordinance," which allows the county to collect repair money for road damages caused by the renewable energy industry.

3.4.4 Impacts to Bridges

None of the four county engineers have noted damage to their bridges that they could directly relate to the biofuels plants or wind energy farms. They did agree that hauling raw material to the plants (both now and in the future) will continue to stress their aging bridges. Figure 3.14 shows how continued stress can impact bridges.

Figure 3.14. Bridge failure under grain cart (photo courtesy of Audubon County)

Although Figure 3.14 does not represent a specific bioplant incident, this grain was being hauled in a grain cart on a public roadway to some destination that could have been bioplant-related. The excessive weight of the grain and cart has obviously destroyed one span of this bridge and very likely damaged bridge members in other spans.

3.5 Maintenance Cost Analysis: Southeastern Counties

In May 2009, additional counties were contacted to determine if the data the research team had developed and the results obtained from the north-central county interviews were typical and representative. The research team wanted to test the theory that variations in terrain and soil types may make quantifiable differences in increased maintenance costs due to the biofuels plants and wind energy farms. The following counties were contacted for information:

- Ethanol Plants—Adams, Freemont, and Crawford Counties; Des Moines County added later
- Biodiesel Plants—Jasper and Washington Counties; Lee County added later
- Wind Farms—Carroll and Sac Counties

Figure 3.15 shows the location of each of these counties.

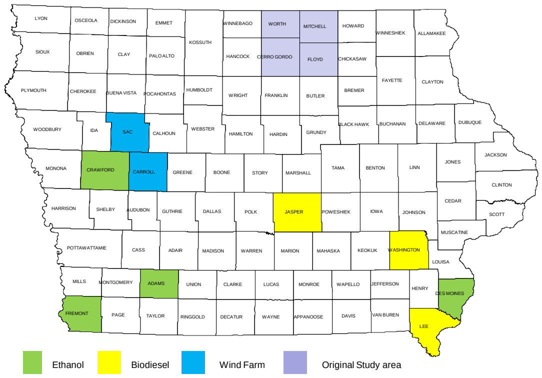


Figure 3.15. Additional counties reviewed for information

Des Moines and Lee Counties were identified from preliminary maps as possible contacts that may have information and be willing to assist the research effort. Graphs of expenditure trends were developed for those two counties. The data and the research team's interpolation of that data were sent to the county engineers for review and comments.

The research team's evaluation of the surveys and maintenance cost history supported the same ideas and concepts that had originally been identified for the north-central counties. Maintenance cost graphs for these counties are included in Appendix D.

3.5.1 Biofuels Impacts

In-person interviews with Des Moines and Lee Counties were scheduled but, due to a scheduling conflict, Lee County's was conducted by phone. The county engineer, Ernie Steffensmeier, said the bioplant in Lee County (Tri-City Energy) is located in the City of Keokuk and that all the raw materials are shipped on state highways. The same is true for the finished products. Ernie has seen no problems on the county roads due to the construction or operation of this plant. Likewise, he has made no changes to any of his maintenance operations or design standards because of this plant.

Des Moines County Engineer Brian Carter was interviewed on July 9, 2009. Items discussed included his experiences, challenges and reactions to the ethanol facilities in his county, and any changes that he has made to the county's maintenance and design standards. The county's gravel roads have been significantly affected, mostly because of the soft road in spring and summer 2008. In reviewing the expenditure analysis graphs for Des Moines County, Brian's feeling was that the spikes shown for pavement repair, winter maintenance, and bridge maintenance had little correlation to the plant operation. Although he felt that the plant operated directly correlated to the expenditure for granular surfacing, the fact that Des Moines County had some severe winter/spring weather the previous two seasons was also a major factor. He, like the other engineers interviewed, emphasized that the expenditures only represent what he can spend with his allocated budget—not what needs to be spent to repair all damages. Brian has not seen a big transition in haul routes (more from elevators) and, in fact, noted that there has recently been a lot of storage bin construction. He believes that many corn producers hold their saleable crop longer to get the highest price. Because of their lack of storage capacity, the elevators have remained filled and have limited their ability to accept new crops. Therefore, the area product still comes in from all directions. One other item of interest was that the ethanol plant would take wetter corn (up to 17% moisture) than the elevator without a penalty. During the past wet seasons, local farmers could take their crops to the ethanol plant and avoid docking and/or drying charges.

In an effort to entice the ethanol plant to locate in Des Moines County, the Board of Supervisors agreed to the expenses of the road work and a highway interchange construction cost. In addition, the board agreed to a tax abatement that allows no taxes to be collected during the first 10 years of operation and then limits taxes by using only 10% of the property valuation during the next 10 years. No additional funds from other sources have been granted to the county road department for the additional maintenance costs incurred. Brian feels that the political attitude toward this type of "economic growth" has not changed and that his board would make the same decision today, except for not allowing as much of a tax break over the 20 years.

Because Brian farms with his father, the research team asked if he had any insight into the future of alternate materials, such as switch grass, corn stalks and cobs, or wood fiber. He thought that many in his area used no-till farming techniques and that they would be very slow to begin selling the stalks, which are used as crop nutrients. He also did not believe that a pipeline would be a feasible method of ethanol transportation because of the cost. As an example, the county has a landfill and had considered selling some of the methane it produced to the ethanol plant via a new pipeline. The idea was abandoned once potential construction costs were developed.

In addition to transportation considerations, fire services are a problem for many rural ethanol plants that are protected by volunteer departments. The volunteer departments are simply not equipped to handle an ethanol fire, especially a large fire at an ethanol plant.

3.5.2 Pavement Designs

Because of recent new construction in Des Moines County (noted later in this report), little pavement deterioration has been noted from the increasing traffic since the ethanol plant began operating in 2004. However, a growing trend seems to be that truck traffic from the north gets off U.S. 61, travels west on Flint Bottom Road to Beaverdale Road, and then comes south to the plant, as shown in Figure 3.16.

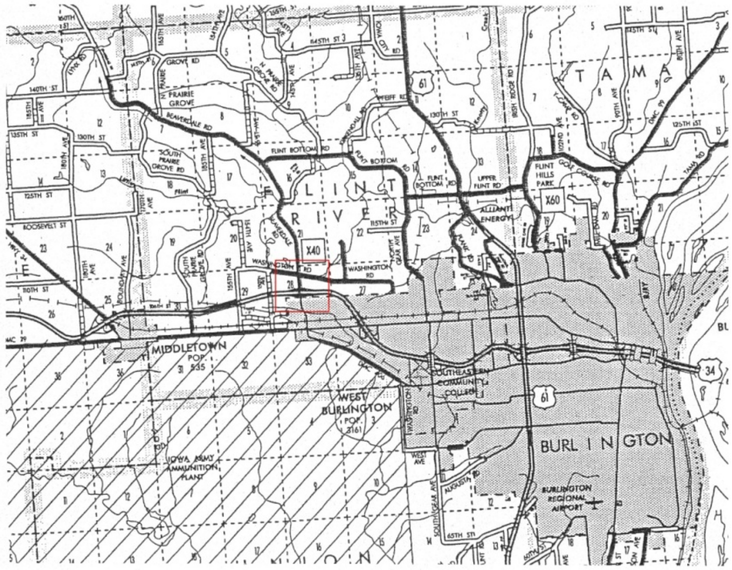


Figure 3.16. Location of Des Moines County ethanol plant

Flint Bottom and Beaverdale Roads seem to be the most vulnerable to the truck increase, although no damage has become apparent. The research team discussed design standards and Brian has not really had to face that issue yet because many of his roads were resurfaced just before the plant began operating. On his last road project, Brian did use cold in-place recycling in addition to adding resurfacing to try to build in more strength. He currently has no fixed ESAL requirements but will be analyzing these requirements closely when he prepares for work on Beaverdale Road.

3.5.3 Impacts to Bridges

Brian agreed that semi-trucks have become the norm for transporting crops for most farm operations. He anticipates that a bridge located on Beaverdale Road will need to be replaced sooner than normal because of the plant operations. Brian has just completed bridge inspections for several county bridges. The Beaverdale bridge will require a posting for one-lane traffic or posting a weight limit restriction.

3.6 Construction Costs were Augmented

Initial infrastructure construction costs were incurred by the counties. This fact was substantiated by reviewing their payment documents, which revealed the following:

1. Paving projects before the construction of the ethanol plants in both Worth County ($222,003) and Mitchell County ($387,820 with $201,800 RISE funds) were designed and monitored by the counties' engineering forces; however, the contracted costs were partially paid with RISE funds and partially with county funding. The cost of the paving located north of the town of Manly where the ethanol storage site was built was paid using casino (gambling) revenues ($30,767).

2. A RISE grant was obtained for part of the infrastructure work needed in both Cerro Gordo and Floyd Counties. Cerro Gordo County's latest project for its ethanol plant road was a joint city-county-RISE–funded endeavor. It was a three-mile road project combined with the installation of utility lines to provide service to the new plant. RISE funds ($312,000), city funds ($589,000), and county funds ($1,770,542) allowed this $2.875 million project to be completed. The property was annexed within a year after project completion and now primarily provides revenue back to the city. In addition to the site reviews and normal permitting for new and widened drives and entrances, Cerro Gordo County dedicated some of its Local Option Sales Tax (LOST) revenues to additional costs incurred with its latest wind farm expansion.
3. Floyd County's RISE project for road turning lanes and improvements was a $1.5 million cooperative project, with its ethanol producer (VeraSun) contributing $100,000, RISE providing $312,000, and the county contributing $1.1 million toward the effort. Drive and entrance work on the wind farm project was all done by the contractor, so little additional construction expense was incurred. Damages and resulting costs for the roads relating to ethanol plants were noted by some of the engineers to be quite severe in some instances. For example, the pavement leading to the plant from the south has deteriorated considerably since the plant opened. Several of the three- to four-inch asphalt roads in the area are also showing stress from the heavy traffic. Dusten Rolando, county engineer in Chickasaw County, also sees the beginning of distress on those county roads that are used to haul material to the Charles City plant.
4. Des Moines County received a RISE grant for a paving project of one mile of portland cement concrete north of old U.S. 34 up to Beaverdale Road, which was already paved. The plant is located in the middle of that mile, and the new road provides access from either end via a paved connection. The construction costs for the Beaverdale interchange off U.S. 34 and 103rd Street (the actual plant road) were split as shown in Table 3.2.

Table 3.2. Breakdown of ROW and construction costs for highway improvements

Beaverdale Interchange	Des Moines County	West Burlington	BADCO	TOTAL
Interchange R.O.W.	$31,403.00	$31,403.00	$31,403.00	$94,209.00
Interchange Grading	$63,919.74	$63,919.74	$0.00	$127,839.48
*includes consultant fees				
Interchange Paving	$642,029.26	$0.00	$0.00	$642,029.26
103rd St. (Ethanol Road)	Des Moines County	West Burlington		TOTAL
103rd St. R.O.W.	$73,687.50	$19,900.00		$93,587.50
103rd St. Grading	$238,365.59	$94,710.47		$333,076.06
*includes consultant fees				
103rd St. Paving	$714,353.90	$135,140.78		$849,494.68
*includes consultant fees				
TOTALS	$1,763,758.99	$345,073.99	$31,403.00	**$2,140,235.98**

GRANTS	
RISE Grant	$500,000.00
EDA Grant	$500,000.00
TOTAL	**$1,000,000.00**

Brian Carter indicated that, although the plant is located outside the city limits of Burlington, the city had also provided a portion of the funds needed to get the plant to come to their area. Old U.S. 34 had been resurfaced before being transferred to the county's jurisdiction just a few years ago, so it was, and still is, in pretty good condition. The new road paving project was 10-inch thick PCC, which is thicker than the 8 or 9 inches Brian normally would use on his other roads. Traffic prior to plant construction had caused another county route, Washington RD, to deteriorate. This route runs east and west along the north end of the new plant road and was formerly under state jurisdiction. Knowing the plant was coming, the road was scheduled for needed rehabilitation work that was completed about the same time that the plant became operational. Therefore, this segment of roadway is still in good condition, despite the increased loading from the ethanol plant traffic. As a part of the initial interagency agreement, the county Board of Supervisors also agreed to pay for the construction of an interchange at the south end of the new road, off U.S. 34. This was done entirely at their expense—an investment of over $642,000.

In addition to all the upfront construction costs, the Des Moines County Board also approved 100% tax abatement for the first 10 years and 90% tax abatement for the next 10 years, so additional "costs" were incurred as a loss to revenues. In Floyd County, the Board of Supervisors abated property taxes and allowed a 90% reduction in assessed valuations for the first 12 years of operation.

All the counties surveyed feel that the political attitude toward this type of "economic growth" has not changed and that their board would allow the same tax advantages today to win a new plant.

3.7 The Future

These thoughts and concerns led the authors to create a list of insights and questions for the future.

- Is the current (or future) demand for ethanol great enough to justify pipeline transport, eliminating some of the transportation problems with the final product? *Probably not.*
- Will alternative raw materials (switch grass, sugar cane, or sugar beets) for the ethanol production adequately change the transport equipment or routes to lessen the associated road problems? *Probably not.* However, research in this area is being conducted and prototype equipment is being designed for this purpose.
- Can a new funding stream be created for both the initial construction as well as repairing and rebuilding roads to adequately provide funds to resolve the problem? *Probably*, as evidenced by the TIF funding and the preservation type ordinances used by Mitchell and Worth Counties. These TIF ordinances, however, must be adopted BEFORE the plant or wind farm start up and will repay initial infrastructure construction costs based on the increased valuation of the property. Payment of *future* maintenance repairs for roads serving both wind farms and bioplants will require a different approach. After the tax base is developed and the life of the TIF district draws to a close, the funding source also ends. Property tax increases from TIF districts all go to repay the initial costs of infrastructure projects, thereby limiting the revenue streams of counties and schools. It is no surprise that this practice, therefore, is not always viewed as a positive measure by all who are concerned. Perhaps using new fees that could be assessed (per gallon produced, per bushel or ton input, or per truckload in and out of the plant) could provide the repair funds that will be needed in the future after the TIF district has expired.
- Can the loss of income to counties be balanced when a city annexes property so that both can at least break even on their economic investment? *Probably* with planning and cooperation between the jurisdictions in spite of the natural tendency of each to watch out only for their own financial welfare. For example, Mason City and Cerro Gordo Counties both invested in the infrastructure costs needed for plant expansion and then agreed to wait for over a year to annex the plant's property into the city.

3.8 Summary

All of the counties interviewed:

- Offered financial concessions to the biofuels companies to entice them to build in their jurisdiction. Current financial troubles and high unemployment rates in most counties keep this as the most anticipated reaction from county boards now and in the future.

- Utilized any available state or federal funds that could be used for economic development projects to initially fund pavement needs. Continued availability of these types of funding will be necessary in the future as county coffers run low in this budget crunch. No common reporting site exists to capture all upfront costs in one place.
- Experienced deterioration of their paved road systems around a biofuels facility within a couple years of the plant opening. Deterioration of the non-paved roads around these plants is much more rapid, usually showing a significant amount in the first year. Damage and deterioration of county roads occurs during the construction phase of a wind turbine farm and is minimal once the farm is operational. Inclement weather (and resulting soft roads) speed this process even more in all cases.
- Lacked adequate revenues to continue full maintenance on all roads. The result is that the increased traffic and loads on the major corn hauling roads require more maintenance and leftover funds must be reallocated to all the other roads. In the future, better records of expenditures on those major hauling roads would allow for a more equitable fee structure if one could ever be enacted.
- Agreed that the unpredictability of where a new biofuels plant might locate complicates the decision of what design ESAC factors to use in pavement designs for new or rehabilitation paving projects. Changes that have occurred in hauling patterns to existing plants have also complicated the truck counts that produce the ESAL predictions. Although adopting higher design standards for all county routes is not an inexpensive option, it does provide adequate pavement structure to hold the loads and minimize pavement failures.
- Lacked formal evidence to support their belief of increased bridge deterioration and shortened life due to the additional hauling over specific routes to get the corn to a plant site. Their concerns were for the countless short wooden structures, which are most common on their low-volume roads and that are susceptible to failure from overloads.

Additional information and data collection in these areas could provide local officials more insight and direction for making many of these decisions.

CHAPTER 4. ESTIMATION OF TRAFFIC GROWTH AND PAVEMENT DETERIORATION

4.1 Introduction

The research objective was to prepare a traffic and local government fiscal impact model. The model will be used to assess the impact of additional crop-based biofuels plants, cellulose-based plants, and wind turbine farms on the transportation system. The approach was to investigate the large truck traffic patterns on Iowa's secondary and local roads and to correlate those patterns with the pavement condition. In addition, the engineering characteristics of the subgrade were evaluated to gain a better understanding of the impacts of the growing renewable energy industry on the transportation infrastructure in Iowa. The research was to quantify and visualize the impacts. In order to accomplish this, the research team focused on the counties with existing biofuels production facilities that were identified in Chapter 3. The research team relied on data from the Iowa DOT and the ICEA Service Bureau in order to document the traffic and fiscal impacts of the renewable energy industry.

4.2 Transportation Infrastructure Issues Associated with Renewable Energy Industry

The renewable energy industry, like any other industry, involves production/collection and distribution of raw materials as well as finished products. As a result, the success of the renewable energy industry depends on the quality of service that the transportation infrastructure can provide. The Iowa Department of Economic Developments (IDED) reports that, nationally, Iowa is number one in ethanol and biomass production, second in biodiesel production, and has recently supplanted California as the second largest producer of wind energy (IDED 2009). These milestones come at a price for the state's transportation infrastructure as increased traffic resulting from the renewable energy industry will likely impact the transportation infrastructure, increasing maintenance expenses for state and local governments (Haddad et al. 2009). The renewable energy industry has two components with different impacts on the transportation infrastructure: impacts based on renewable fuel production plants (ethanol and biodiesel plants) and impacts based on renewable energy (wind farms).

4.2.1 Impacts Associated with Biofuels Plants

Two categories of impacts associated with biofuels plants are considered in this study. The first impact is that of increased heavy vehicle traffic transporting grain to the ethanol plant and the finished products to retail markets. Figure 4.1 shows the location of ethanol and biodiesel plants in the Iowa. Figure 4.2 shows the typical transport system for the biofuels production process. The truck transportation associated with ethanol and biodiesel production consists of four phases:

1. Farm to storage (sometimes farm to fuel production plant)
2. Storage to renewable fuel production plant
3. Fuel production plant to fuel blending and/or storage
4. Storage to retail markets

The last three phases normally use conventional trucks to move products. Iowa has the capacity to produce more than 3.9 billion gallons of ethanol annually (more than 30% of the entire U.S. production), approximately 52% of which is sold to markets outside of Iowa. According to a survey conducted by Iowa State University, high demand for ethanol industries is expected to generate more need for in-state transportation (Tun-Hsiang 2008). These three phases depend on trucking and the primary and secondary roadway systems to move the finished products to market.

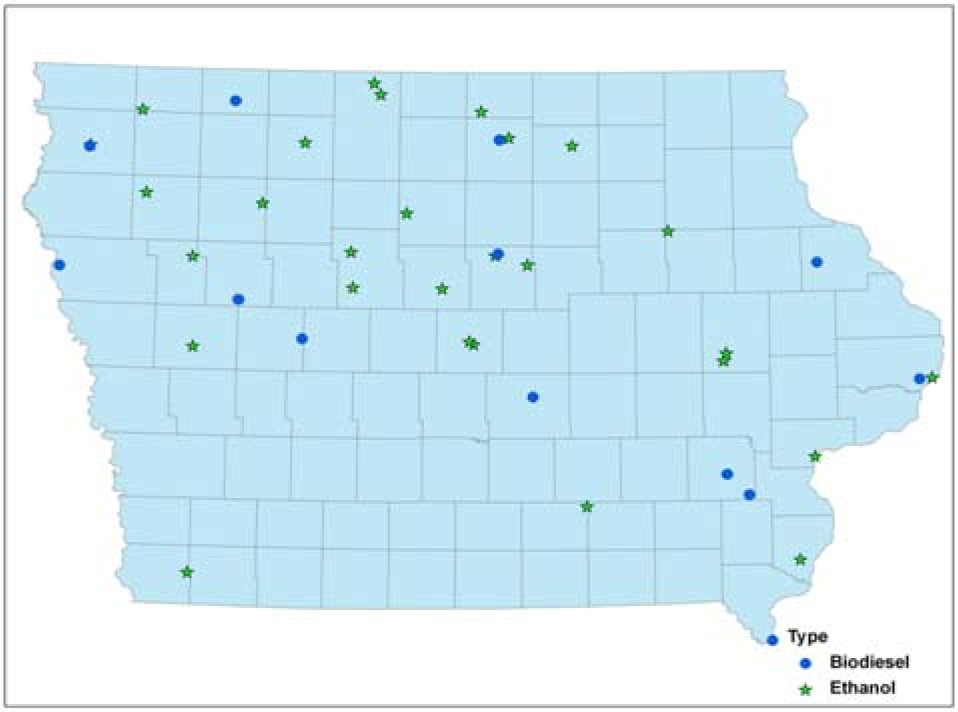


Figure 4.1. Distribution of ethanol and biodiesel plants in Iowa

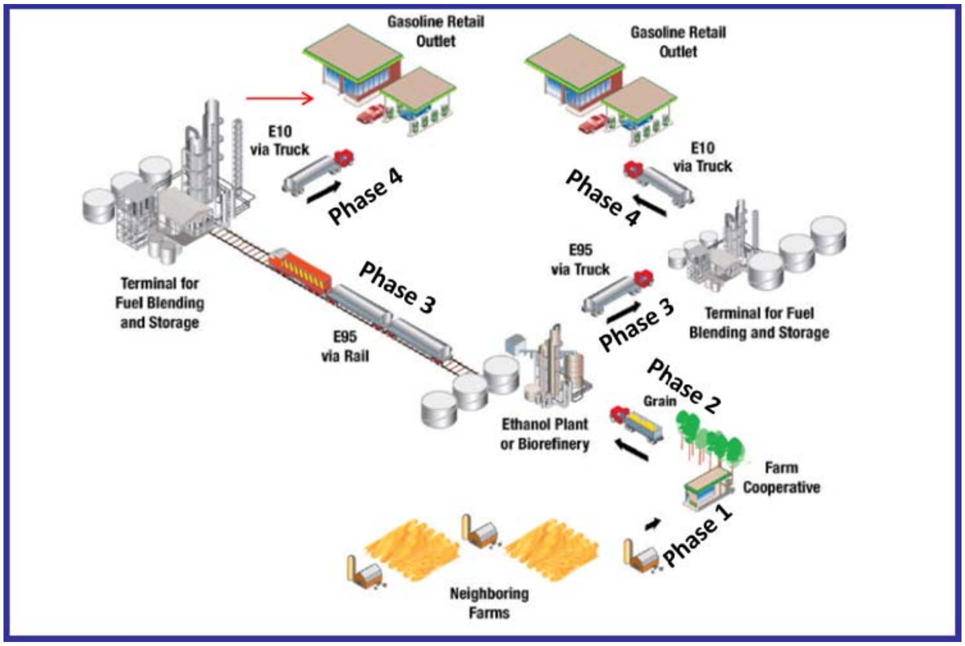


Figure 4.2. Typical transport system for biofuels production (National Bioenergy Center, National Renewable Energy Laboratory)

The second impact is the potential impact due to cellulosic ethanol plants. Studies have shown that cellulose materials, such as wheat and rice straw, switch grass, paper pulp, and agricultural products (corn cobs and corn stover), produce more renewable fuel than the starches and sugars found in corn. As discussed in Chapter 2, cellulose production for renewable fuels may shift toward genetically modified perennial grasses, such as switch grass and Miscanthus. Cellulose materials are bulky and will potentially require large-sized vehicles for transportation to processing plants.

Both scenarios present a challenge to those sections of Iowa's functionally obsolete infrastructure (such as narrow bridges and roads), which prohibits the movement of large-sized vehicles (TRIP 2008). While heavy vehicle movements could be restricted (or limited) on structurally deficient infrastructure (such as load-limited bridges, thin pavements, and gravel and unpaved roadways), the oversized vehicles are not as easily managed. The challenges to be confronted are the weight and the physical dimensions of transportation vehicles used in the renewable fuels production process.

4.2.2 Impacts Associated with Wind Energy Farms

The impacts of the wind energy industry on the state's transportation system are generated when turbines, parts, and materials are moved with oversized vehicles from manufacturing plants to the wind turbine construction site. As the turbine blades become larger, the weight and length increases, which is a concern when they are transported on the secondary roadway system.

After construction is complete, oversized vehicles are seldom needed for the production and operation of the turbines, except during maintenance or turbine replacement. Wind energy does not generate on-going heavy vehicle traffic like the renewable fuels industry does. Figure 4.3 shows the distribution of wind turbines in Iowa. Wind farms are generally located in the north and northwest areas of the state.

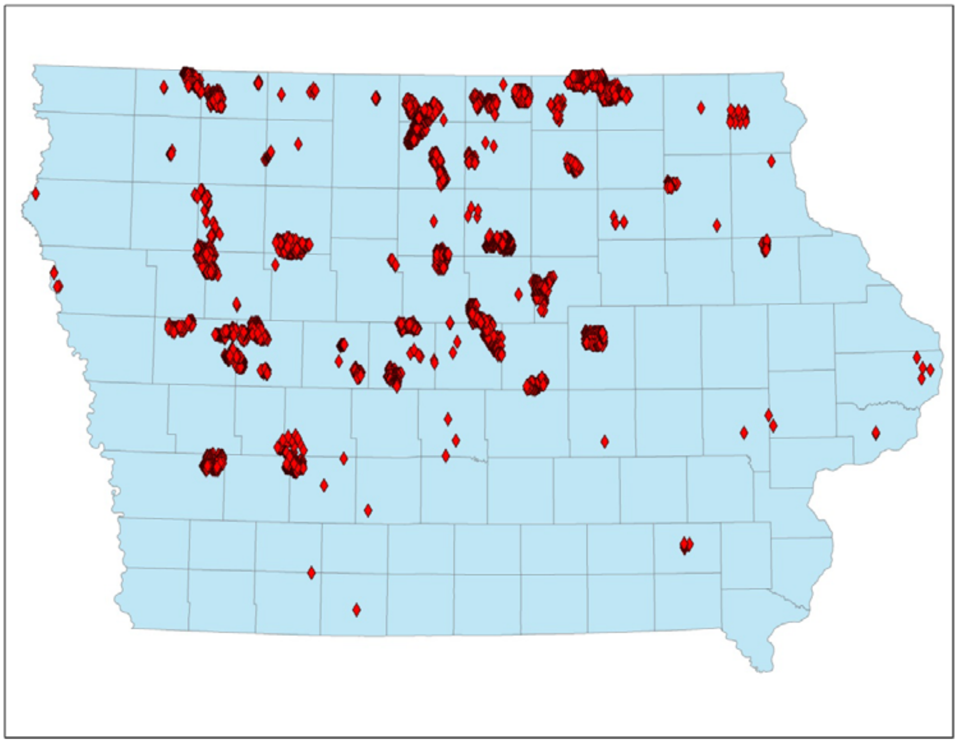


Figure 4.3. Distribution of wind turbines in Iowa

4.3 Transportation Growth in Iowa, 1998 to 2008

To understand the impact of the renewable energy industry on secondary and local roadways, the research team first investigated primary highway and Interstate traffic growth in Iowa from 1998 to 2008. The team looked at the overall annual vehicle miles traveled (VMT) and specifically at large-truck VMT. Large truck, as used in this report, is defined as single- or multiple-trailer trucks with four or more axles. The traffic data were provided by the Iowa DOT Geographic Information Management System (GIMS). In addition to examining statewide VMT growth, the research team focused on impacts around select ethanol and biodiesel plants. Figure 4.4 diagrams the impacts of the ethanol and biodiesel plants on the primary and secondary routes surrounding these select plants.

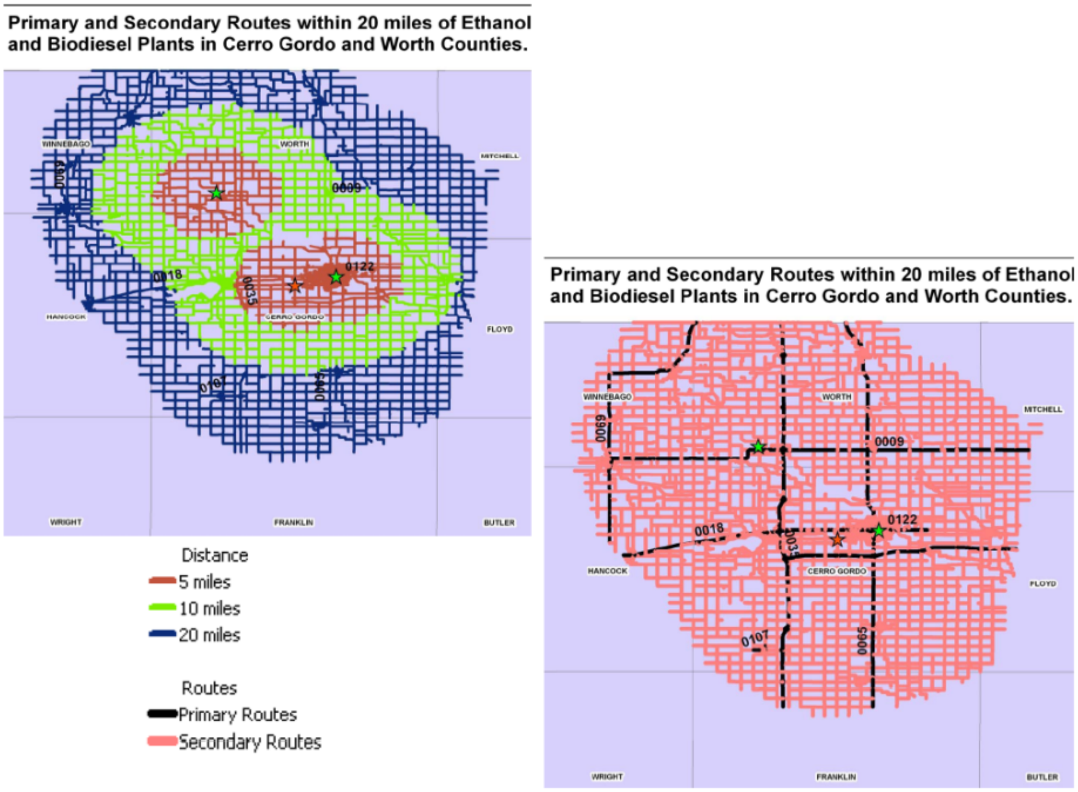


Figure 4.2. Diagram showing impacts radius of plants

4.3.1 Statewide Trends

Figures 4.5 through 4.8 show the traffic growth trends on Iowa's primary and Interstate highways and secondary and urban road systems. Figures 4.5 through 4.7 covers the period from 1998 to 2008, and Figure 4.8 covers the period of 2002 to 2008. Figures 4.9 through 4.12 show the large-truck traffic trends. The data for the secondary and local road systems were derived from the Iowa DOT annual VMT reports. Separate charts are provided for primary urban and rural road systems. In general, the figures show a slight increase in annual VMT for all vehicles on the primary road system and a fairly steady rate for the secondary and local roads; however, there is a noticeable increase in large-truck VMT on the primary and Interstate highway systems. The secondary road system also recorded an increase, although smaller, in large-truck VMT in the last two years.

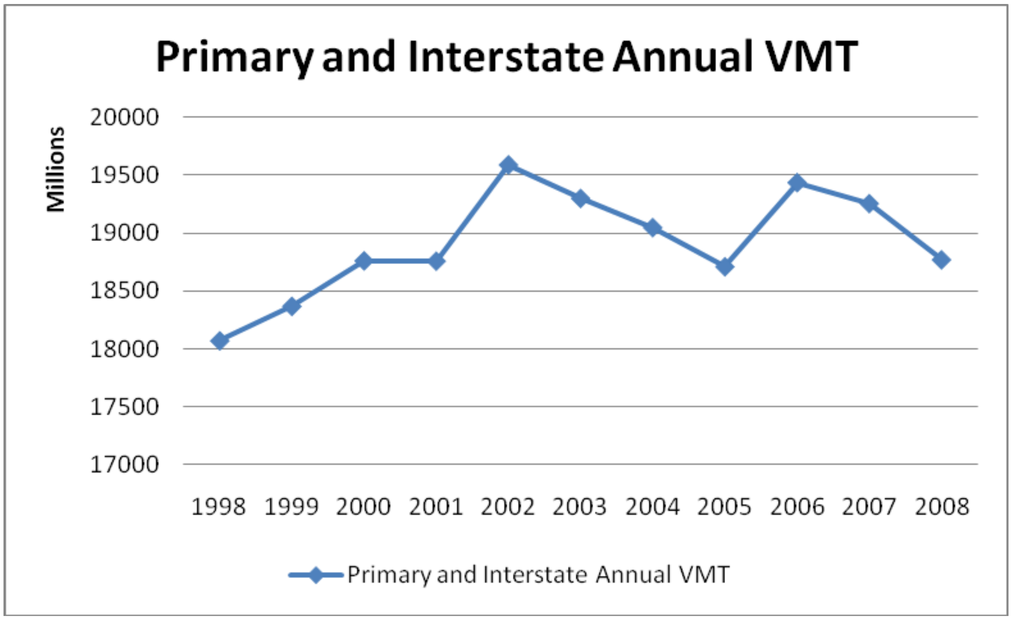


Figure 4.3. Traffic growth on Iowa primary road system 1998–2008

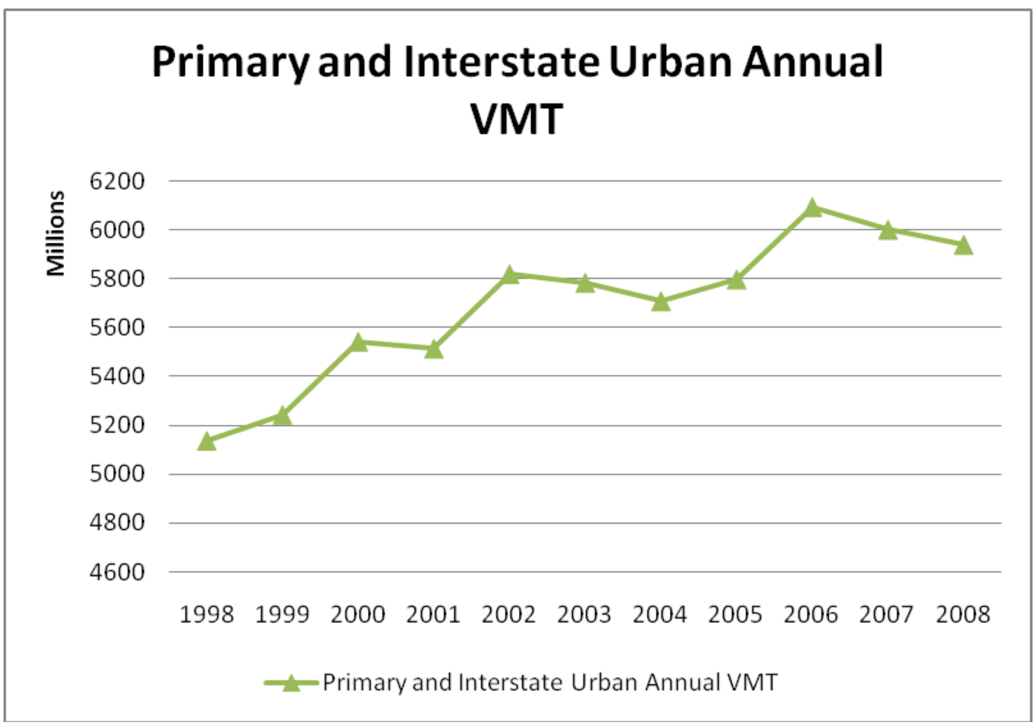


Figure 4.4. Traffic growth on Iowa urban primary road system, 1998–2008

4.3.2 Annual Trends—All Vehicles

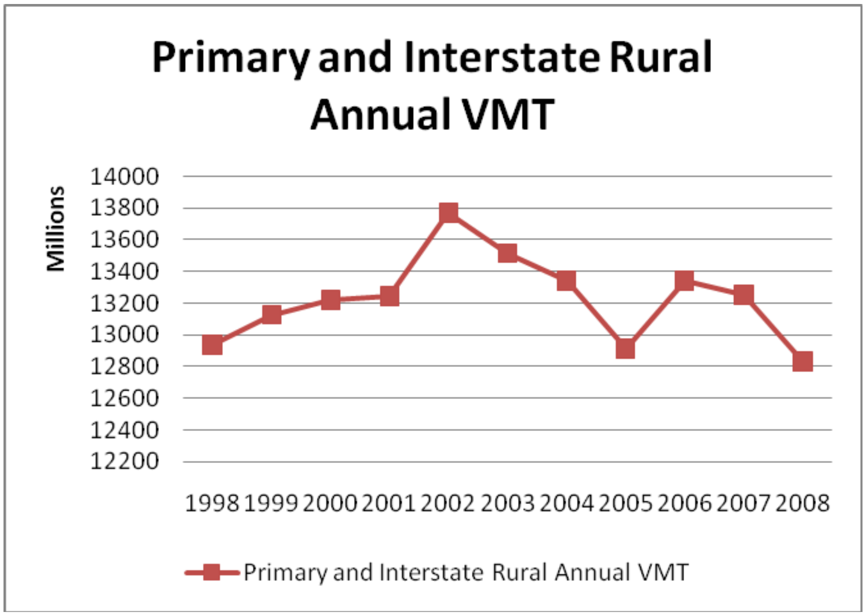


Figure 4.7. Traffic growth on Iowa rural primary road system, 1998–2008

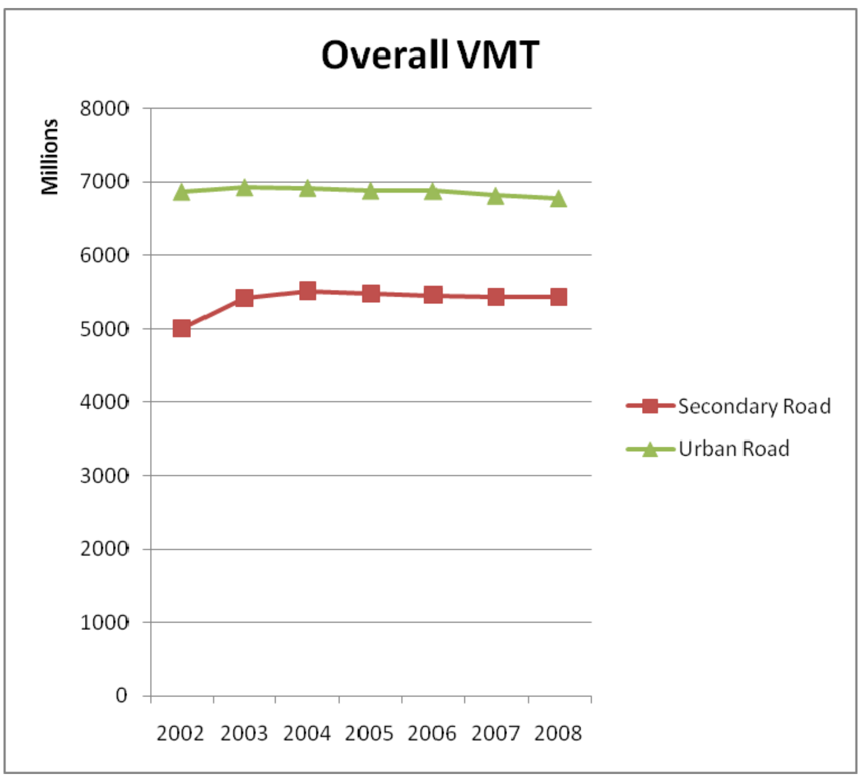


Figure 4.8. Traffic growth on Iowa secondary and local (urban) road system, 2002–2008

4.3.3 Annual VMT Trends—Large Trucks

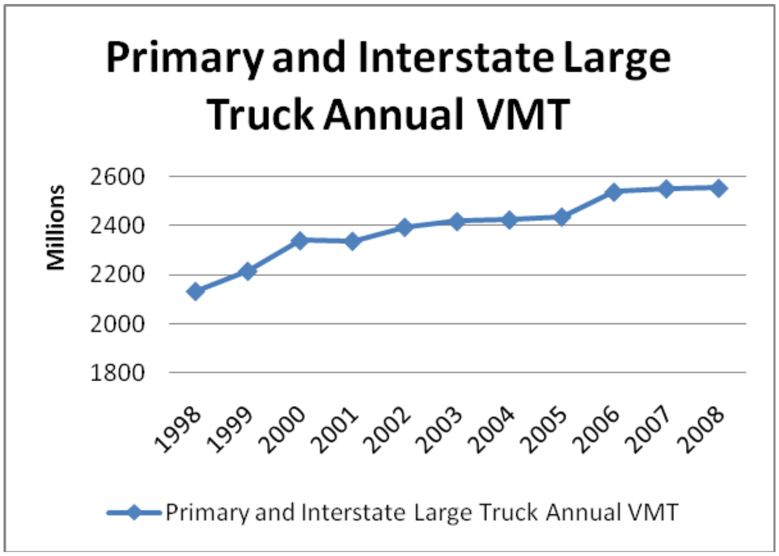


Figure 4.9. Large-truck traffic growth on Iowa primary road system, 1998–2008

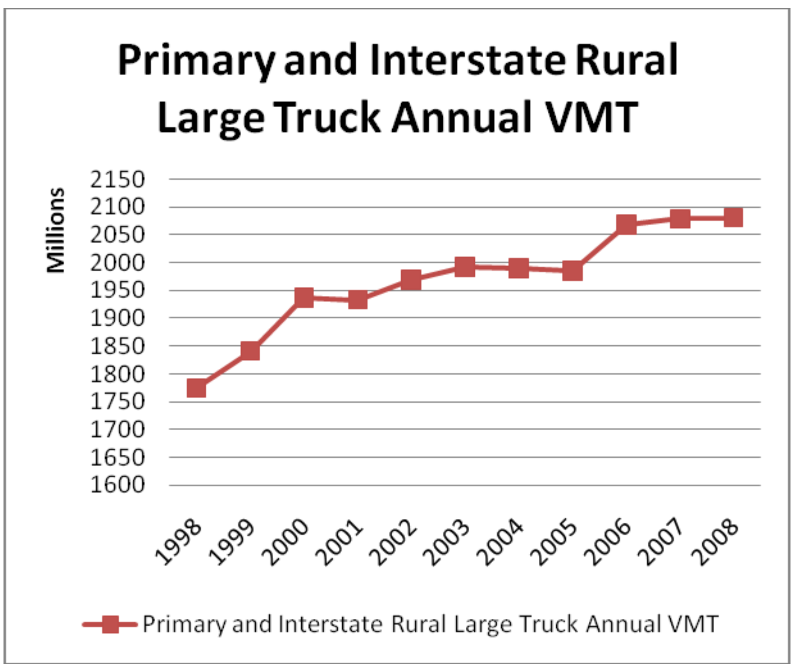


Figure 4.10. Large-truck traffic growth on Iowa rural primary road system, 1998–2008

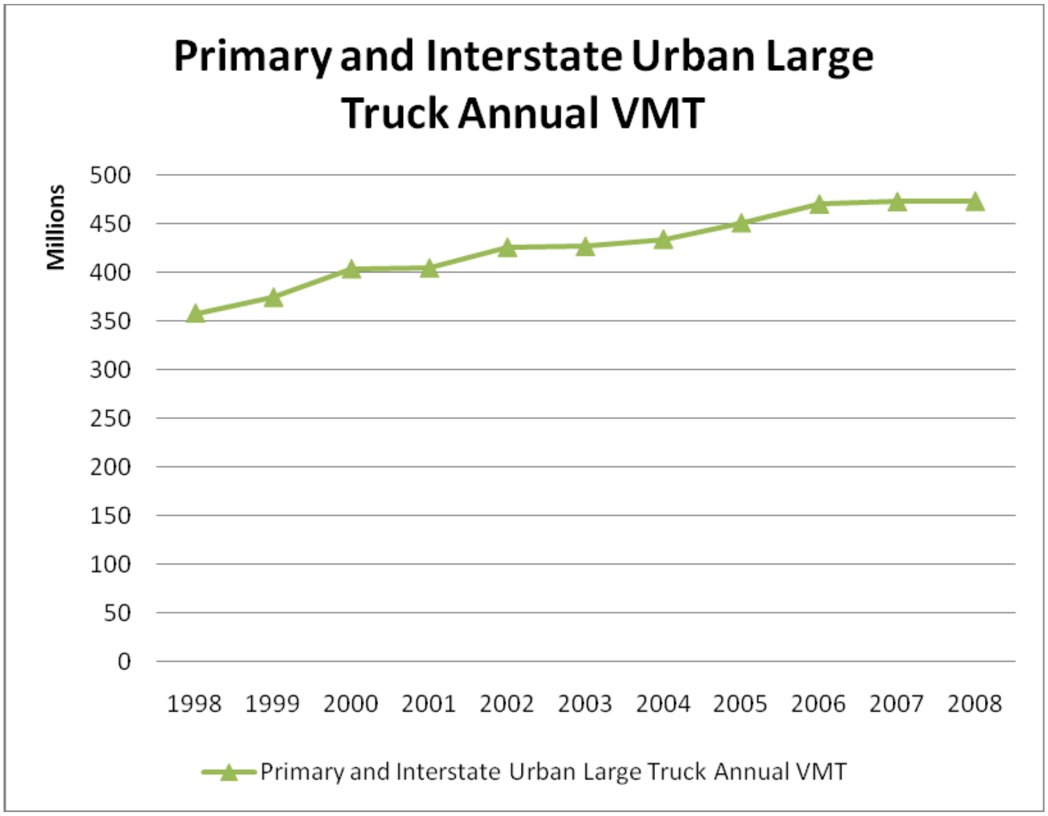


Figure 4.11. Large-truck traffic growth on Iowa urban primary road system, 1998–2008

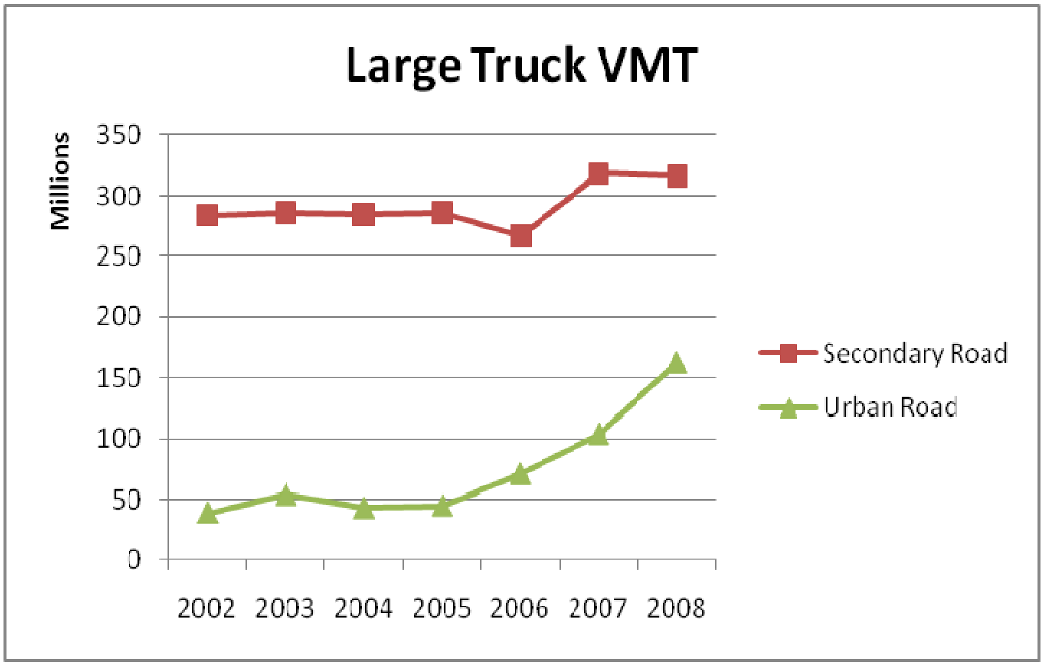


Figure 4.12. Large-truck traffic growth on Iowa secondary and local (urban) road system, 2002–2008

4.3.4 Growth Trends in Select Counties

Chapter 3 discussed the selection of counties for evaluation. Figure 4.13 shows a map of the selected counties, the ethanol and biodiesel plants within those counties, and the counties within a 20-mile radius of these plants. The counties shown in Figure 4.13 have more than 50% of the road network within this 20-mile radius. The map also shows the wind energy farm locations.

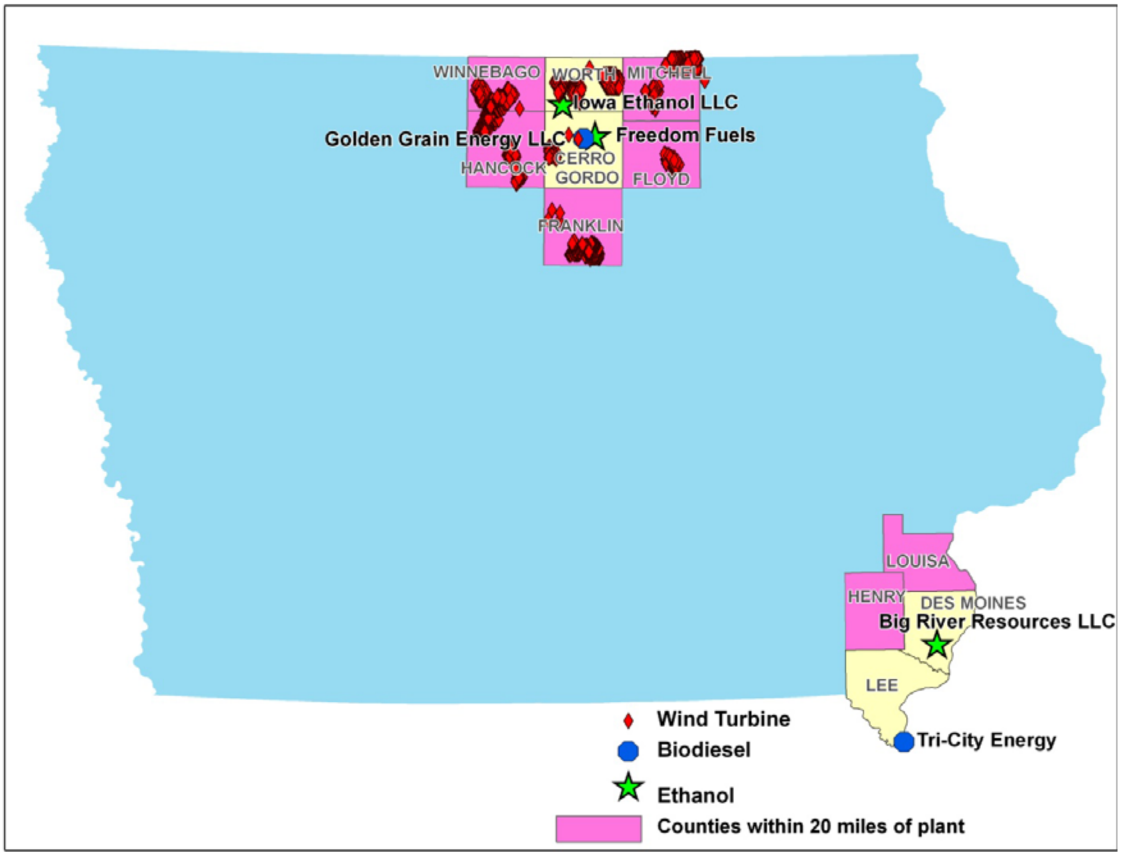


Figure 4.13. Map showing selected plants, wind turbines, and counties

Figures 4.14 and 4.15 show the annual distribution of large-truck traffic within a 20-mile radius of the plants from 2002 to 2008.

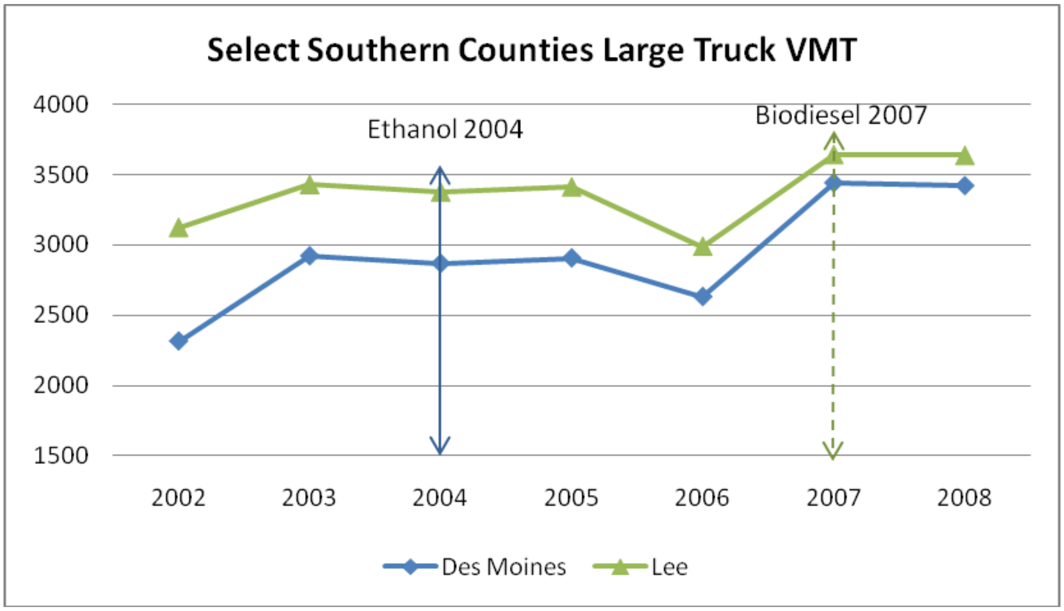


Figure 4.14. Large-truck traffic growth on secondary roads in select southern counties

In the south, the ethanol plants in Des Moines and Lee Counties became operational in 2004 and 2007, respectively. Figure 4.14 shows a significant increase in the large-truck annual VMT during 2003 and during 2006 and 2007. The increased VMT is due to the construction activities for these plants.

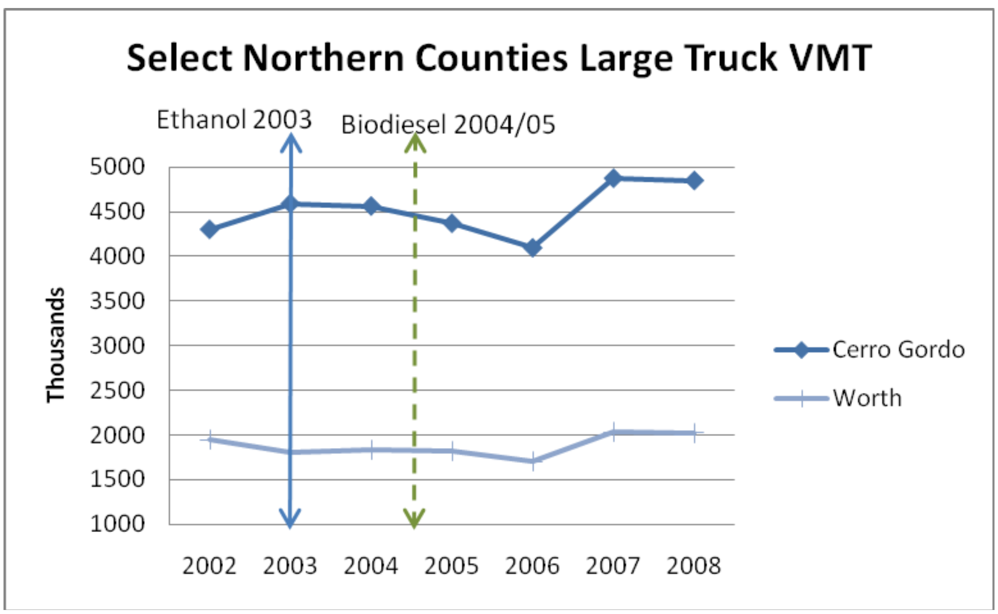


Figure 4.15. Large-truck traffic growth on secondary roads in the northern counties

In the north, the ethanol plants became operational in 2003 in both Cerro Gordo and Worth Counties, and the biodiesel plant began operating in Cerro Gordo in 2005. Although the "before" data is lacking, the research team was able to see that the Worth County large-truck VMT in

2002 is greater than the large-truck VMT in 2003 when the ethanol plant became operational. Also, the large-truck VMT in 2004 is greater than the large-truck VMT in 2005 and 2006 when the biodiesel plant became fully operational. This trend shows that there was increased traffic due to plant construction. The truck traffic dipped after the plants became operational but never returned to the level prior to the plants' construction. These findings suggest an increase in truck traffic during plant construction and, even though volumes decrease afterwards, they are still above the pre-plant levels.

4.4 Pavement Deterioration

Increased traffic of semi-trailers and other heavy vehicles from the growing renewable energy industry will likely accelerate the deterioration of the transportation infrastructure, thereby increasing the maintenance expenses for state and local governments (Fox and Porca 2001). In view of this trend, the research team examined the road conditions around select ethanol and biodiesel plants to determine if there were impacts on the pavement condition.

The Pavement Condition Index (PCI) is a numerical index between 0 and 100 that is used to indicate the condition of a roadway based on measurements of roughness and surface distress. It is widely used in transportation. Figure 4.16 shows the breakdown of how roads are classified based on their PCI rating. Some agencies calculate PCI for a network by collecting road distress data (such as roughness index, rutting, cracking, etc.) on sample sections of the network and by computing PCI based on those sample sections to represent the whole network. In Iowa, distress data are collected on the entire network (where possible) and, as much as possible, PCI is calculated based on 100% coverage.

PCI	Rating
Very Poor	0-20
Poor	21-40
Fair	41-60
Good	61-80
Excellent	81-100

Figure 4.16. PCI rating system

4.4.1 Primary Highway System

The Iowa DOT, county, and city agencies charged with road maintenance typically use PCI as a trigger to schedule maintenance or rehabilitation, determine the extent and cost of repair, determine the overall network condition, and allow for equal comparisons of different pavements' performance (Deighton 1998). Although it might be a trigger, actual pavement project implementation depends on the availability of funds. A PCI of 40 or less may not necessarily generate a pavement rehabilitation project.

In order to track the pavement condition, the research team used weighted average PCI as opposed to average PCI. The weighted PCI takes the proportional relevance of each pavement segment into consideration rather than treating each segment equally. For example, if a county maintains a road network of 5 miles spread across 5 road segments and one segment is 3 miles long and the others are 0.5 mile long, the weighted PCI assigns more weight to the 3 mile segment. Table 4.1 shows the weighted PCI summary for the primary road system, and Table 4.2 shows the number of projects approved by the Iowa DOT on sections of roadway within the selected counties. These projects are not necessarily pavement surface improvement projects. Considering that the overall PCI in Table 4.1 is consistently good implies that these projects in some way end up improving the pavement condition in addition to accomplishing other primary or secondary considerations that warranted it. The fact that the number of projects seems to be the same each year shows the amount of deterioration the pavement suffers within a given year. The research team cannot attribute all the large-truck traffic on these roads to the biorenewable industry and cannot conclusively say how much of the truck traffic is a result of the renewable energy industry.

Table 4.1. Primary weighted PCI summary for counties within the study area

County	2000	2001	2002	2003	2004	2005	2006	2007	2008
Cerro Gordo	72	74	69	70	74	76	74	76	74
Des Moines	64	72	68	61	60	64	69	67	66
Floyd	72	73	71	72	74	72	66	68	67
Franklin	72	75	66	63	67	67	65	68	69
Henry	75	80	80	80	76	80	80	82	82
Lee	70	71	67	69	69	72	77	78	77
Louisa	67	69	63	54	66	68	67	64	63
Mitchell	70	70	59	58	74	72	65	64	65
Winnebago	69	69	65	65	67	66	59	59	56
Worth	75	76	76	74	75	73	65	65	68

Table 4.2. Number of highway projects on the primary and Interstate road sections within the select counties per year

County	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Cerro Gordo	61	70	72	58	60	57	57	57	57	57	57
Des Moines	42	42	46	42	42	33	35	26	34	32	32
Floyd	33	36	47	41	41	37	38	38	38	38	38
Franklin	35	35	34	33	33	31	33	33	33	34	34
Hancock	15	15	13	13	13	13	13	13	15	15	15
Henry	30	37	40	36	39	37	38	31	37	40	37
Lee	60	60	61	59	59	49	50	40	66	61	58
Louisa	34	34	34	32	32	23	23	23	23	23	23
Winnebago	21	21	22	17	17	16	16	16	17	17	17
Worth	29	29	29	26	26	23	23	23	23	23	23

4.4.2 Secondary Road System

A summary of the pavement condition of the secondary road system in Iowa is provided through the Iowa Pavement Management Program. Unfortunately, the northern counties have not collected pavement condition data since 2004. The weighted PCI summaries for the southern counties are shown in Table 4.3. This table only captures four cycles of data collection, which is not enough to generate any conclusion of statistical significance.

Table 4.3. Secondary weighted PCI summary for select southern counties

County	2001	2003	2005	2007
Des Moines	57	55	60	60
Lee	58	65	68	70

In view of the data limitations, the research team examined the annual expense reports of the counties (discussed in Chapter 3) to assess any relationships between the increase in traffic and maintenance costs.

Figure 4.17 shows pavement-related expenditures for the southern counties, while Figure 4.18 shows the pavement-related expenditures for the northern counties. These expenditures include pavement repairs, hot mix asphalt (HMA), PCC, and seal coat applications. From Figure 4.17, expenditures peaked in 2003 and again in 2006, which illustrates the impact of the construction activities. Figure 4.18 shows a similar trend of increased expenditures in the years before the plants became operational. This observation is validated by Figures 4.14 and 4.15, which show increased truck traffic during the construction of the plants.

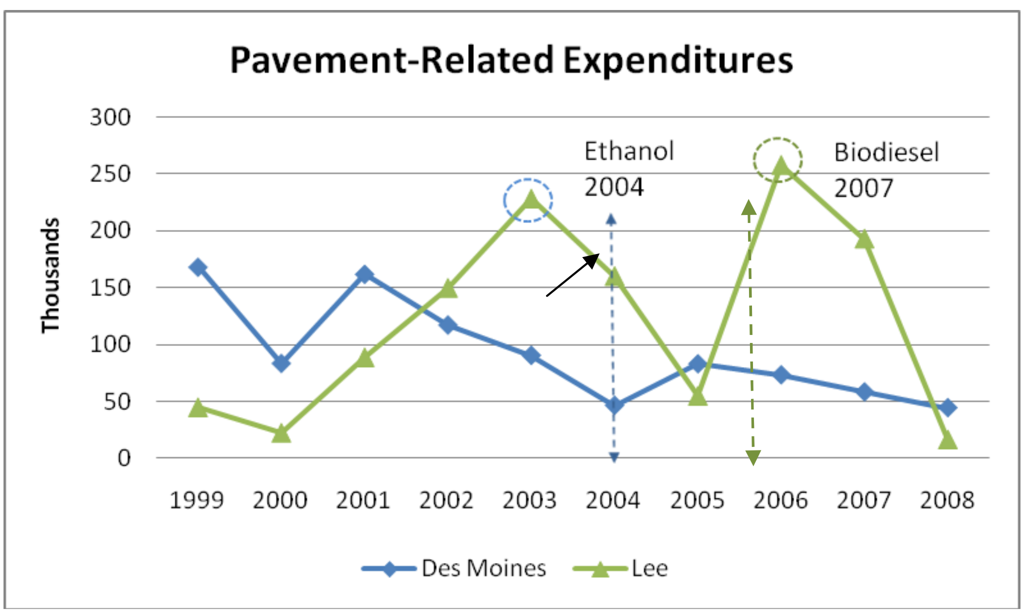


Figure 4.17. Pavement-related expenditures for Des Moines and Lee Counties

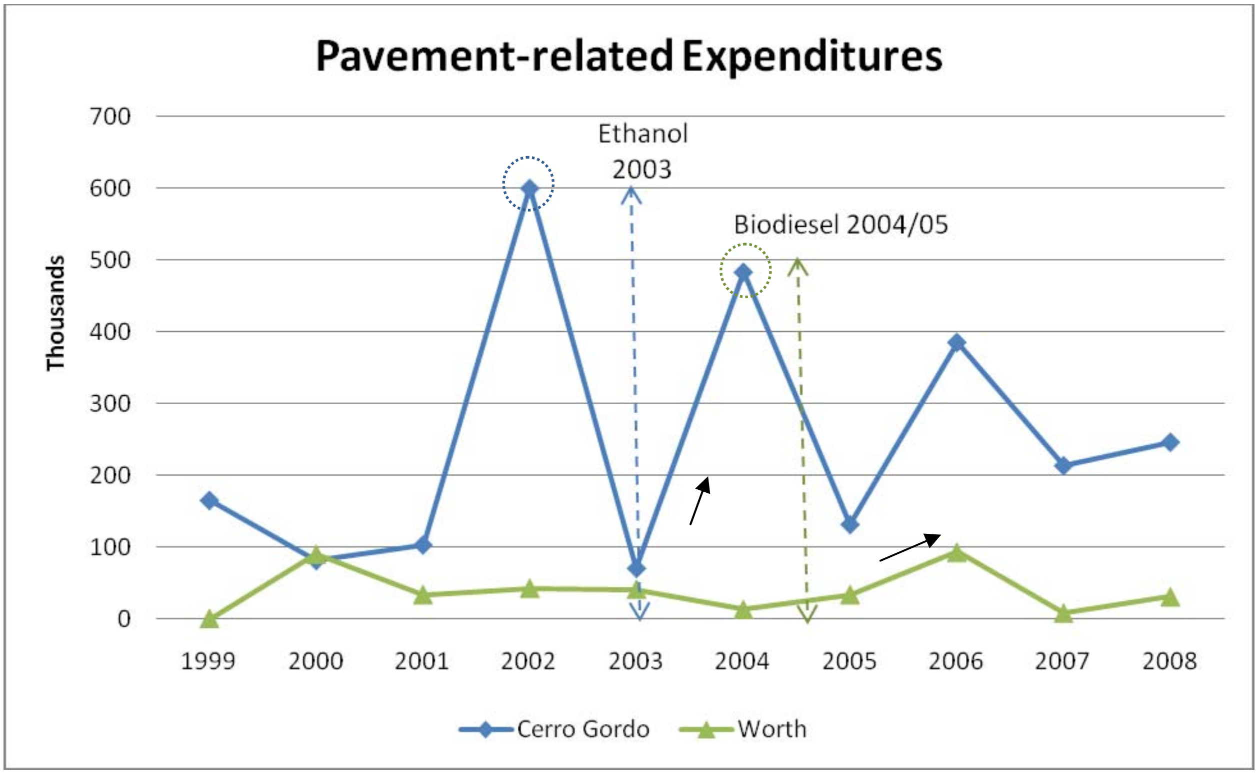


Figure 4.18. Pavement-related expenditures for Cerro Gordo and Worth Counties

Figures 4.19 and 4.20 show the fluctuation in maintenance costs for gravel roads. Overall, Figures 4.19 and 4.20 show a consistently increasing trend of expenditures for maintaining gravel roads.

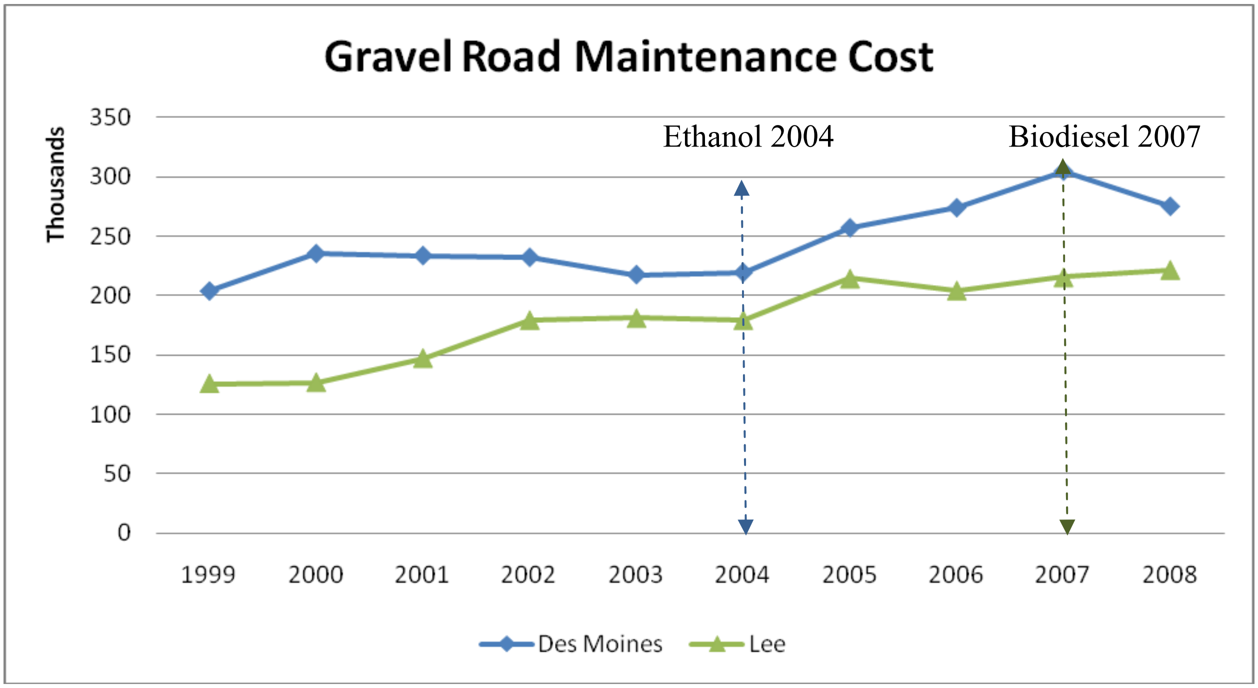


Figure 4.19. Gravel road maintenance cost for Des Moines and Lee Counties

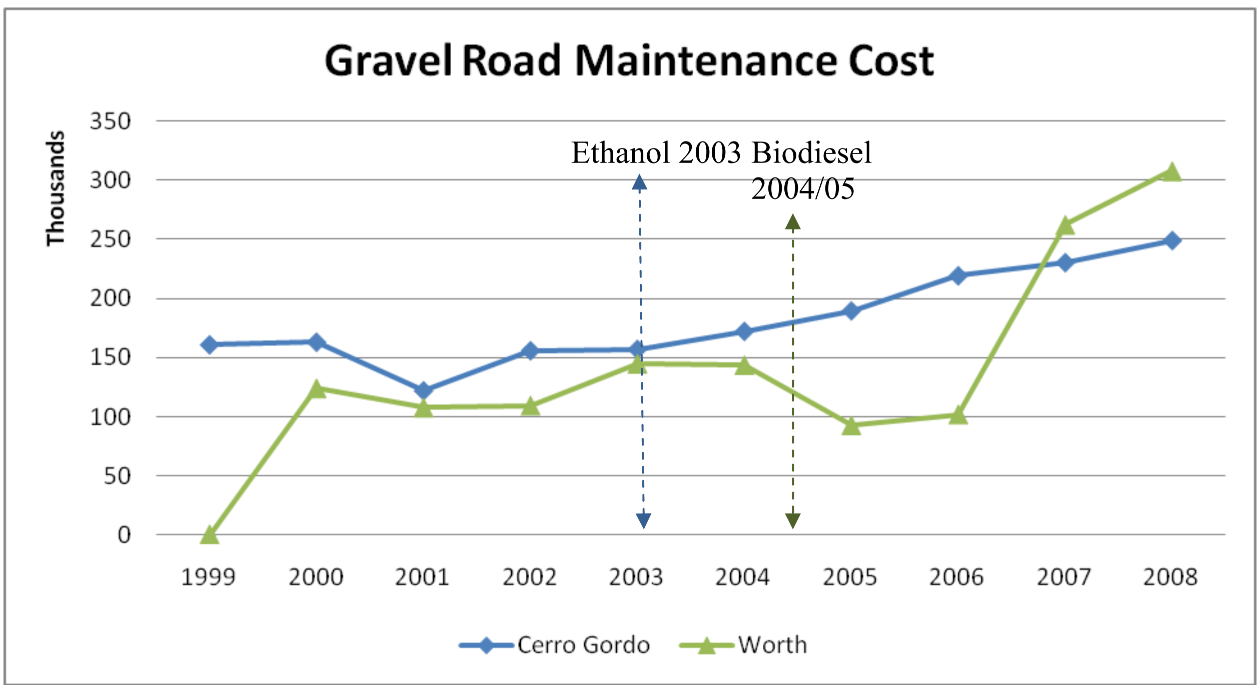


Figure 4.20. Gravel road maintenance costs for Cerro Gordo and Worth Counties

4.5 Soil Condition

This section investigates the pavement deterioration and its dependency on the engineering properties of the subgrade. Figure 4.21 shows the soil properties in the selected and surrounding counties. The soil designation is based on the American Association of State Highway and Transportation Officials (AASHTO) classification system. The system is used for road construction and provides ratings of the subgrade. There are eight major groups: A1 through A8. The classification A8 is for organic soils, ranging from good (A1–A3) to fair (A4–A5) to poor (A6–A7). Soil conditions vary from county to county.

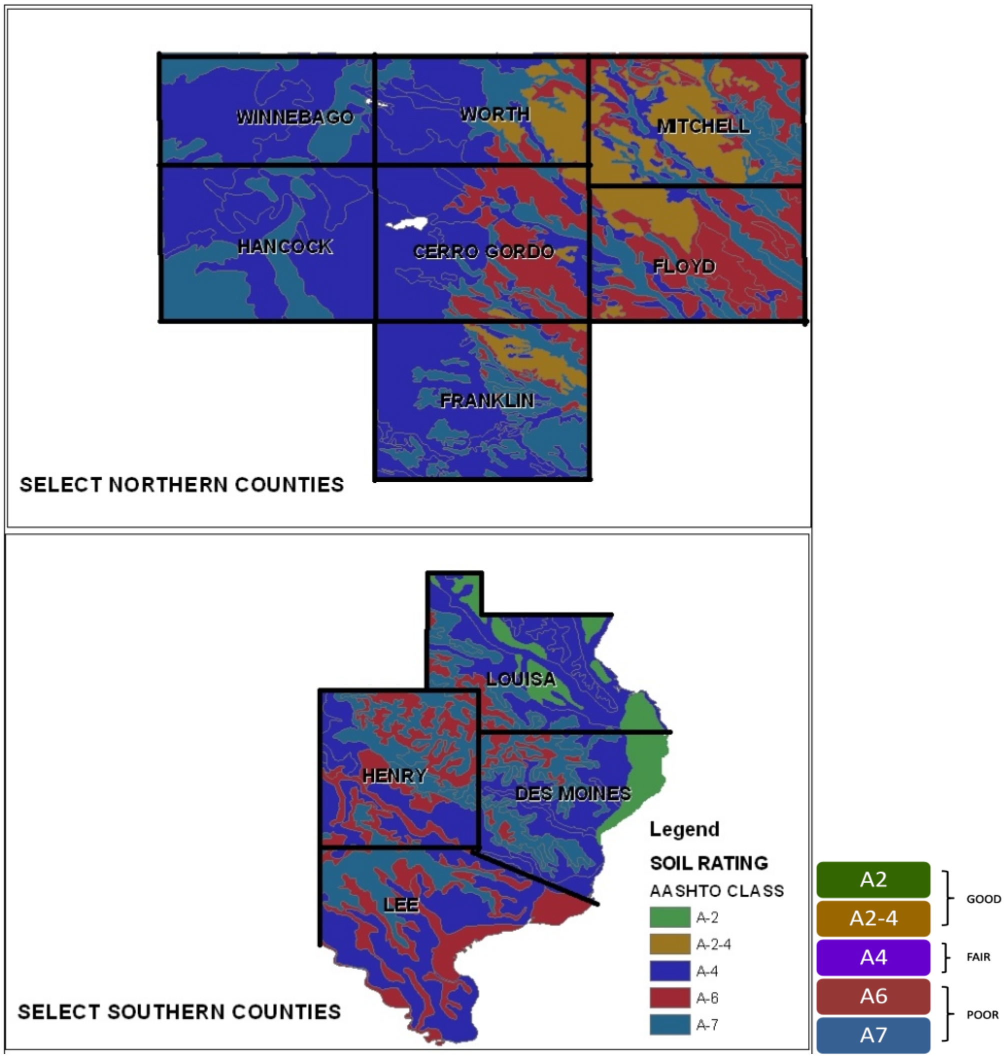


Figure 4.21. AASHTO soil classification in the selected counties

In order to rate the subgrade of the roadways evaluated, the 2008 Iowa DOT road network was spatially joined to the U.S. General Soil Map data for Iowa (obtained from the U.S. Department of Agriculture). The roads were spatially joined to the nearest soil type, as shown in Figure 4.22. The percentages in Table 4.4 represent the proportion of roadway miles in each broad category of soil (poor, fair, and good) per county. To arrive at a single weighted soil rating, the three broad categories were assigned numerical weights ranging from 1 for poor soil to 3 for good soil. Table 4.2 shows that the ratings range from 1.28 to 1.87, which means that the pavement subgrades in these counties are in poor to fair condition.

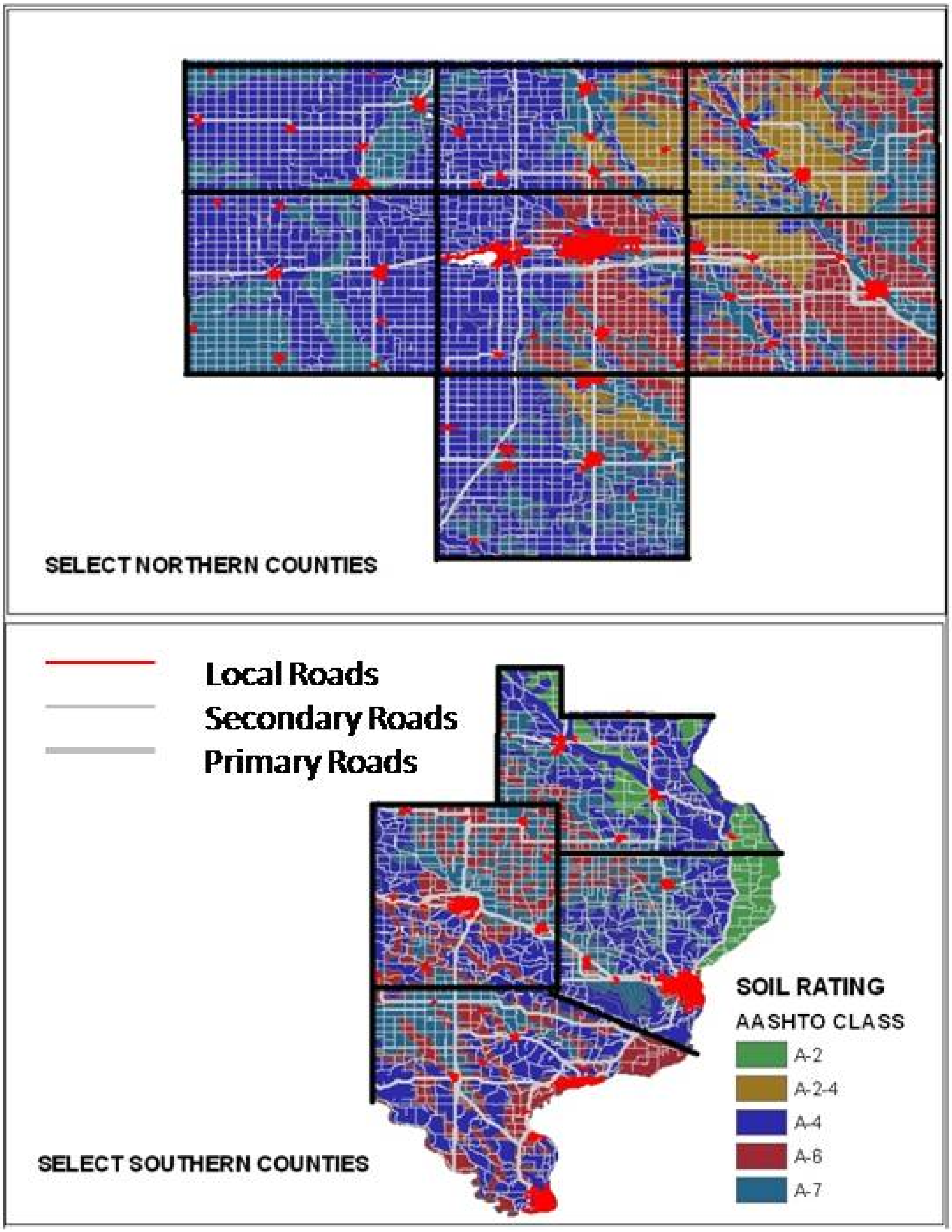


Figure 4.22. AASHTO soil classification in the selected counties with the road network overlay

Table 4.4. Soil rating for selected counties based on AASHTO classification

	SOIL RATINGS			
County	**Good (%)**	**Fair (%)**	**Poor (%)**	**Weighted Rating**
Cerro Gordo	1.59	53.66	44.75	1.57
Des Moines	8.13	53.08	38.79	1.69
Lee	0.00	48.41	51.59	1.48
Worth	16.06	53.06	30.87	1.85

4.6 Summary

In this chapter, the research team looked at the large-truck VMT on primary, secondary, and local roads from both a statewide perspective and a narrower perspective of the select counties that have a biofuels production plant. The research team sought to look at the large-truck VMT distribution based on distance from the plant, but there was no available valid data to accomplish that. Preliminary investigation of the large-truck traffic trend suggests that truck traffic increases and accompanies plant construction and that, even though the truck traffic decreases following construction, it is still enough to create concern for the county and local engineers.

In addition, the research team evaluated pavement deterioration using expenditures on pavement repairs and maintenance in the selected counties from 1999 through 2008. The results show increased expenditures accompanying plant construction and an increasing trend afterwards. The counties are experiencing increased overheads for maintaining their gravel roads, which accounts for more than 70% of their system. This pattern is likely to increase as Iowa continues to lead the way in the renewable energy industry.

Finally, the research team looked at the subgrade characteristics in each county to ascertain if that variable played a role in advancing pavement deterioration. The results show that all counties surveyed had similar subgrade characteristics.

In conclusion, the research team believes that pavement deterioration should be further investigated with actual PCI values.

CHAPTER 5. TRAFFIC IMPACT MODEL AND PAVEMENT THICKNESS DESIGN

5.1 Impact Calculator

In order to determine the roadway service life and fiscal/budgetary impacts of having biofuels plants on Iowa's secondary roads, a simple spreadsheet model system was developed. The tool is a small area model as opposed to a network model of an entire county. This model is designed to systematically estimate additional truck trips as a result of the presence of a biofuels plant. It allows the estimated truck traffic to be assigned to the major road leading out of the proposed or existing plant. The impact calculator is designed to calculate the incremental cost of new traffic generated as a result of the biofuels plant. This incremental cost is limited to paved surfaces because these plants have to meet certain Environmental Protection Agency (EPA) guidelines and having a gravel road close to plant can complicate compliance.

In order to model the maintenance costs for the two pavements types, the research team consulted with county engineers, city public works engineers, the Asphalt Paving Association of Iowa, and the Iowa Concrete Pavement Association and used the Iowa Department of Transportation bidding system to acquire an average cost per mile given the various maintenance practices used in the state.

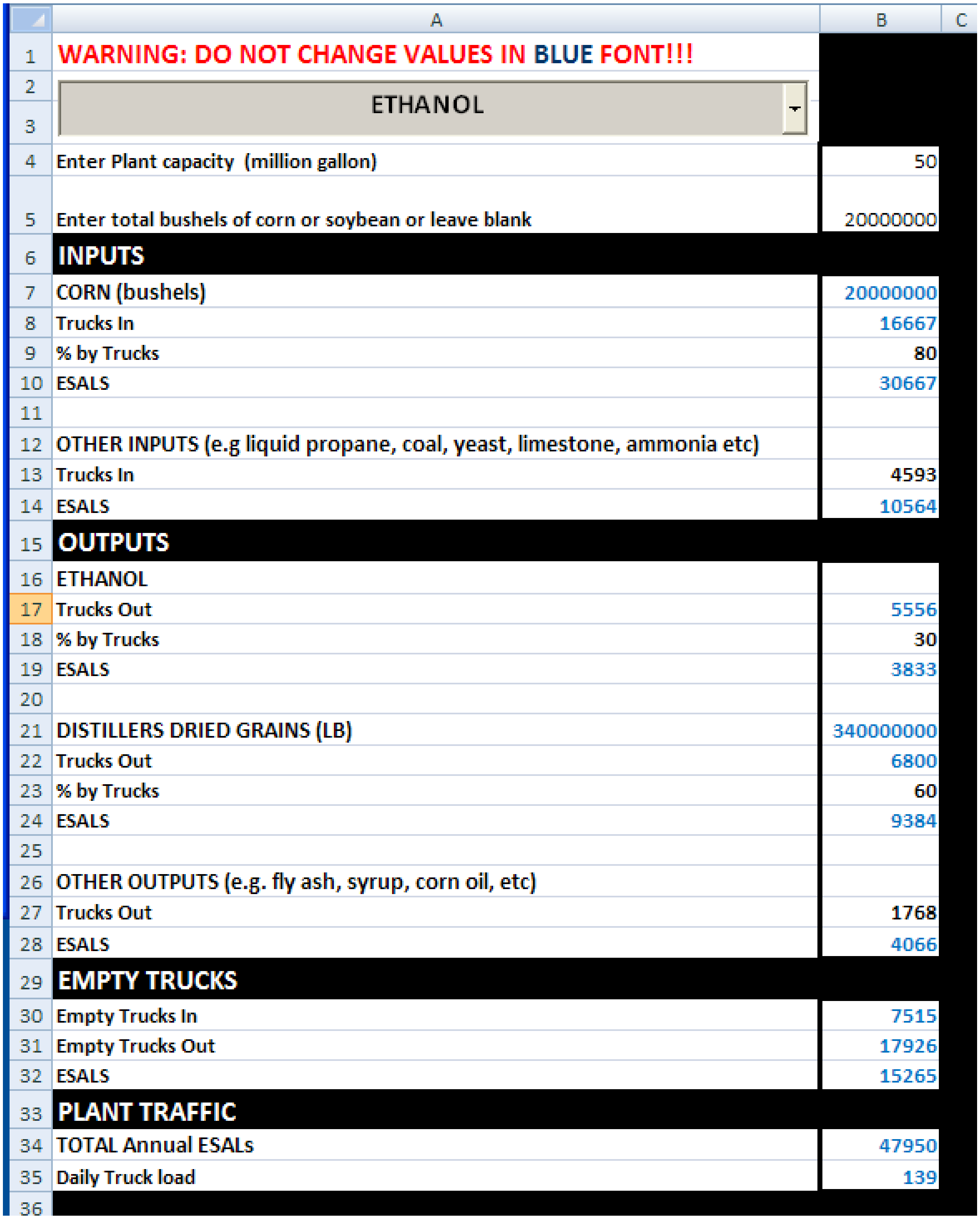
5.2 Critical Input Information

The critical input information for the calculator is broken into two categories: plant inputs (capacity, etc.) and current traffic inputs.

5.2.1 Plant Inputs

The major input in this category is the plant capacity in millions of gallons. Based on the plant capacity, the calculator will estimate the bushels of corn and the truckloads needed to move raw materials and finished products. Figure 5.1 shows the plant input module. Only the values in black font can be modified.

The calculator provides the user with two options for determining truckloads. The default is to use the plant capacity, or the plant capacity can be input in addition to actual bushels of raw materials used to estimate truckloads. The user can manually enter the percentage of the raw materials and finished products that are moved by trucks in line 5 (Figure 5.1). Also, considering that there are different types of plants (natural gas and coal-fired plants), the user can enter any other raw materials or finished products that are specific to the plant in lines 13 and 27, respectively (Figure 5.1).



	A	B
1	WARNING: DO NOT CHANGE VALUES IN BLUE FONT!!!	
2–3	ETHANOL	
4	Enter Plant capacity (million gallon)	50
5	Enter total bushels of corn or soybean or leave blank	20000000
6	INPUTS	
7	CORN (bushels)	20000000
8	Trucks In	16667
9	% by Trucks	80
10	ESALS	30667
11		
12	OTHER INPUTS (e.g liquid propane, coal, yeast, limestone, ammonia etc)	
13	Trucks In	4593
14	ESALS	10564
15	OUTPUTS	
16	ETHANOL	
17	Trucks Out	5556
18	% by Trucks	30
19	ESALS	3833
20		
21	DISTILLERS DRIED GRAINS (LB)	340000000
22	Trucks Out	6800
23	% by Trucks	60
24	ESALS	9384
25		
26	OTHER OUTPUTS (e.g. fly ash, syrup, corn oil, etc)	
27	Trucks Out	1768
28	ESALS	4066
29	EMPTY TRUCKS	
30	Empty Trucks In	7515
31	Empty Trucks Out	17926
32	ESALS	15265
33	PLANT TRAFFIC	
34	TOTAL Annual ESALs	47950
35	Daily Truck load	139
36		

Figure 5.1. Plant input module

5.2.2 Traffic Inputs

Figure 5.2 shows the traffic input module. The calculator assumes a roadway design period of 20 years and an annual traffic growth rate of 2%. These values can be modified accordingly by the user. This module captures the current traffic without the traffic generated by the plant. This value is entered manually in lines 8 and 9. The calculator assumes that passenger cars have a negligible effect on the incremental cost. In addition to the current traffic information, the user must enter the pavement thickness (measured from the stable subbase to the pavement surface). The plant traffic is populated from the plant traffic module, as shown in Figure 5.2. Additional information on the ESAL calculation method and the assumptions adopted in this analysis are provided in Appendix E.

	A	B	C	D
3	TRAFFIC			
4	Growth Rate, %	2.00		
5	Design Period, Years	20		
6	Multiplier	24.297		
7	CURRENT DAILY TRAFFIC		ASPHALT	
8	Number of Single Unit Trucks		120	
9	Number of *Combo Unit Trucks		78	
10	**Pavement thickness		24	
11	Annual Esal		66588	
12	Design Period Esal		1617914	
13	PLANT TRAFFIC		ASPHALT	
14	% of Impact		100	
15	Daily Traffic		263	
16	Annual Esal		89655	
17	Design Period Esal		2178370	
18	TOTAL ESALS			
19	ASPHALT	3,796,285		
20				
21	*COMBO = single and multiple trailer units with 5 axles and above			
22	**Total thickness measured from stable subgrade to surface.			
23	HMA (17 -32 inches), PCC (6 - 13.5 inches)			

Figure 5.2. Traffic input module

5.2.3 Model Outputs

As shown in Figure 5.3, the calculator output summarizes the incremental costs by pavement type as a result of a new or proposed biofuels plant. The roadway design ESALs value (line 5) is determined from the pavement thickness (from the traffic input module), based on the 1993 AASHTO *Pavement Design Guide for New and Rehabilitated Pavements* (Table 5.4, shown on page 79 of this report). The calculator compares the design ESAL of the roadway with the total ESALs resulting from the biofuels plant (with line 6 populated from the traffic input module) and uses that information to estimate costs. If the total ESALs value resulting from the plant is greater than the number of ESALs the road was designed for, the pavement is going to deteriorate faster than designed; hence, its maintenance cost will go up by a factor of the difference in ESALs. All costs are on per-mile basis and assume a road design period of 20 years.

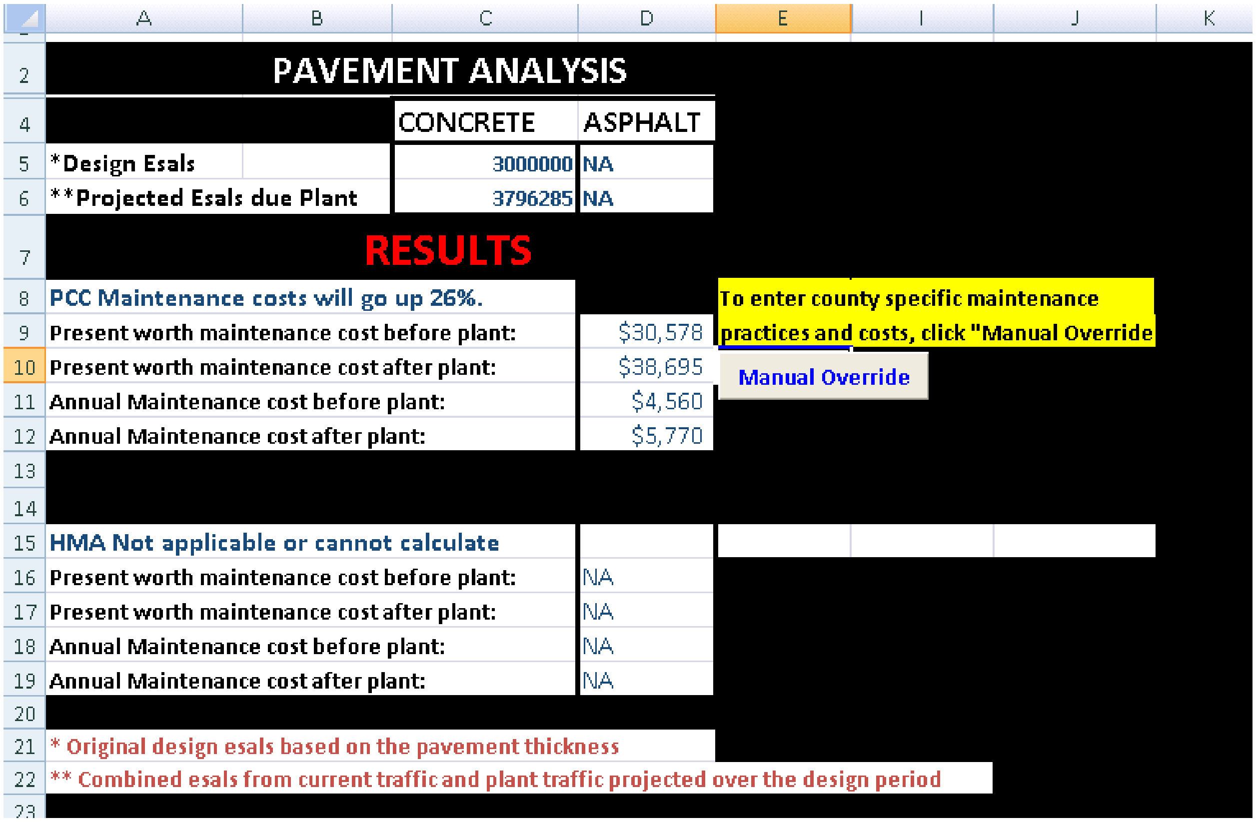


Figure 5.3. Incremental cost analysis

5.2.4 Maintenance Practices

Table 5.1 summarizes the default maintenance practices and costs used in estimating the annual maintenance costs and the present worth maintenance costs. Present worth captures the annual maintenance costs projected over the design period; it assumes a 4% discount rate.

The table is a product of various consultations with county engineers, city public works officials, the various pavement associations in the state, and the Iowa DOT bidding system. In estimating the maintenance costs for HMA, the calculator assumes that crack sealing and seal coating are performed alternately; hence, if the user selects both practices, the calculator alternates them. For example, for a 20-year design period crack sealing is done the third year, followed by seal coating the eighth year and then crack sealing the eleventh year, followed by another seal coat the sixteenth year, and finally crack sealing the nineteenth year. Since maintenance practices might vary from county to county, the calculator provides for the user to be able to override the default values in Table 5.1 by clicking on the Manual Override button, as shown in Figure 5.3. Figure 5.4 shows the dialog box that opens as a result of the clicking that button.

Table 5.2. Pavement maintenance practices

Maintenance Practice	Nominal Interval (Year)	Recent cost ($/mile)
	Asphalt (HMA)	
Crack Sealing	3	3500
Seal Coat	5	15000
Overlay	10-15	45000 (per inch depth)
Pavement Marking	2	1500
	Concrete (PCC)	
Patching	7	6000 – 15000
Overlay	25-30	50000 (per inch for 6” depth)
Pavement Marking	2	1500

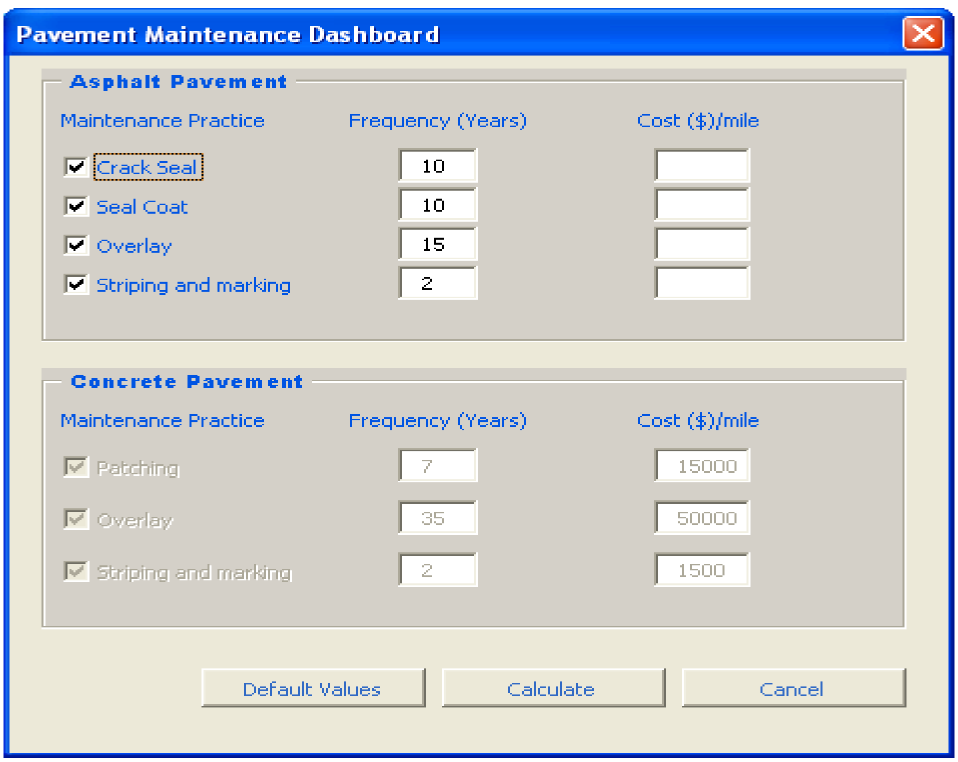


Figure 5.5. Manual override dashboard

5.3 Application—Lincolnway Energy Cooperative

The Lincolnway Energy Cooperative was formed in March 2004 and began production on May 22, 2006. It is a 50 million gallon per year coal-fired dry mill ethanol plant. The plant is located between Ames and Nevada, Iowa, as shown in Figure 5.5, in an area of abundant corn production. The site was annexed by the City of Nevada to take advantage of the municipal electrical service, inexpensive water supply, waste water discharge, fire protection, and other municipal services. The plant is adjacent to the Union Pacific's Class I railroad and the Heart of Iowa Cooperative, which handles the corn feedstock for the plant.

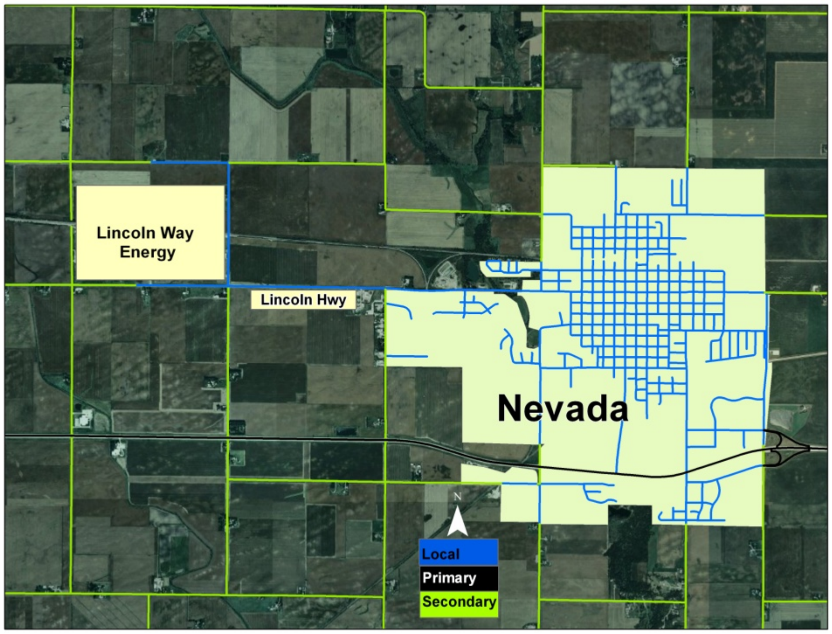


Figure 5.5. Map showing location of Lincolnway Energy Cooperative

5.3.1 Plant Inputs

The plant inputs were loosely based on an interview with the plant manager on Tuesday, December 1, 2009. These inputs are summarized in Figure 5.6. The plant uses 20 million bushels of corn annually.

	A	B
1	WARNING: DO NOT CHANGE VALUES IN BLUE FONT!!!	
2–3	ETHANOL	
4	Enter Plant capacity (million gallon)	50
5	Enter total bushels of corn or soybean or leave blank	20000000
6	**INPUTS**	
7	CORN (bushels)	20000000
8	Trucks In	16667
9	% by Trucks	80
10	ESALS	30667
11		
12	OTHER INPUTS (e.g liquid propane, coal, yeast, limestone, ammonia etc)	
13	Trucks In	4593
14	ESALS	10564
15	**OUTPUTS**	
16	ETHANOL	
17	Trucks Out	5556
18	% by Trucks	30
19	ESALS	3833
20		
21	DISTILLERS DRIED GRAINS (LB)	340000000
22	Trucks Out	6800
23	% by Trucks	60
24	ESALS	9384
25		
26	OTHER OUTPUTS (e.g. fly ash, syrup, corn oil, etc)	
27	Trucks Out	1768
28	ESALS	4066
29	**EMPTY TRUCKS**	
30	Empty Trucks In	7515
31	Empty Trucks Out	17926
32	ESALS	15265
33	**PLANT TRAFFIC**	
34	TOTAL Annual ESALs	47950
35	Daily Truck load	139

Figure 5.6. Summary of plant inputs for Lincolnway Energy Cooperative

5.3.2 Traffic Inputs

The current daily traffic figures are from the Iowa DOT GIMS 2004 snapshot. The year 2004 was used because that was before the plants were constructed. The pavement thickness value is also based on GIMS. The pavement thickness was obtained from the Story County engineering office and City of Nevada.. Figure 5.7 summarizes the traffic inputs.

3	**TRAFFIC**		
4	Growth Rate, %	2.00	
5	Design Period, Years	20	
6	Multiplier	24.297	
7	**CURRENT DAILY TRAFFIC**		ASPHALT
8	Number of Single Unit Trucks		120
9	Number of *Combo Unit Trucks		78
10	**Pavement thickness		24
11	Annual Esal		66588
12	Design Period Esal		1617914
13	**PLANT TRAFFIC**		ASPHALT
14	% of Impact		100
15	Daily Traffic		139
16	Annual Esal		47950
17	Design Period Esal		1165069
18	**TOTAL ESALS**		
19	ASPHALT	2,782,983	
20			
21	*COMBO = single and multiple trailer units with 5 axles and above		
22	**Total thickness measured from stable subgrade to surface.		
23	HMA (17 -32 inches), PCC (6 - 13.5 inches)		
24			

Figure 5.7. Summary of traffic inputs for Lincolnway Energy Cooperative

5.3.3 Model Outputs

Based on the plant and traffic inputs, for a 20-year design period and given the pavement thickness, the roadway maintenance costs is not going to be impacted by the plant activities, as shown in Figure 5.8, because the roadway was designed to handle the anticipated amount of traffic from the plant. But if the plant was to increase production capacity to 100 million gallon with the current pavement thickness, the projected traffic increase would increase maintenance costs by 26%, as shown in Figure 5.9. Basically, to eliminate extra costs, the pavement thickness should be increased to handle anticipated traffic increase.

PAVEMENT ANALYSIS		
	CONCRETE	ASPHALT
*Design Esals	NA	3,000,000
**Projected Esals due Plant	NA	2,782,983
RESULTS		
PCC Not applicable or cannot calulate		
Present worth maintenance cost before plant:	NA	To enter county specific maintenance practices and costs, click "Manual Override
Present worth maintenance cost after plant:	NA	
Annual Maintenance cost before plant:	NA	Manual Override
Annual Maintenance cost after plant:	NA	
HMA Maintenance cost WILL NOT be affected by the plant at current operating capacity.		
Present worth maintenance cost before plant:	$68,291	
Present worth maintenance cost after plant:	$68,291	
Annual Maintenance cost before plant:	$5,833	
Annual Maintenance cost after plant:	$5,833	
* Original design esals based on the pavement thickness		
** Combined esals from current traffic and plant traffic projected over the design period		

Figure 5.8. Module outputs for Lincolnway Energy Cooperative

PAVEMENT ANALYSIS		
	CONCRETE	ASPHALT
*Design Esals	NA	3,000,000
**Projected Esals due Plant	NA	3,803,885
RESULTS		
PCC Not applicable or cannot calulate		
Present worth maintenance cost before plant:	NA	To enter county specific maintenance practices and costs, click "Manual Override
Present worth maintenance cost after plant:	NA	
Annual Maintenance cost before plant:	NA	Manual Override
Annual Maintenance cost after plant:	NA	
HMA Maintenance costs will go up 26%.		
Present worth maintenance cost before plant:	$68,291	
Present worth maintenance cost after plant:	$86,591	
Annual Maintenance cost before plant:	$5,833	
Annual Maintenance cost after plant:	$7,396	
* Original design esals based on the pavement thickness		
** Combined esals from current traffic and plant traffic projected over the design period		

Figure 5.9. Module outputs for Lincolnway Energy Cooperative at double operating capacity

5.4 Limitations of the Calculator

The calculator does not factor in the impacts of construction traffic nor does it account for traffic due to regular maintenance of the plants. In addition, it does not account for safety-related costs, such as the cost to add turn lanes and other safety countermeasures. Furthermore, the maintenance costs should be updated periodically.

5.5 Pavement Thickness Design

Several pavement design simulations were conducted using the 1993 AASHTO *Pavement Design Guide for New and Rehabilitated Pavements*. The design levels ranged from 300,000 to 30,000,000 ESALs, and designs were created at both the 80% and 95% levels of reliability for both flexible and rigid pavements. Typical values were used while developing the designs and are summarized in Tables 5.2 and 5.3 for rigid and flexible pavement designs, respectively.

Table 5.2. Rigid pavement design assumptions

Design Assumption	Property Value
Concrete Modulus of Rupture, psi	650
Concrete Elastic Modulus, psi	4,500,000
Modulus of Subgrade Reaction, psi/in	300
Standard Deviation	0.45
Load Transfer Coefficient	3.3
Drainage Coefficient	1
Initial Serviceability	4.5
Terminal Serviceability	2.5

Table 5.3. Flexible pavement design assumptions

Description	Layer Coefficient, ai	Drainage Layer Coefficient, mi	Elastic Modulus, psi
AC Layer	0.46	1.00	400,000
Gran Base A	0.14	0.90	35,000
Stabilized Subgrade	0.14	0.80	20,000
Subbase	0.11	0.80	15,000
Design Assumption		**Property Value**	
Standard Deviation		0.45	
Subgrade Resilient Modulus, psi		3,000	
Initial Serviceability		4.5	
Terminal Serviceability		2.5	

A silty clay typical of central Iowa was assumed to be the subgrade.

Utilizing the aforementioned design assumptions, the 20-year pavement designs are summarized in Table 5.4.

Table 5.4. Summary of 20-year pavement designs

Design ESALs	Reliability, percent	Flexible Pavement Design Layer Thickness, in			Rigid Pavement Design Thickness, in.
		HMA	Granular Base	Stabilized Subgrade	
100,000*	80	4.0	5.0	6.0	5.0
	95	5.0	6.0	6.0	5.0
300,000 *	80	5.0	6.0	6.0	6.0
	95	5.5	8.0	6.0	6.0
1,000,000	80	6.0	8.0	6.0	6.5
	95	7.0	8.0	6.0	7.5
3,000,000	80	7.0	10.0	6.0	8.0
	95	8.0	11.0	6.0	9.5
10,000,000	80	9.0	10.0	6.0	10.0
	95	10.0	11.0	6.0	11.5
30,000,000	80	10.0	13.0	6.0	11.5
	95	11.0	15.0	6.0	13.5

* The minimum thickness for the AASHTO Pavement Design Guide is 5 inches, thus Design ESAL level is actually 330,000 for both the 100,000 and 300,000 Design ESALs for the 80% reliability, and 150,000 Design ESAL for the 100,000 Design ESALs and 95% reliability.

5.6 Comparison with Linn County Design Standards

Linn County, Iowa, has formalized a process to manage development areas within the county. County standard specifications have been developed by the office of the Linn County Engineer. The latest edition was adopted April 25, 2007 by resolution 2007-4-53. The intention is that the suggested design criteria and construction specifications will be the required limits for developing construction plans for proposed rural subdivision streets.

Linn County has a roadway classification system as follows: classification A road—major arterial; classification B road—minor arterial; classification C and D roads—collector roads and rural subdivision streets; classification E—private roads; and classification F road—private lane.

A major county arterial carries through traffic across the county, between communities, and between other major arterial roads. These roads are intended to receive a high-quality pavement and carry a major portion of the traffic on the secondary roads in Linn County. As shown in Table 5.5, major arterials are divided into three subclasses for design purposes.

Table 5.5. Subclasses for major arterial roads

Major Arterial subclassification	Traffic Count, AADT	
	Current	20 Years
A-1	Over 750	1000 to 2000
A-2	250 to 750	400 to 1000
A-3	50 to 750	100 to 400

A minor arterial connects the rural subdivisions and collector streets. It is generally one to six miles in length and connects its service roads with the major arterial system. The ultimate roadway surfacing is intended to be a dust free surface or high-type pavement. As shown in Table 5.6, minor arterials are divided into two subclasses.

Table 5.6. Subclasses for minor arterial roads

Minor Arterial subclassification	Traffic Count, AADT	
	Current	20 Years
B-1	250 to 750	400 to 1000
B-2	50 to 250	100 to 400

Classification C and D roads connect to major arterial roads, minor arterial roads, or collector roads. These roads are intended for local use and low traffic volumes and are generally rock surfaced.

Classification E and F roads are under the jurisdiction of private interests. They serve local transportation needs and may have a high-type surfacing or may be rock surfaced. The criteria for major and minor arterials may apply, depending on the traffic volumes generated by the land use.

Figure 5.10 and 5.11 show how subdivision streets should be surfaced. It should be noted that these typical sections are only 2 of the 10 used by Linn County (see Appendix F).

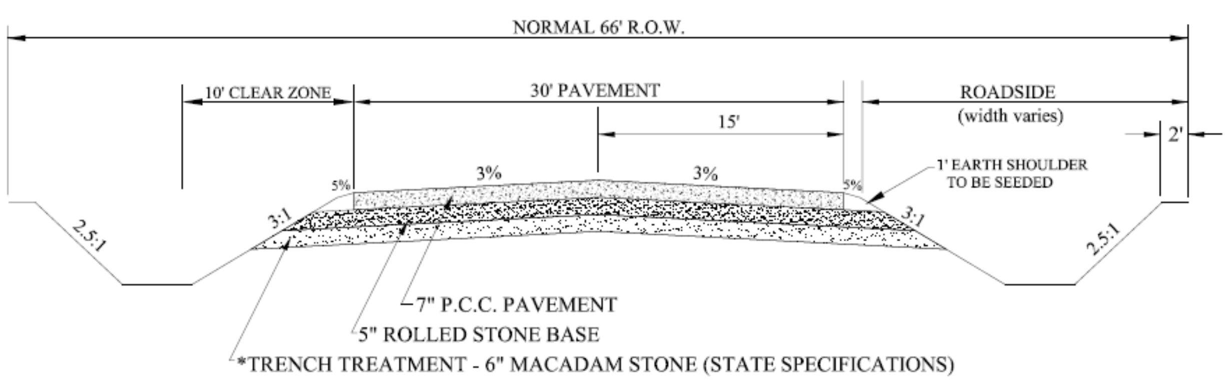


Figure 5.10. Typical minimum PCC pavement—open ditch section

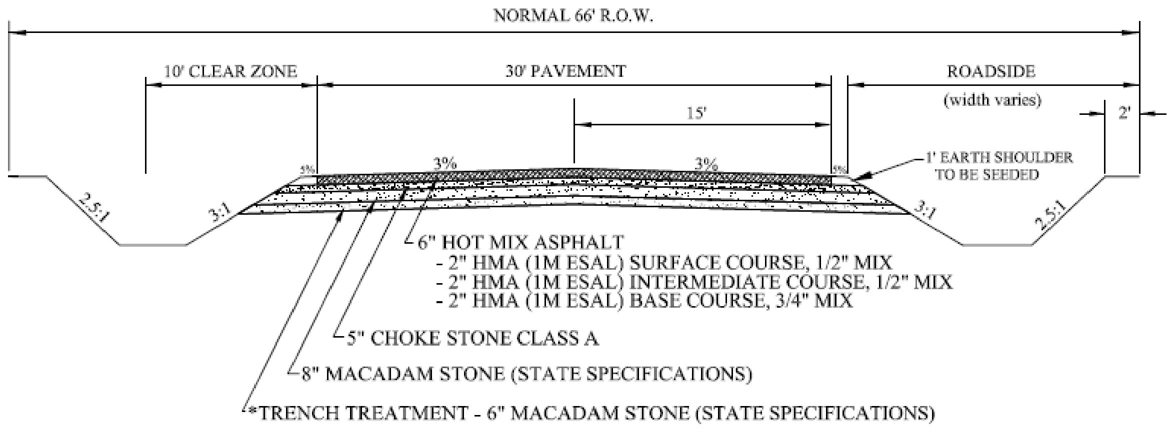


Figure 5.11. Typical minimum HMA pavement, macadam stone base—open ditch section

The county engineer should approve the PCC mix design. A classification of C-4 concrete with Class 2 coarse aggregate is the minimum that is acceptable. The HMA mix should be determined by the job mix or as approved by the county engineer. Typically, a ½ inch, 1,000,000 ESAL, PG 64-22 mix is used, with a 6% target asphalt content. The research team found that these requirements are similar to those utilized by the county engineers who participated in the local agency survey and who were interviewed, as described in Chapter 3 of this report.

The requirements are compatible with the calculations presented in this chapter. Please refer to Table 5.4. Linn County uses an ESAL value of 1,000,000 in its pavement calculations. The pavement thickness comparisons can be seen in Table 5.7.

Table 5.7. Pavement thickness comparisons

1,000,000 ESALS	Pavement Thickness	
	PCC (in.)	HMA (in.)
Linn County	7	6
Research Calculations	6.5–7.5	6–7

Linn County requires roadways to be constructed per the county standard specifications for major subdivisions with four or more lots, cluster/conservation subdivisions, and rural village extension developments. The standard specifications also require conditional use permits and should be shown on minor site plans and all platting submittals.

CHAPTER 6. TRUCK SIZE, CONFIGURATION, AND WEIGHT ISSUES

6.1 Introduction

This task generated an understanding of trucks, trailers, and other vehicles that are currently being used or will likely be used to support the conventional biofuels industry, the wind power industry, and the cellulosic biofuels industry. Size (e.g., turning radius) and weight/axle loadings were examined for a variety of vehicles. The truck, trailer, and vehicle characteristics have implications in terms of roadway geometrics, unpaved roadway structure designs, pavement designs, structural designs, and roadway maintenance practices and costs.

The research team visited the wind energy manufacturing facilities of Clipper Turbine Works, Inc., in Cedar Rapids, Iowa. The team was hosted by Greg Kint, senior manufacturing engineer, who guided the team on a tour and explained the assembly and testing processes utilized prior to shipping turbines to construction sites. During that tour, the team received the "WYG Component Transportation Configuration Specifications" used in the shipping activities. These specifications are included in Appendix G and graphically illustrate the truck and trailer configurations used. The specifications for shipping the blade assemblies are shown on page 24 of 36 (G-25). Each tower has three blade assemblies. The overall length from the front axle of the tractor to the rear axle of the trailer is normally 99 feet. In addition, there is an overhang off the back of the trailer, but it is not a critical concern when planning the turning radius needed.

In further discussions with Clipper representatives, the research team discovered that Clipper does not have a vehicle fleet to conduct the shipping activities themselves. They contract for transportation services, which seems to be a fairly routine way for wind generator manufacturers to conduct business. In researching the various transportation firms involved with Clipper, the team identified four trucking firms located in Cedar Rapids, Iowa; Minnesota; and Texas. In discussions with representatives of these trucking firms, the research team found that the loads shipped to the construction sites are not uniform in size, shape, or weight. That is the reason for the shipping specification used by Clipper. In other words, tractor trailer configurations are inconsistent within the industry. There are many variables in axle spacing, the goose neck connection, and overall vehicle length. As a result, the research team did not have a typical tractor-trailer combination to use for determining the turning radii for local road intersections.

6.2 Construction Activities

Chapter 3 of this report included an in-depth discussion of the construction activities and how the renewable energy industry has responded to the impact on local roads. In general, the contractor has maintained the roadways during construction and restored them prior to completing projects. The counties did not have recorded cost data to show that maintenance costs increased during construction activities. In several locations, RISE funding was used for improvements on major routes into production facilities. A cost was incurred but not directly by county budgets. As a result of the findings in Chapter 3, the research team did not focus on the impacts of construction vehicles on the local roads, except for the turning radii of long trailers used for transporting the wind turbine blade assemblies.

6.3 Ethanol and Biodiesel Facilities

In Chapter 2 of this report, the research team identified current production conditions in Iowa and predicted what the future may have in store for this industry. In general, the industry will soon be limited by the supply of corn available for processing. In order to expand production and meet national goals for energy production, it will be necessary to develop biofuels from cellulosic materials, such as corn stover, wood products, etc. When that time comes, it will be important to identify the transportation mode and the vehicles that will be utilized. Researchers should take a lead role in analyzing the local transportation infrastructure impacts as these materials and vehicles are identified and designed.

The vehicle loads and lengths currently used in the biofuels industry are, in theory, all legal vehicles. In practice, when grain deliveries are made by individual producers to the plant (or adjoining elevator), many may indeed be too heavy or too long for some situations, although all of them are supposed to be within legal limits or are governed by a permitting process. Other than discussing the impacts in other chapters, the research team did not focus on oversized vehicles associated with the renewable fuels industry.

The number of trips generated by the input and output materials and products of the renewable fuels industry can be calculated using the model presented in Chapter 5. The model will also predict the volumes and weights for transporting materials in and products out of a plant site.

6.4 Wind Energy Farms

The construction of wind farms and the ongoing impacts on the transportation infrastructure were discussed in Chapters 3 and 4 of this report. In general, the industry assumed the maintenance cost during construction and restored the roadways at the end of the project. The cost data reviewed by the research team did not identify specific costs associated with the wind farm construction and the ongoing operations. In the future, when components are replaced, there should be a research effort to estimate and document the size of the truckloads required and the potential impact to the local agency transportation infrastructure.

The vehicle loads and lengths currently used in the wind energy industry are all legal vehicles. They may be too heavy or too long for some situations, but all of them are within legal limits or are governed by a permitting process. The one vehicle type identified in the research team's proposal was the long tractor-trailer units required for transporting the blade assemblies. There may be as many as 10 truckloads of equipment shipped from the fabrication plant to the construction site. The last leg of this journey will be on county roads and bridges.

In discussions with representatives of trucking firms who transport these blade assemblies, the research team found that there is not one tractor-trailer configuration that is consistent within the industry. There are many variables in axle spacing, the goose neck connection, and overall vehicle length. In addition to these variables, some of the trailers are constructed with rotating rear wheel assemblies that alter the turning radii. An example of this application is a hook and ladder fire truck that has a steerable rear wheel assembly. The purpose of the assembly is to reduce the turning radii and allow for turning at city intersections. The same principle is applied to some trailers used to transport the blade assemblies.

6.5 Turning Radii for Blade Assembly Trailers

In discussions with representatives of trucking firms who transport these blade assemblies, the research team found that there is not one tractor-trailer configuration that is consistent within the industry. There are many variables in axle spacing, the goose neck connection, and overall vehicle length. In addition to these variables, some of the trailers are constructed with rotating rear wheel assemblies that alter the turning radii. The wheel assembly can rotate up to 37 degrees in order to help negotiate tight roadway corners. The research team discussed the design features with trailer manufactures. International Specialized Trailer Manufacturing, LLC, located in Litchfield, MN, was helpful in identifying the design features. The many trailer designs and a video illustration of the rotating wheel assembly can be found at http://www.isttrailers.com/blade-trailer.cfm. It is a very interesting video clip and is most helpful for illustrating how the turning radii are impacted.

The research team was able to find illustrations of turning radii used in roadway design applications. The team found that a 125-foot radius for the rear trailer axel unit has been successfully designed and is operational for wind farms in Wyoming.

The research team discussed the permitting process for the blade assembly trailers with Iowa DOT officials and found that the Iowa DOT does not monitor the vehicle length. The Iowa DOT's position is that the shipper should identify a route that can be negotiated by these tractor-trailer combinations.

6.6 Future Trends

In order to expand production and meet national goals for biofuels production, it will be necessary to develop biofuels from cellulosic materials, such as corn stover, wood products, etc. When that time comes, it will be important to identify the transportation mode and the vehicles that will be utilized to transport materials from the farm to the plant. Researchers should be in a lead role to analyze the impacts of the local transportation infrastructure as these materials and vehicles are identified and designed.

Wind energy turbines continue to get bigger and bigger. They were initially 0.5 MW in Iowa and are now up to 3.0 MW (Franklin County). Chapter 3 discussed the size evolution of wind turbines. The result of these larger turbines is increased weight of the components that will be delivered to the construction sites. The county transportation system will be impacted by the increased loads of materials. Figure 6.1 provides an example of the size evolution of the wind turbines.

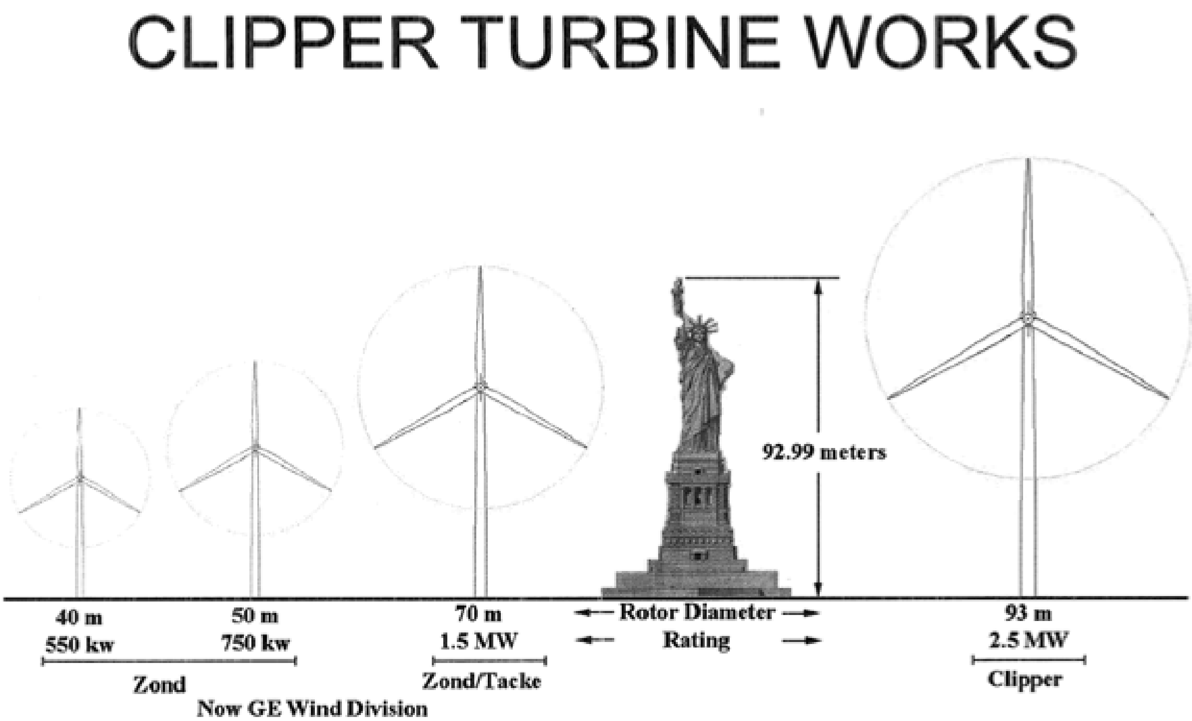


Figure 6.1. Clipper turbine evolution

The initial 40 m turbines were installed in the 1980s, and already the size has grown to 93 m. Figure 6.1 uses the Statue of Liberty to compare how the size of turbines has grown in the past 30 years. Future trends in wind energy production would indicate that the turbines will continue to get larger as the demand for electricity grows.

CHAPTER 7. PUBLIC POLICY IMPLICATIONS

While collecting information and data from the counties that the research team interviewed for this report, it became apparent that many items need further clarification for an effective analysis. During the analysis portion of this research, areas of non-existent or incomplete data also became apparent and limited any conclusions that would have been data driven. Accessible and accurate information is vital to any detailed analysis of the full economic impacts to local jurisdictions. Several additional items became apparent during this work and could be addressed by changes in public policies relating to the local government and to the administration of those policies.

Standardize the reporting and format of all expenditures by all entities involved. Although some biofuels plants have existed for several years, little local government data specific to the plants' construction and operation are available. While some limited data are available, it is not reported in any particular place or format. In many cases, a combination of county, city, and state dollars (economic development or RISE funds) are spent to entice facilities and to maintain plant operation. The final expenditures from each spending area usually needed to be obtained from each entity and sometimes from more than one area of the annual reports (construction and maintenance) and sometimes over a two–fiscal-year period.

Many of the counties interviewed were unable to separate their specific increase in road maintenance costs after a plant's opening compared to the costs before the plant began operating. Without some accurate records of past costs, predicting future ones (to forecast needs) is impossible.

Likewise, all revenues provided need to be reported in a standardized format by all entities involved and aggregated in some uniform report. Also, the safety-related costs—costs for turn and acceleration lanes for outgoing traffic—need to be accounted for and included in the total cost of plant operation. The research team recommends working with the county engineers and their service bureau to develop a common, all-inclusive reporting form to resolve this.

Cooperate and communicate with cities (adjacent to a plant site). Discussions regarding possible annexations need to take place early in the process, and future tax revenues (or loss thereof) need to be considered in any economic analysis. If the property were annexed into a city after a county has paid the initial costs of road or utility improvements, the unexpected loss of valuation and tax dollars would greatly change the financial picture that the county had anticipated. Initial costs of providing needed utilities are valid costs, and the proper jurisdiction for joint projects should logically receive compensation. An example of annexation by an adjacent city to provide necessary utilities is shown in Figure 7.1. In this case, the City of Nevada (in Story County, Iowa) annexed a strip of highway right-of-way to connect the ethanol property to the city limits. They also created a TIF district as a method of paying for the needed utility and roadway improvements by earmarking the (future) tax revenues.

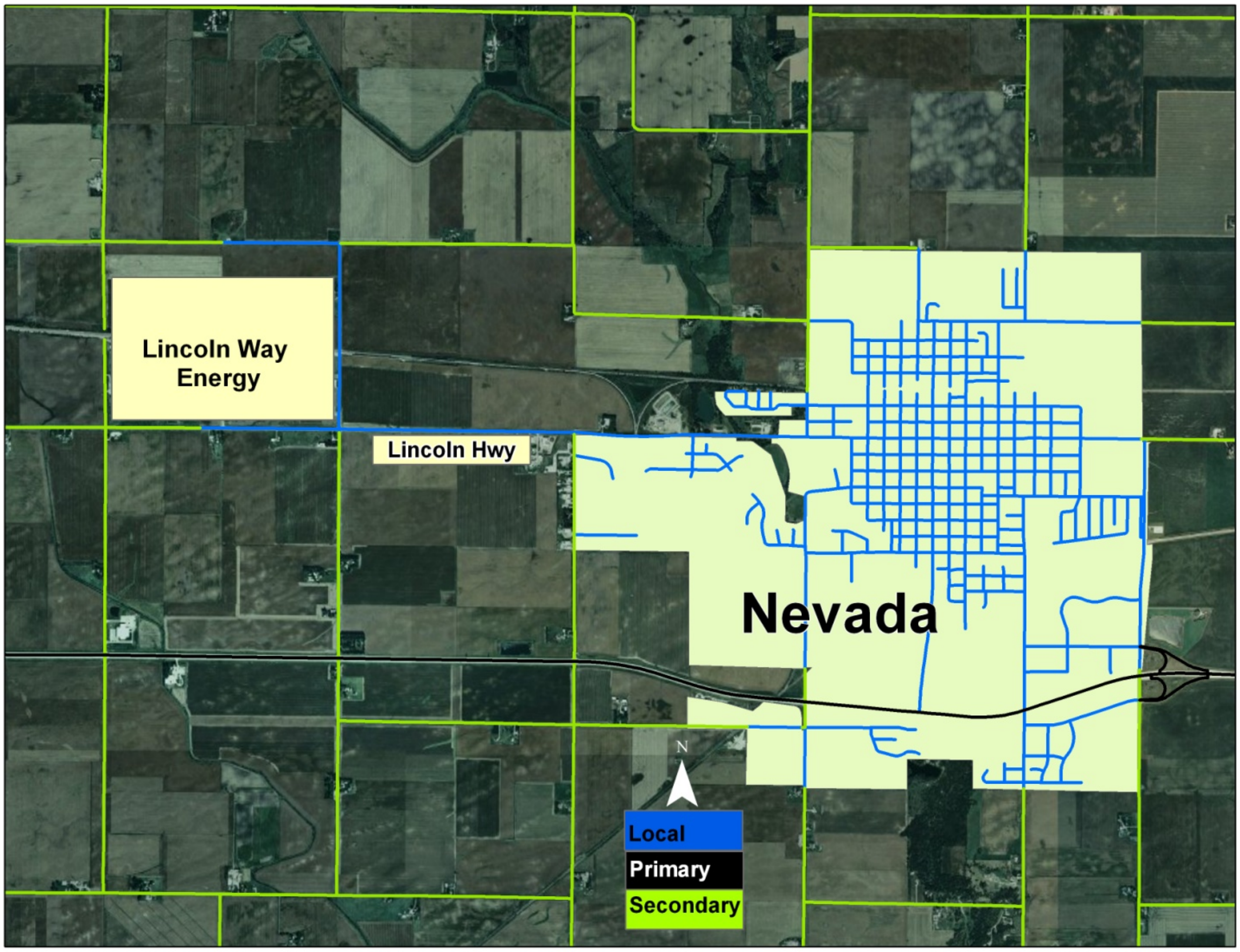


Figure 7.1. Example of annexation

Consider utilizing TIF districts as a short-term tool. TIF districts could be used to produce revenues within a local jurisdiction. This technique has been used successfully in some northern counties in conjunction with new wind farm construction and is being adopted by a few more. Using this method requires the conviction of the Board of Supervisors early in the planning process and may have some effect on "negotiating" to get a wind farm in any individual jurisdiction. However, the developer needs to be aware of the county's intent and the board should sign no agreements that limit their ability to use this financing tool. Although the TIF procedures themselves do not have to be initiated that early, all TIF documentation, hearings, and final action to create it MUST be in place before any power is produced and sent to the power grid for distribution.

Consider developing policies or regulations for where these types of plants may locate. These policies and regulations should be based on the proximity of a paved road system. However, most developing plants have their own checklist of highly desired amenities for their chosen site. Only one of these amenities is good highway access. Many also look for the needed utilities, alternate transportation options (railroad), and proximate access to vast quantities of raw product, such as an elevator storing corn. Thus, the ability to always influence a developer's choice on location does not often exist.

Several of the counties reported that having the actual plant site along a state highway or on an existing county pavement could reduce their initial costs for providing services to the plant. Those roads also tended to perform better than unpaved ones, especially during spring thawing conditions, thus reducing their overall maintenance costs. As previously noted, the increased loadings on those pavements may also cause severe damage if they do not have the structural strength to support them. Adopting standard zoning and roadway design standards and specifications, such as those of Linn County (Appendix F), may help avoid many problematic situations before they worsen.

Conduct regular pavement evaluations on a county's system. Regular evaluations will provide data that will allow a much better picture of the main roads used both before and after a plant's opening. Although many counties began using a pavement management system several years ago, most have discontinued the program because of the cost of the inspections and the limited past use of the data. A few counties still collect data but only for their federal aid routes. Reviewing the road data available within varying radii of a plant should reveal varying rates of deterioration due to the increased truck traffic near a plant. Having consistent rate data for a given radius would provide more information for establishing some type of assessment system to increase revenues. Also, this type of data would enable more consistency for counties that want to adopt appropriate pavement design standards in the vicinity of the actual plant site. However, in order for this degree of statewide testing and evaluation to be fully implemented, the cost of the inspections would need to be absorbed by resources (regional or state) other than individual county funds.

Consider the implications of providing tax reductions or abatements. Counties have a very strong political impetus to provide economic incentives to get the new facilities (especially the tax base and additional jobs) in their jurisdiction; however, there are also financial implications in terms of ongoing road maintenance costs that need to be considered as well. Especially in this era of shrinking revenues for that purpose, some method of "creative financing" should be implemented to offset any revenue losses given away through promised tax reductions. As noted earlier in the report, it is almost impossible for elected officials to go against or to complicate the plans of developers and local business investors when something is being proposed in the name of community development. Departments are often left short on the resources that are necessary to maintain facilities to the standards now required for the industry. The advantages and disadvantages of implementing a statewide policy on tax abatements and potential tax reductions should be considered as well.

Consider more effective ways to tax (or assess) the industry. The local jurisdiction usually accrues additional costs, so there should be more effective ways to tax the industry for appropriate additional costs. Although current Iowa law does not specifically allow this, there may be a possible "fee for service" option that could be established in an initial agreement with the developer that would be legal. Other options would be a tax or fee (per bushel of corn, gallon of product, kilowatt-hour, or whatever unit is appropriate) that could be legislated to properly compensate the local entity for increased road maintenance and construction due to increased traffic from a facility's new or expanded land use. Any consideration like this should include allowances for inflation as well as potential increases in plant production. Because counties are currently restricted under "home rule" laws from adopting ordinances that impose "taxes" on their constituents, legislative action by the state legislature would be necessary. Additional options that were proposed by the project's TAC for further consideration include implementing an axle-based weight-mile tax to account for the road damage caused by trucks (similar to Oregon) and reinstating the road use tax for diesel fuel (for agricultural use).

Other. Investigation into the amount of construction traffic involved with the building of a new ethanol (or biofuels) plant and the weight of the materials that go into it were not defined or evaluated as a part of this project. Therefore, a method of estimating these items and including them as increased pavement loads could be included in the model and should be part of future research. Increased detail could be obtained by a review of past plan sets and by interviews with designers and contractors. More accurate loads accounting and their effects on subsequent pavement deterioration could then be evaluated.

CHAPTER 8. TECHNOLOGY TRANSFER ROAD MAP

The technology transfer plan involves transferring the findings of this research to practitioners at the state and local levels in Iowa. The research team's plan consists of presenting to professional organizations and submitting articles to journals. This research was the initial study that sets the groundwork to fully analyze and recommend a course of action for Iowa's renewable energy. The professional organizations that will be the main target are those representing local and state governments.

The ICEA conducts a planning meeting each January for the purpose of developing the training agenda for their four annual meetings. An Institute for Transportation (InTrans) staff member is on the planning committee and will continue to provide topics related to this research for the ICEA's consideration. The research team has been invited twice to present the research objectives and anticipated benefits at the annual ICEA meeting. The director of the Iowa LTAP sits on the Iowa Chapter of the American Public Works Association (APWA) board as the chair of the educational committee. In this capacity, the LTAP director facilitates and assists in the planning of educational events hosted by the chapter. The director will continue to look for opportunities to share the results of this research with the APWA members, both locally in Iowa and nationally through the national APWA network.

In addition, the Iowa LTAP director plans, organizes, and produces educational and training events for Iowa's local governments. In that capacity, the director has the opportunity to create materials and organize workshops and seminars using the results of this research. The director will include this research in the planning of LTAP activities.

There will always be an opportunity to share the research results on a larger platform. This may be at the local, regional, and even national levels. Two quick examples include an invited presentation at the rural financing workshop during the 89th Transportation Research Board (TRB) meeting in January 2010 and an invitation to submit an article to *TR News* (TRB's bimonthly magazine), presenting the results of this research. The research team also plans to present at the 10th International Conference on Low-Volume Roads in July 2011.

A more important mission will be to develop and implement public policy issues as they relate to the renewable fuels industry and the impacts to local governments. Actual implementation of a specific technology transfer plan is beyond the scope of this proposed research project, but many initiatives will be used to share the research results.

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APPENDIX A. INITIAL COUNTY SURVEY

Seeking Information from Counties

Currently, corn-based ethanol is the leading biofuel in the nation, and Iowa is the top producer of corn-based ethanol. In order to meet the 20-percent national goal that the U.S. Department of Transportation has set, cellulose-based fuels will have to be produced. When this occurs, the tonnage of feedstock transported to the biofuels manufacturing plant will increase dramatically. Iowa has also quickly become one of the top five states in the nation in terms of wind energy production. Many local agencies face the challenge of supporting movements of heavy wind generation equipment on county secondary roads. It is apparent that there is a need to understand the transportation infrastructure support needs of these industries.

The Center of Transportation Research and Education (CTRE) is conducting research for the Iowa Highway Research Program (IHRB) to assess the impacts on Iowa's transportation infrastructure due to the needs created by the developing bio-economy. As part of this research, we are seeking information from counties concerning their involvement with the development of ethanol plants and expanded power generation. Any information you can provide would be greatly appreciated.

Our experience with this survey indicates that it will take approximately 3-5 minutes to complete. Some of the key questions of the research team are listed below, but any additional observations or comments you may have are certainly welcome. Also, if you could provide the name of any other person in your county that we may contact in case we have additional questions, it would be much appreciated.

To fill out the survey, simply hit the "Reply to All" button, fill out, and hit "Send."

Please complete the survey by Monday, **November 24, 2008** If you wish, you may fax your response at: (515) 294-0467, attention to: Nadia Gkritza.

Thank you for your assistance in this research.

Iowa's Renewable Energy and Infrastructure Impacts Research

County______________________________ Date _________________________

1. Does your county have any involvement with renewable energy sources in operation currently?

Yes ☐ No ☐

   a. If yes, please complete the survey.
   b. If no, please submit your survey and thank you for your time.

2. What is the status of **Ethanol Plant(s):**

	Yes	No
Planned?	_______	_______
Under Construction?	_______	_______
Operating?	_______	_______
If operating, since when?	_______	_______

3. What is the status of **Biodiesel Plant(s):**

	Yes	No
Planned?	_______	_______
Under Construction?	_______	_______
Operating?	_______	_______
If operating, since when?	_______	_______

4. What is the status of **Wind Turbine Farm(s):**

	Yes	No
Planned?	______	______
Under Construction?	______	______
Operating?	______	______
If operating, since when?	______	______

5. What is the status of any **Co-generation Facility (e.g., corn stover/coal):**

	Yes	No
Planned?	______	______
Under Construction?	______	______
Operating?	______	______
If operating, since when?	______	______

6. Does your county have any information that would be helpful for estimating additional agency infrastructure costs, if any, associated with the construction and ongoing operation of the renewable energy facilities?

Yes ☐ No ☐

7. Would you be willing to share that information for this research?

Yes ☐ No ☐

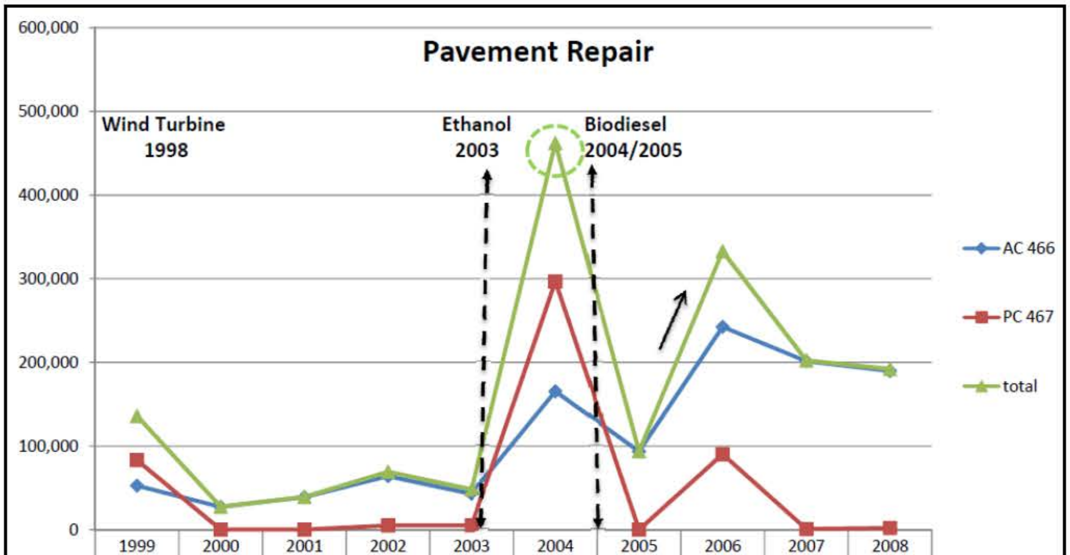
Contact name: (If other than the County Engineer)

____

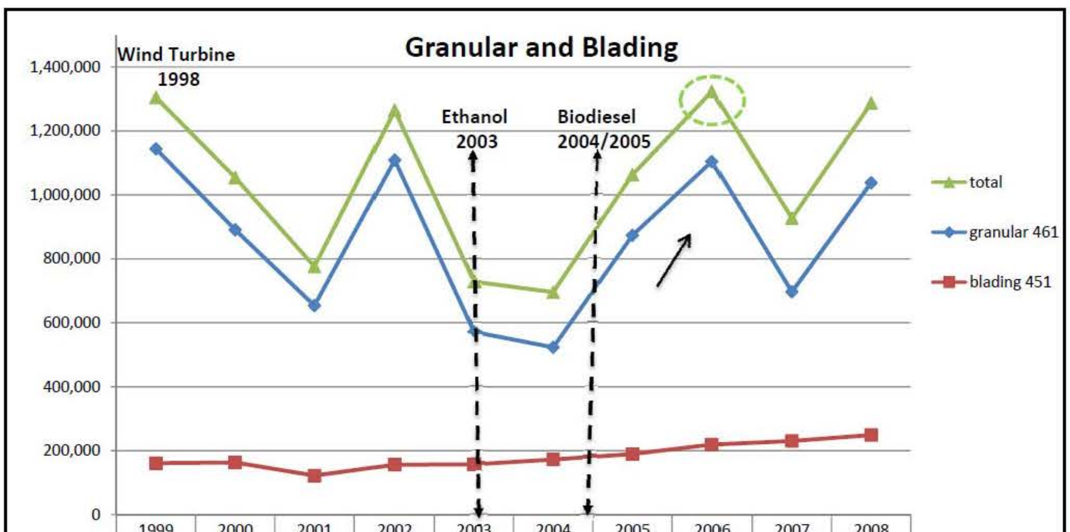
____

APPENDIX B. MAINTENANCE COST GRAPHS FOR CERRO GORDO, FLOYD, MITCHELL, AND WORTH COUNTIES

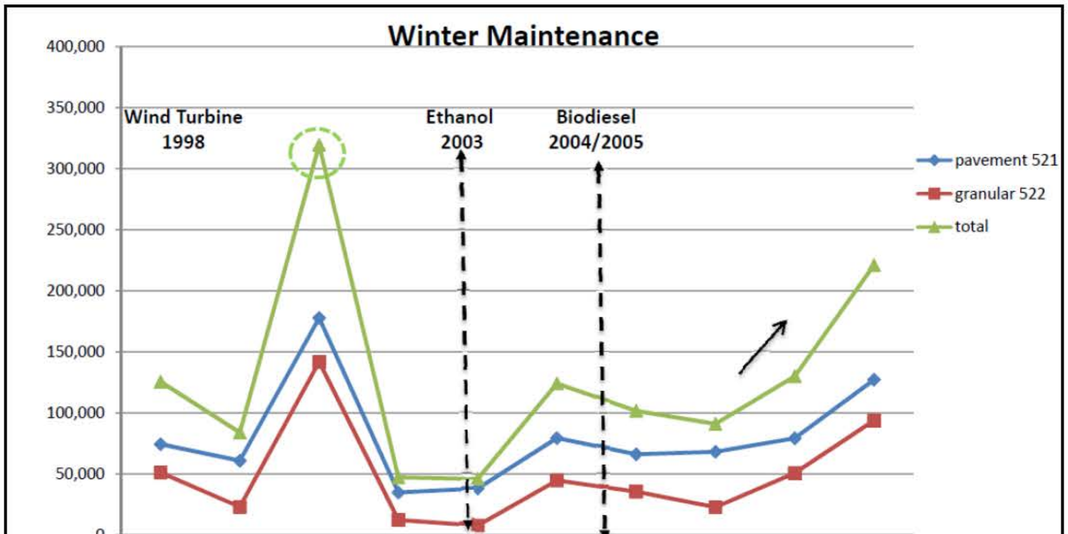
Cerro Gordo County



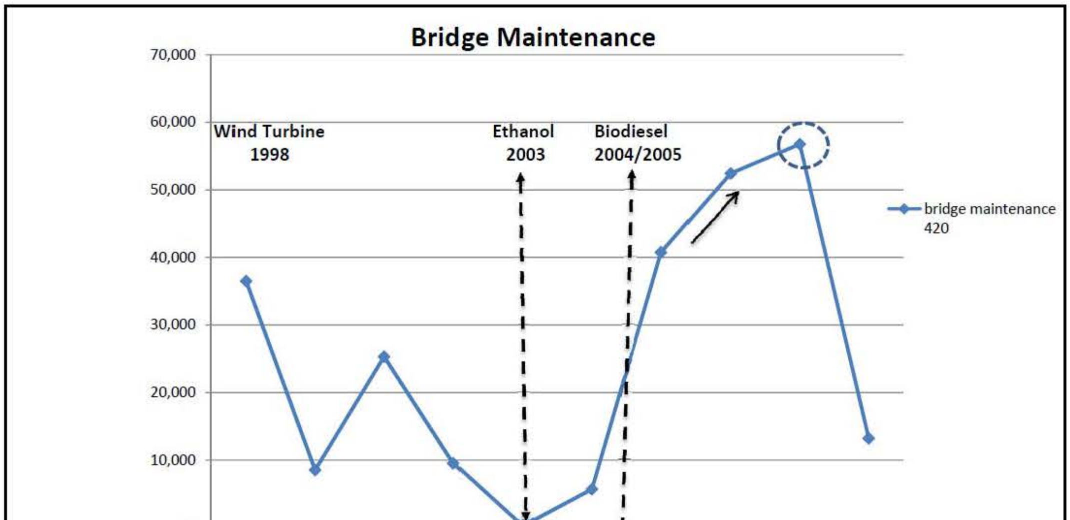
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AC 466	52,716	27,276	38,985	64,099	42,929	165,435	93,618	242,526	201,403	189,854
PC 467	83,200	168	229	5,105	5,209	296,711	61	90,332	892	2,121
total	135,916	27,444	39,214	69,204	48,138	462,146	93,679	332,858	202,295	191,975



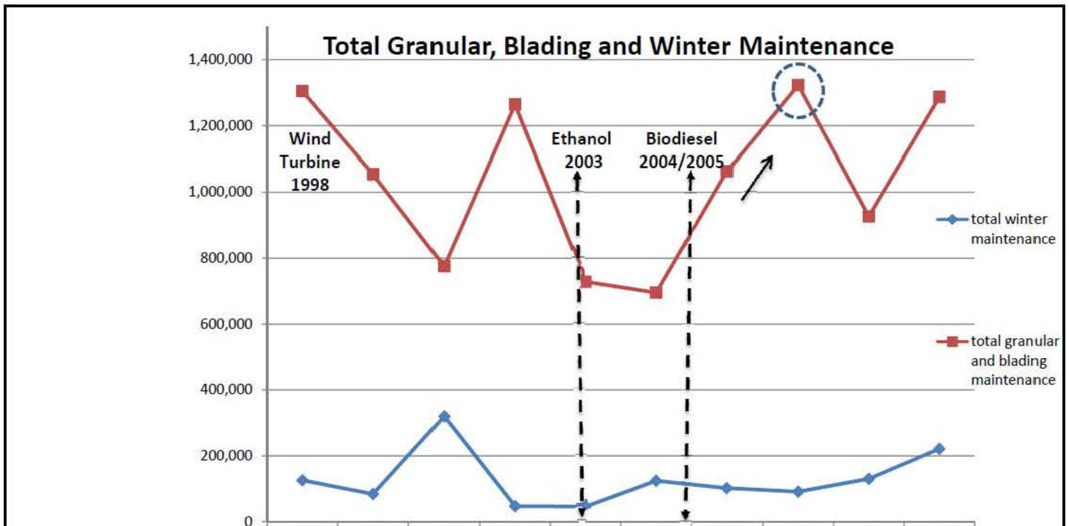
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total	1,304,53	1,053,80	775,706	1,264,45	728,479	695,431	1,062,79	1,322,85	926,858	1,286,60
granular 461	1,143,58	890,673	653,492	1,108,51	571,408	523,190	873,257	1,103,78	696,667	1,037,81
blading 451	160,948	163,134	122,214	155,937	157,071	172,241	189,534	219,068	230,191	248,797



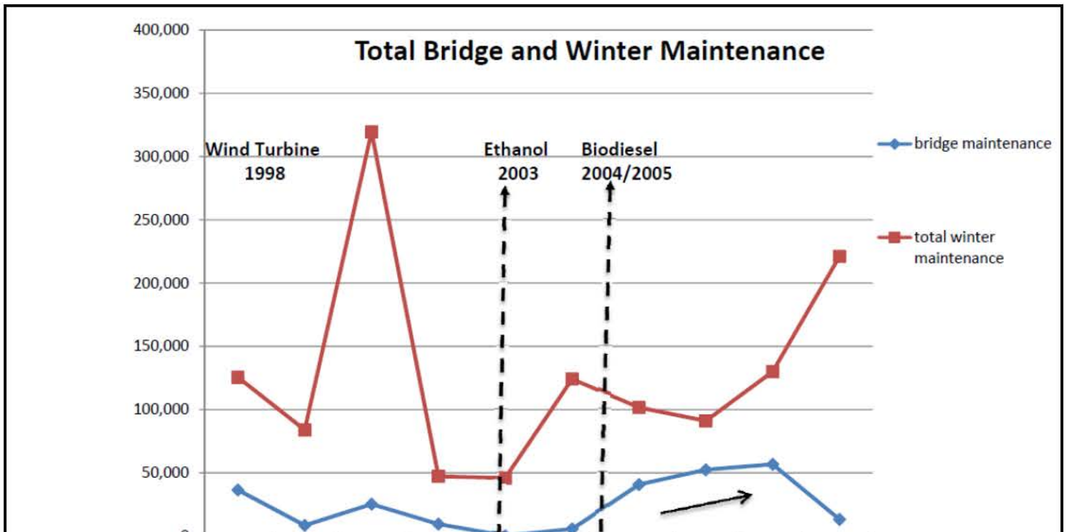
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
pavement 521	74,402	60,883	177,793	34,863	38,125	79,430	66,164	68,222	79,282	127,236
granular 522	51,202	23,067	141,756	12,389	7,790	44,720	35,545	22,829	50,752	93,846
total	125,604	83,950	319,549	47,252	45,915	124,150	101,709	91,051	130,034	221,082



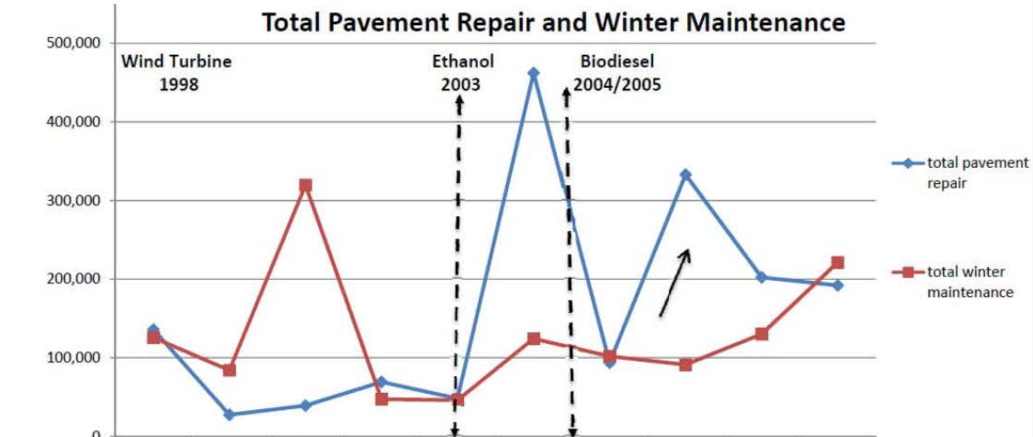
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
bridge maintenance 420	36,501	8,530	25,309	9,530	250	5,693	40,753	52,445	56,764	13,227



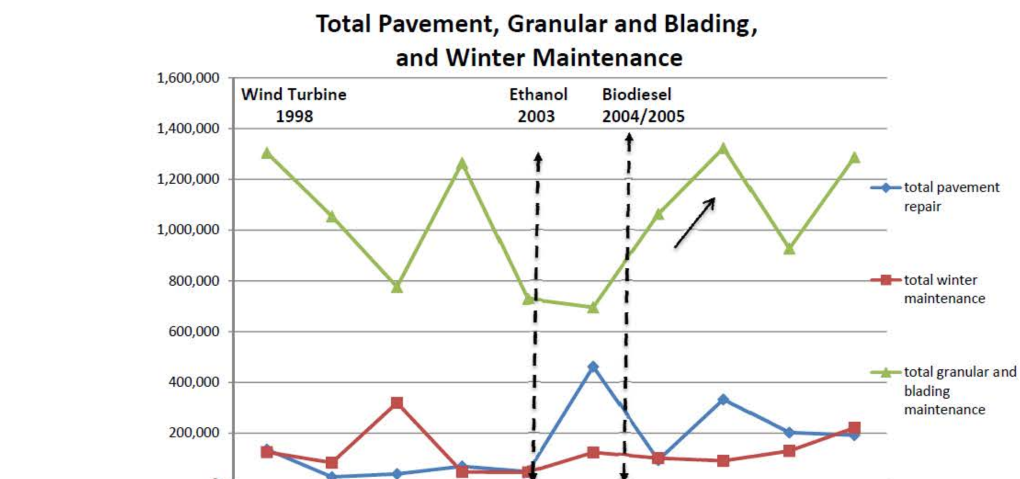
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total winter maintenance	125,604	83,950	319,549	47,252	45,915	124,150	101,709	91,051	130,034	221,082
total granular and blading maintenance	1,304,530	1,053,807	775,706	1,264,450	728,479	695,431	1,062,791	1,322,853	926,858	1,286,607



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
bridge maintenance	36,501	8,530	25,309	9,530	250	5,693	40,753	52,445	56,764	13,227
total winter maintenance	125,604	83,950	319,549	47,252	45,915	124,150	101,709	91,051	130,034	221,082

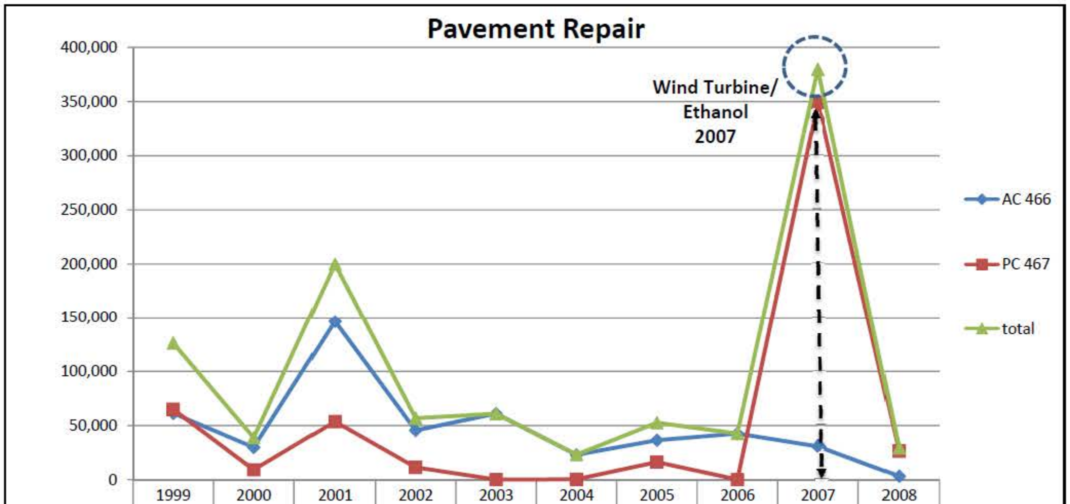


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair	135,916	27,444	39,214	69,204	48,138	462,146	93,679	332,858	202,295	191,975
total winter maintenance	125,604	83,950	319,549	47,252	45,915	124,150	101,709	91,051	130,034	221,082

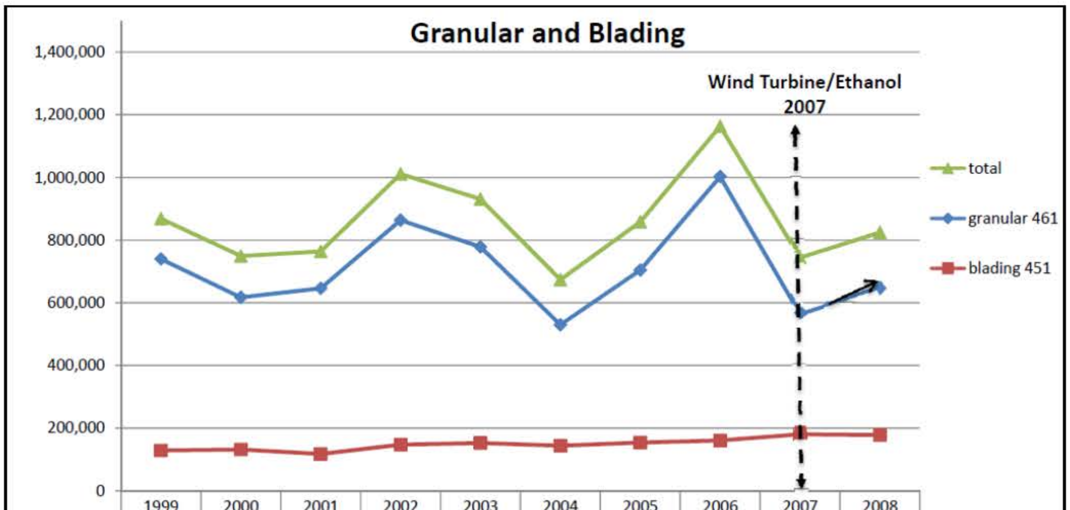


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair	135,916	27,444	39,214	69,204	48,138	462,146	93,679	332,858	202,295	191,975
total winter maintenance	125,604	83,950	319,549	47,252	45,915	124,150	101,709	91,051	130,034	221,082
total granular and blading maintenance	1,304,530	1,053,807	775,706	1,264,450	728,479	695,431	1,062,791	1,322,853	926,858	1,286,607

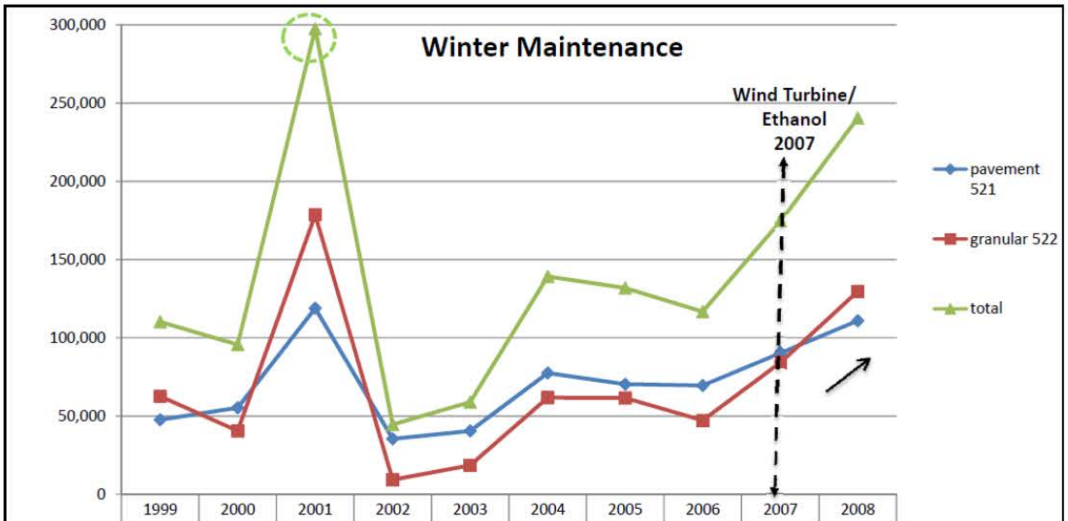
Floyd County



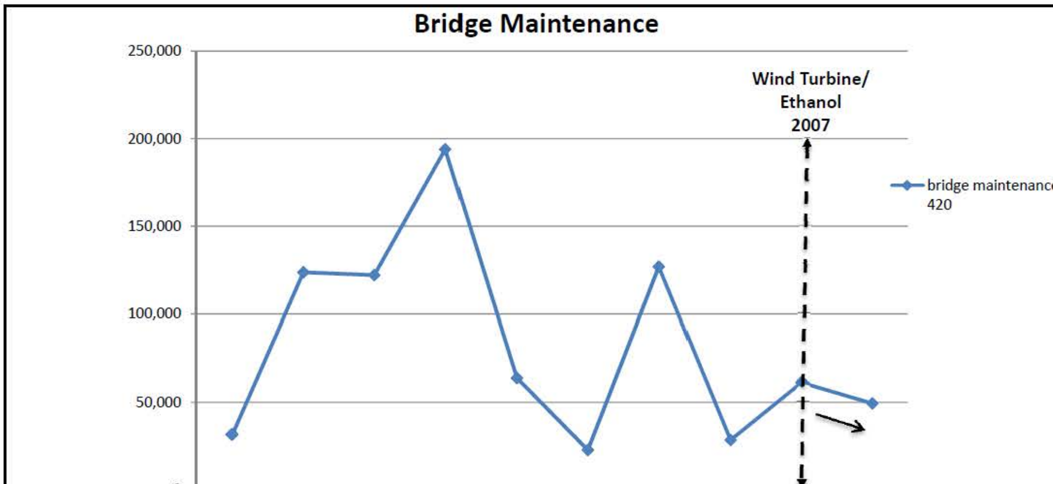
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AC 466	61,238	29,740	146,259	45,391	60,916	22,869	36,359	42,516	30,611	3,134
PC 467	64,920	9,024	53,539	11,320	25	266	16,153	30	349,088	26,332
total	126,158	38,764	199,798	56,711	60,941	23,135	52,512	42,546	379,699	29,466



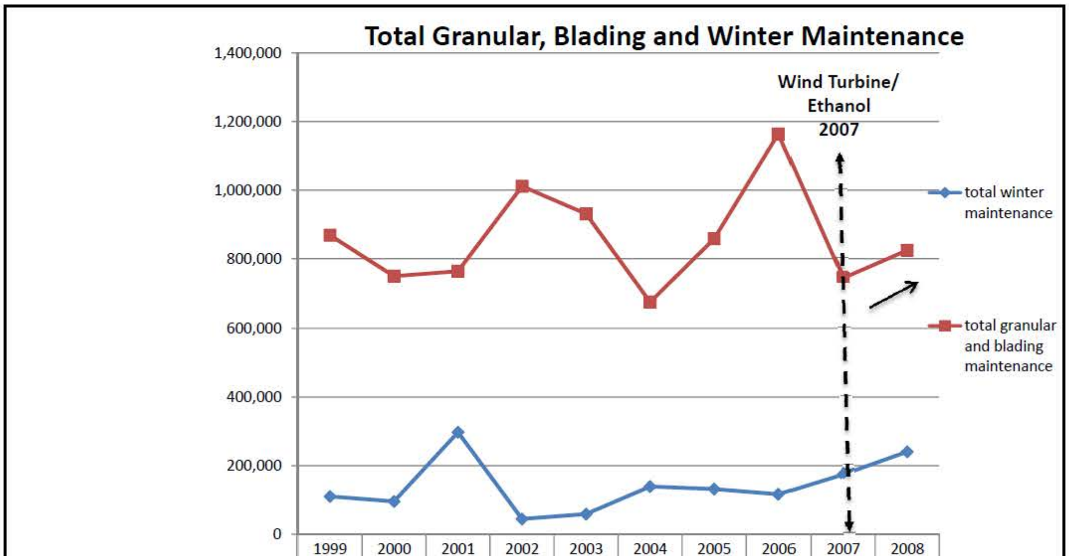
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total	868,499	749,289	763,787	1,011,145	930,922	673,792	858,292	1,163,346	743,780	824,624
granular 461	739,723	617,427	646,288	863,745	778,321	529,921	704,280	1,002,733	563,335	646,538
blading 451	128,776	131,862	117,499	147,400	152,601	143,871	154,012	160,613	180,445	178,086



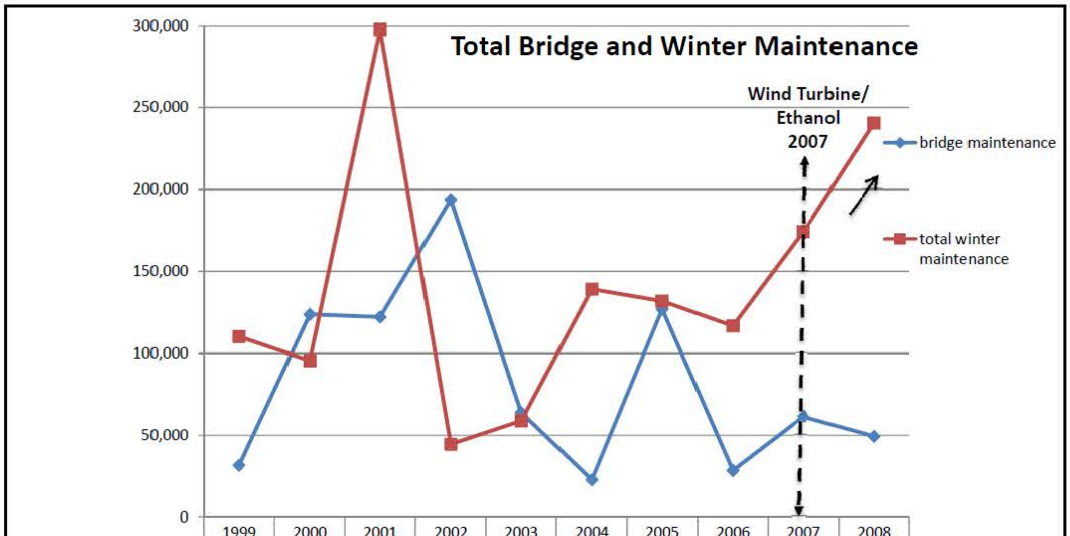
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
pavement 521	47,565	55,219	118,883	35,358	40,432	77,470	70,312	69,508	90,163	110,894
granular 522	62,607	40,409	178,593	9,205	18,415	61,688	61,509	47,151	84,003	129,561
total	110,172	95,628	297,476	44,563	58,847	139,158	131,821	116,659	174,166	240,455



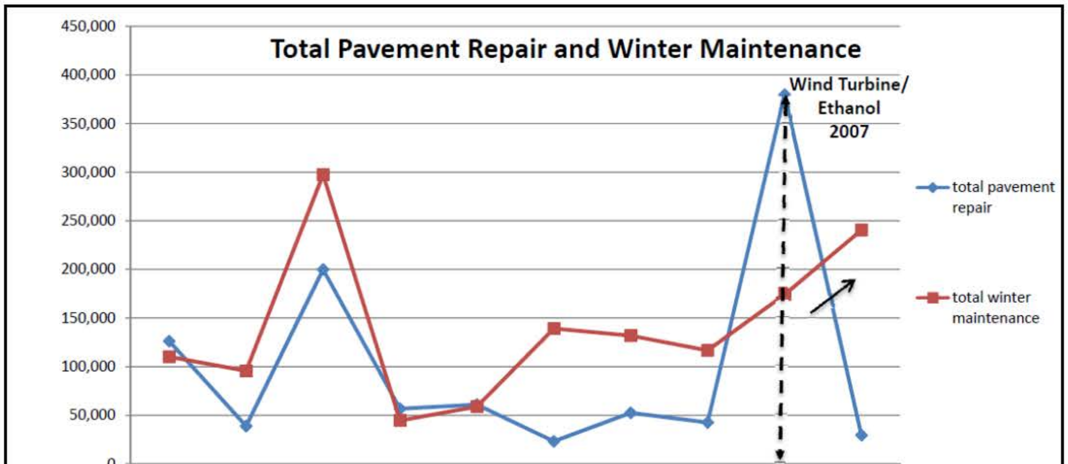
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
bridge maintenance 420	31,700	123,712	122,110	193,868	63,876	22,802	126,898	28,508	61,283	49,394



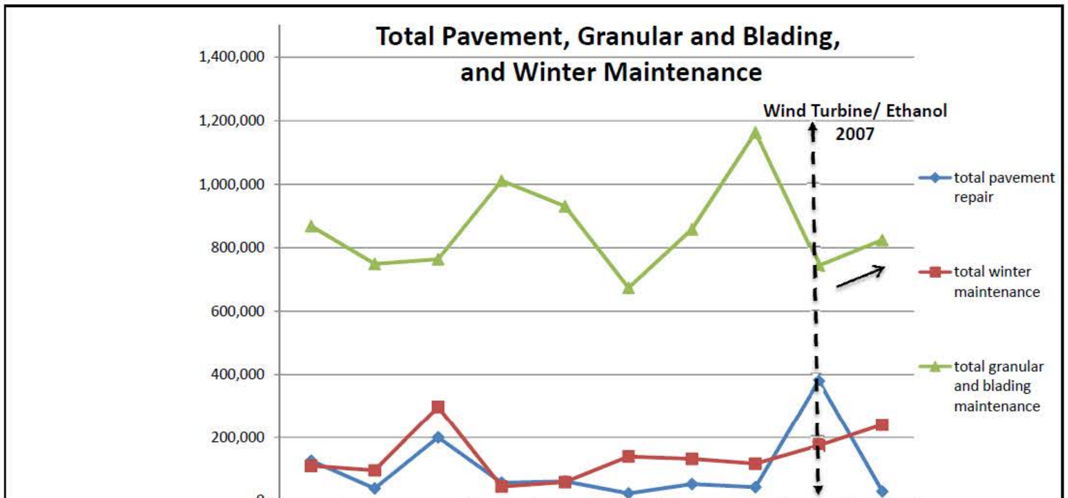
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total winter maintenance	110,172	95,628	297,476	44,563	58,847	139,158	131,821	116,659	174,166	240,455
total granular and blading maintenance	868,499	749,289	763,787	1,011,1	930,922	673,792	858,292	1,163,3	743,780	824,624



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
bridge maintenance	31,700	123,712	122,110	193,868	63,876	22,802	126,898	28,508	61,283	49,394
total winter maintenance	110,172	95,628	297,476	44,563	58,847	139,158	131,821	116,659	174,166	240,455

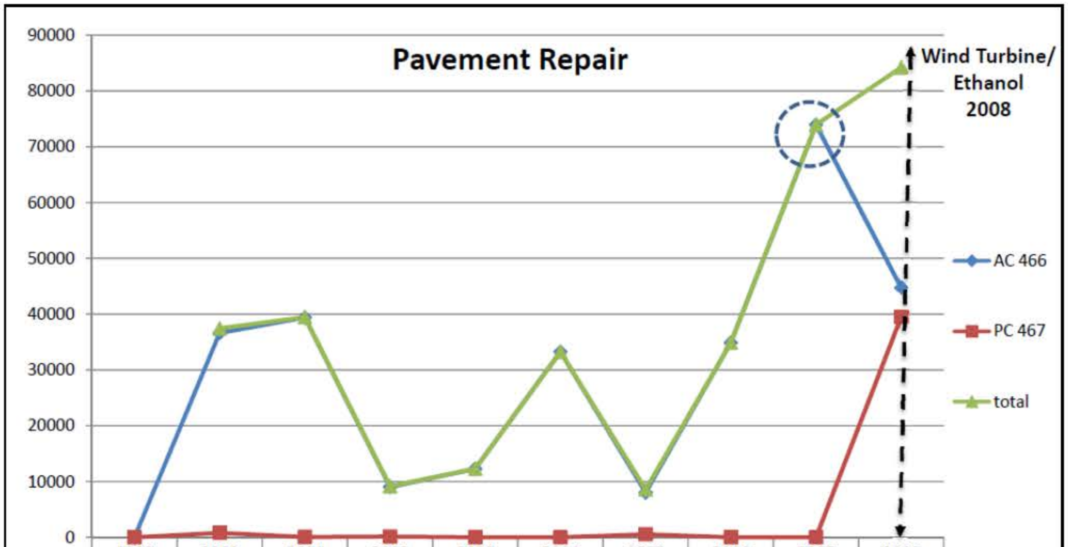


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair	126,158	38,764	199,798	56,711	60,941	23,135	52,512	42,546	379,699	29,466
total winter maintenance	110,172	95,628	297,476	44,563	58,847	139,158	131,821	116,659	174,166	240,455

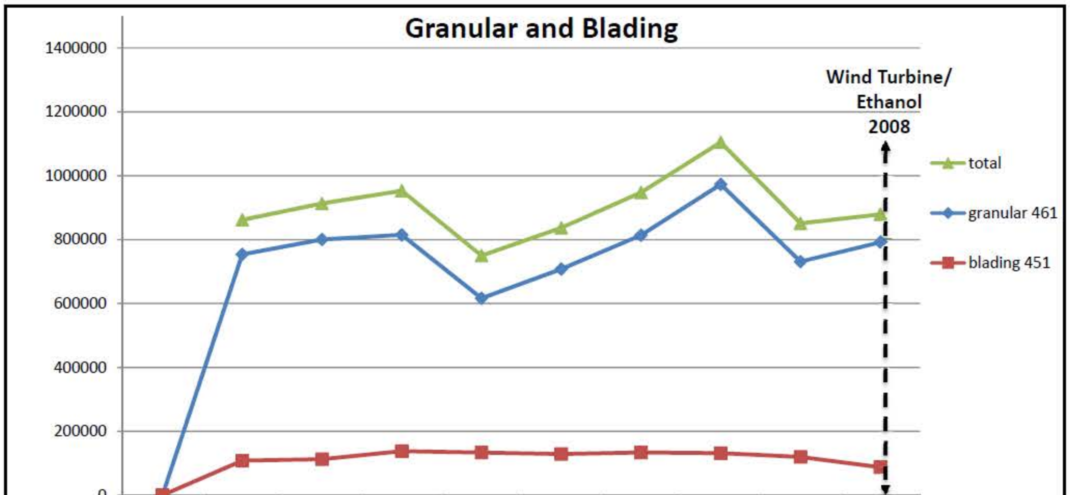


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair	126,158	38,764	199,798	56,711	60,941	23,135	52,512	42,546	379,699	29,466
total winter maintenance	110,172	95,628	297,476	44,563	58,847	139,158	131,821	116,659	174,166	240,455
total granular and blading maintenance	868,499	749,289	763,787	1,011,1	930,922	673,792	858,292	1,163,3	743,780	824,624

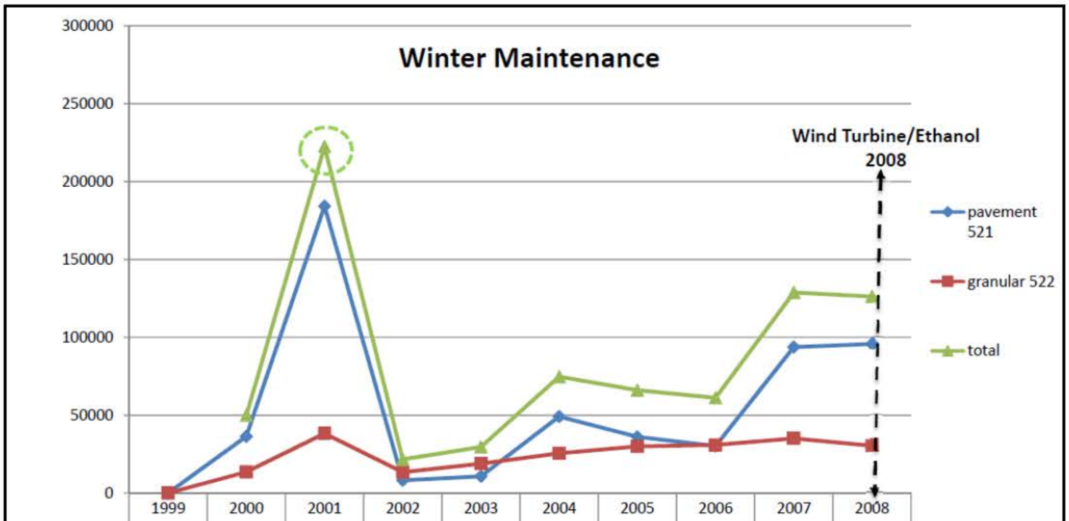
Mitchell County



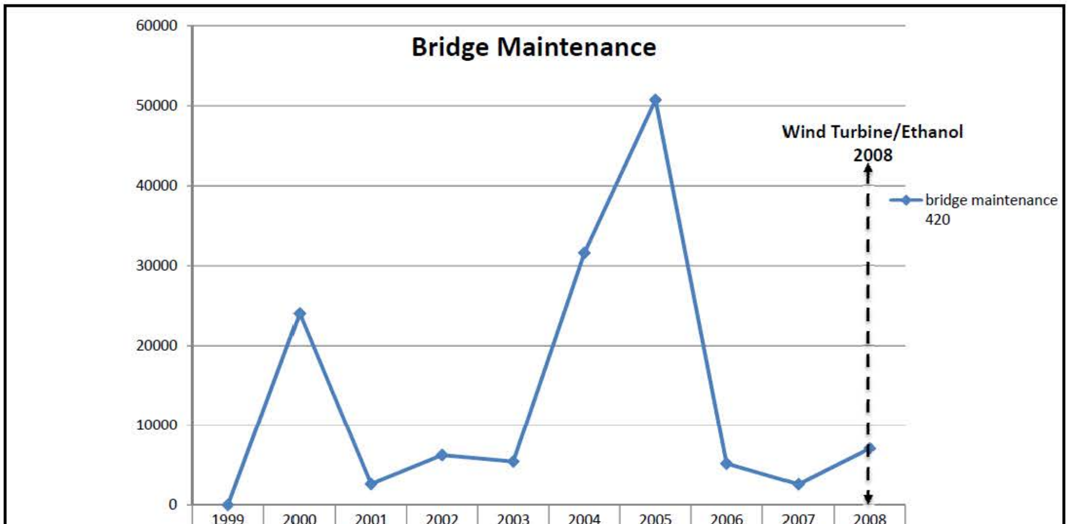
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AC 466	0	36,631	39,382	9,016	12,286	33,256	8,018	34,878	73,932	44,699
PC 467	0	806	63	146	0	0	555	0	0	39,499
total		37,437	39,445	9,162	12,286	33,256	8,573	34,878	73,932	84,198



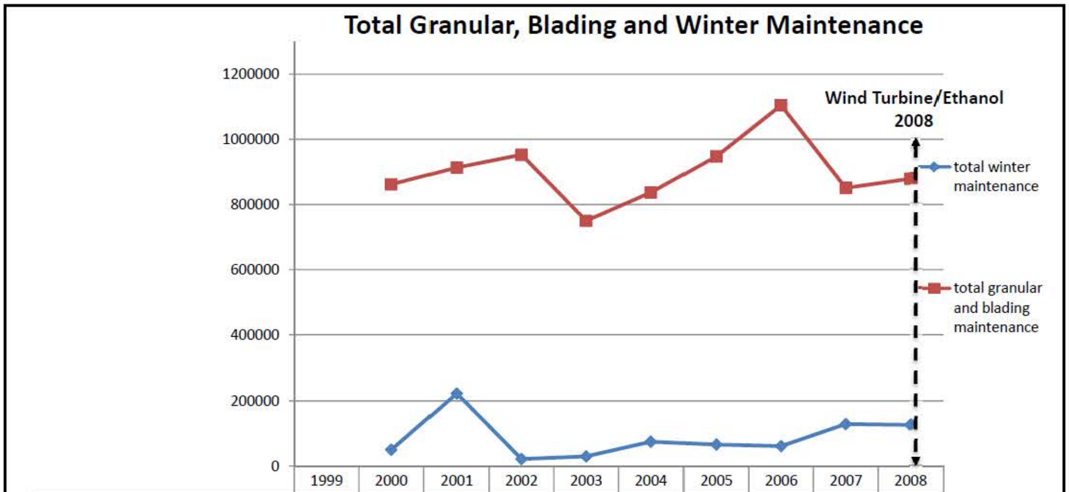
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total		861,931	913,200	952,749	749,990	836,857	947,409	1,104,472	850,979	879,131
granular 461	0	753,840	800,534	814,902	616,513	707,948	813,770	972,868	731,318	791,662
blading 451	0	108,091	112,666	137,847	133,477	128,909	133,639	131,604	119,661	87,469



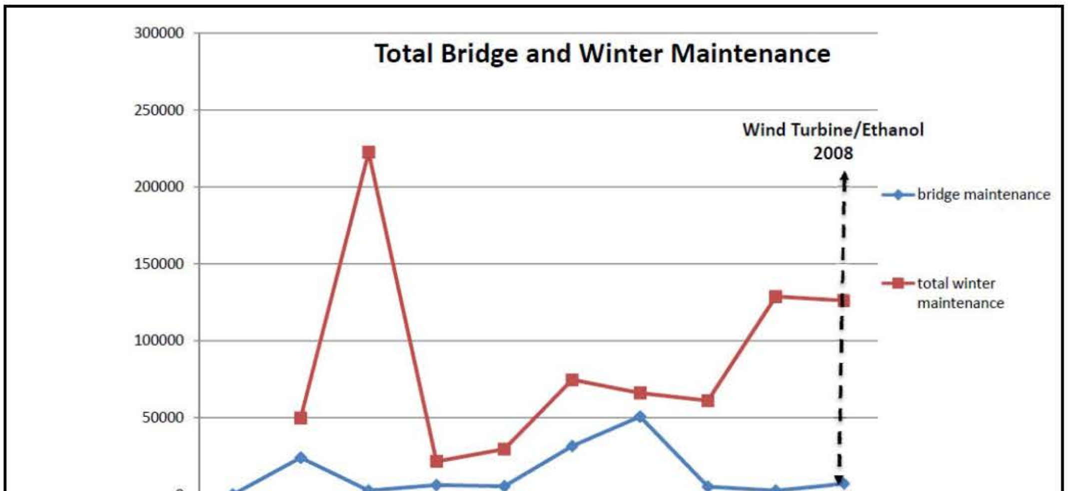
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
pavement 521	0	36,360	184,216	8,203	10,742	49,134	36,079	30,226	93,701	95,733
granular 522	0	13,561	38,281	13,386	18,864	25,550	29,945	30,892	35,090	30,399
total		49,921	222,497	21,589	29,606	74,684	66,024	61,118	128,791	126,132



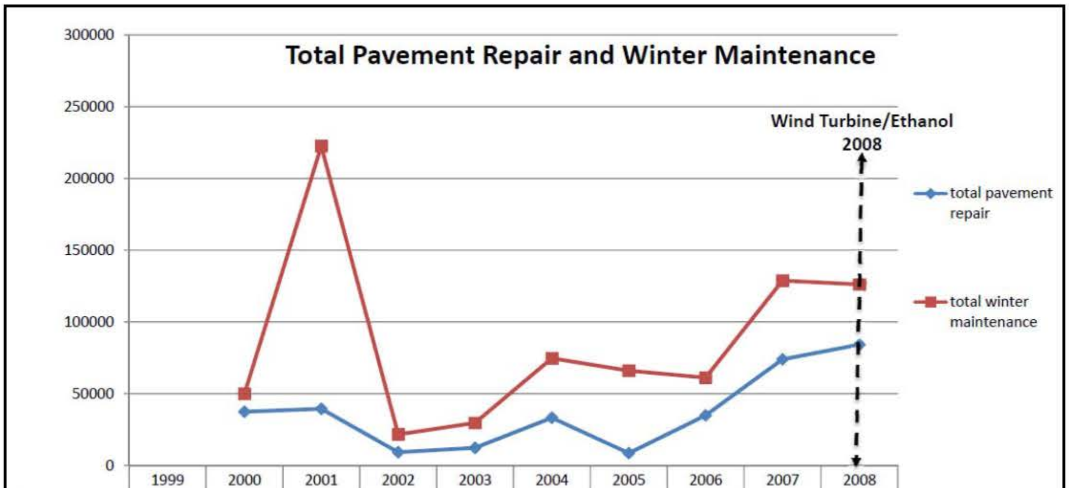
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
bridge maintenance 420	0	24,047	2,612	6,227	5,420	31,607	50,726	5,163	2,588	7,051



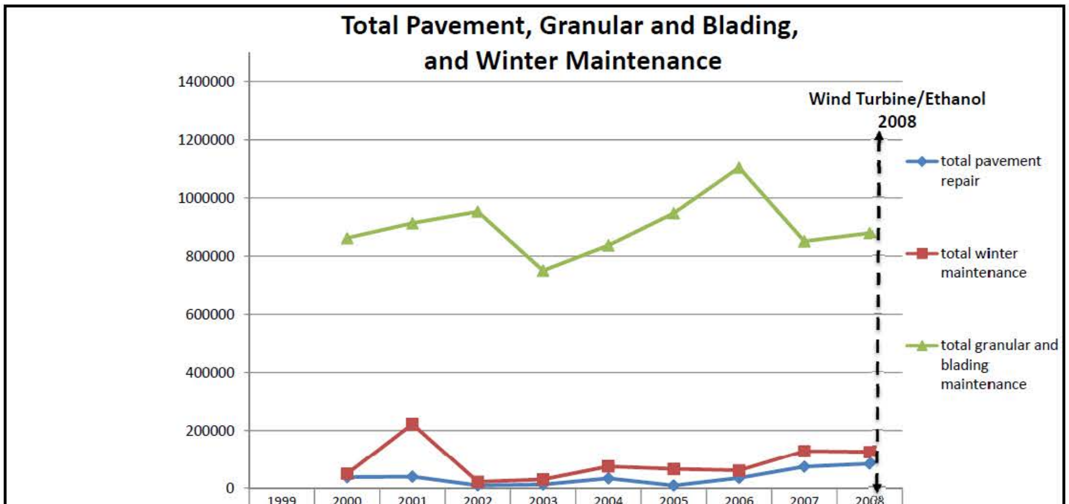
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total winter maintenance		49,921	222,497	21,589	29,606	74,684	66,024	61,118	128,791	126,132
total granular and blading maintenance		861,931	913,200	952,749	749,990	836,857	947,409	1,104,4	850,979	879,131



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
bridge maintenance	0	24,047	2,612	6,227	5,420	31,607	50,726	5,163	2,588	7,051
total winter maintenance		49,921	222,497	21,589	29,606	74,684	66,024	61,118	128,791	126,132

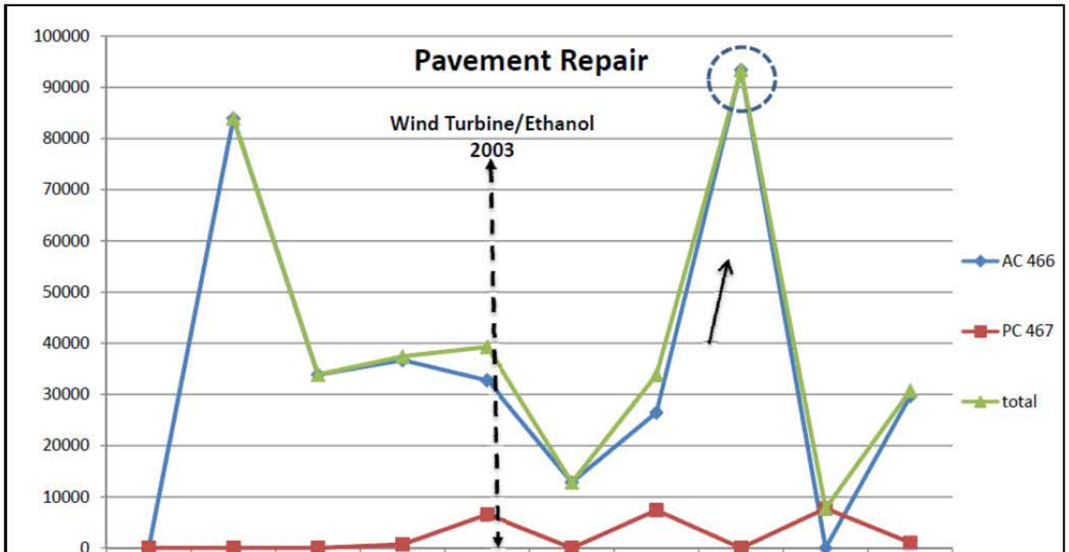


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair		37,437	39,445	9,162	12,286	33,256	8,573	34,878	73,932	84,198
total winter maintenance		49,921	222,497	21,589	29,606	74,684	66,024	61,118	128,791	126,132

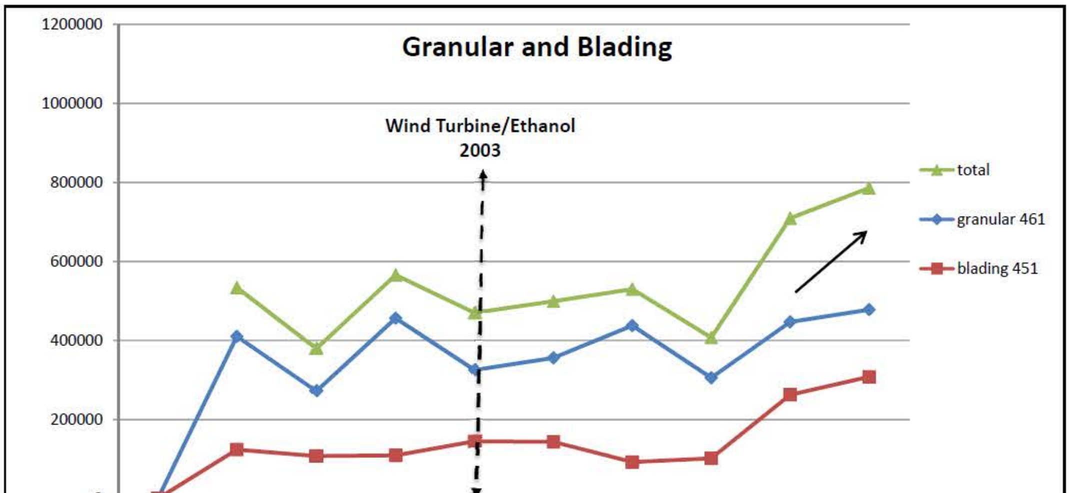


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair		37,437	39,445	9,162	12,286	33,256	8,573	34,878	73,932	84,198
total winter maintenance		49,921	222,497	21,589	29,606	74,684	66,024	61,118	128,791	126,132
total granular and blading maintenance		861,931	913,200	952,749	749,990	836,857	947,409	1,104,47	850,979	879,131

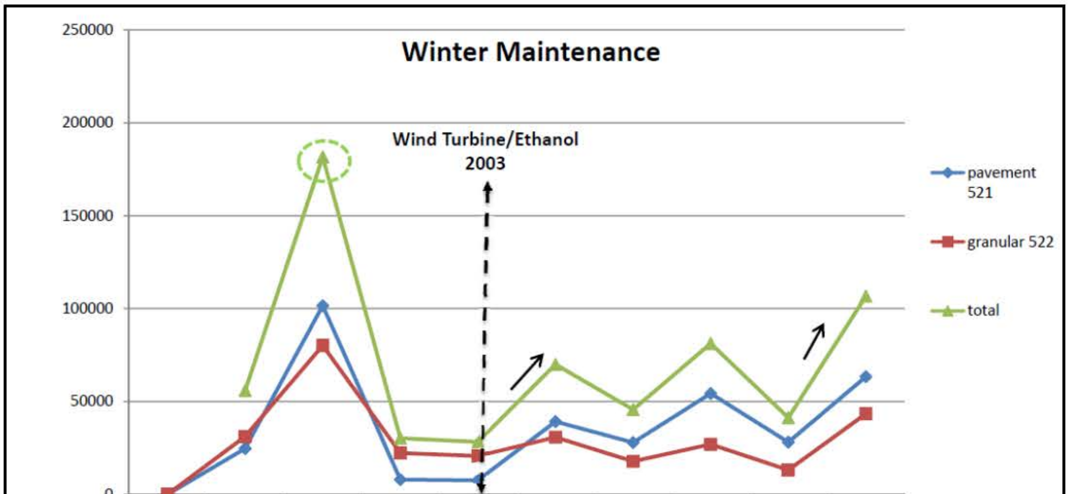
Worth County



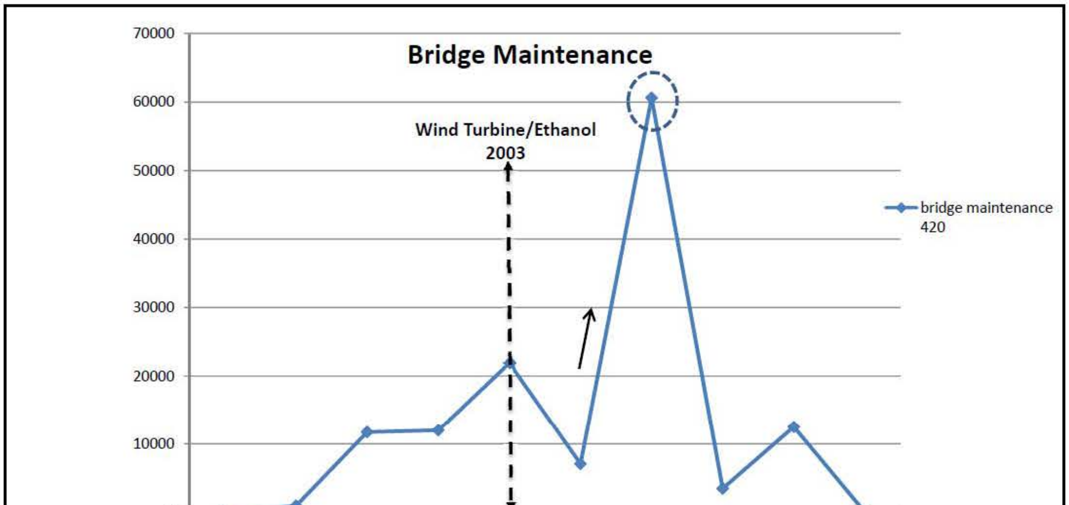
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AC 466	0	83,908	33,857	36,715	32,736	12,812	26,453	93,395	0	29,682
PC 467	0	0	0	708	6,551	0	7,372	0	7,732	1,050
total		83,908	33,857	37,423	39,287	12,812	33,825	93,395	7,732	30,732



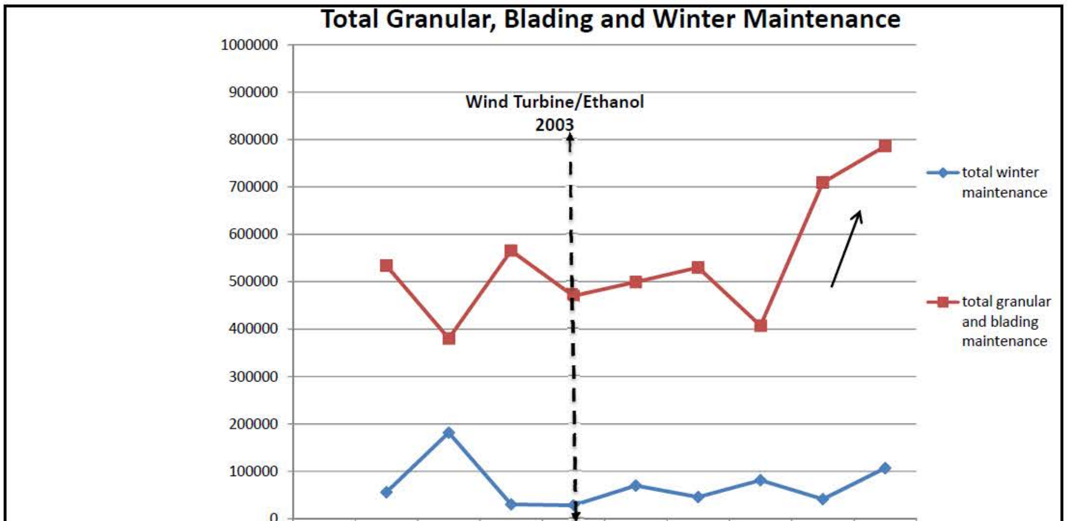
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total		533,996	380,293	565,627	469,982	499,359	529,960	407,245	709,374	785,928
granular 461	0	410,197	272,746	456,391	325,235	355,929	437,540	305,547	446,899	477,968
blading 451	0	123,799	107,547	109,236	144,747	143,430	92,420	101,698	262,475	307,960



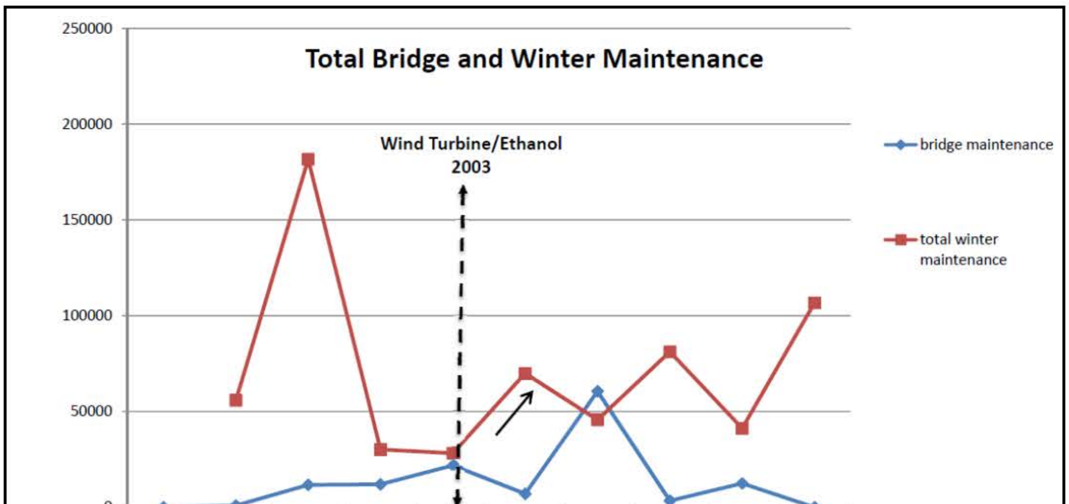
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
pavement 521	0	24,691	101,516	7,970	7,585	39,166	27,879	54,279	28,105	63,345
granular 522	0	31,157	80,113	22,239	20,647	30,764	17,773	26,931	13,124	43,350
total		55,848	181,629	30,209	28,232	69,930	45,652	81,210	41,229	106,695



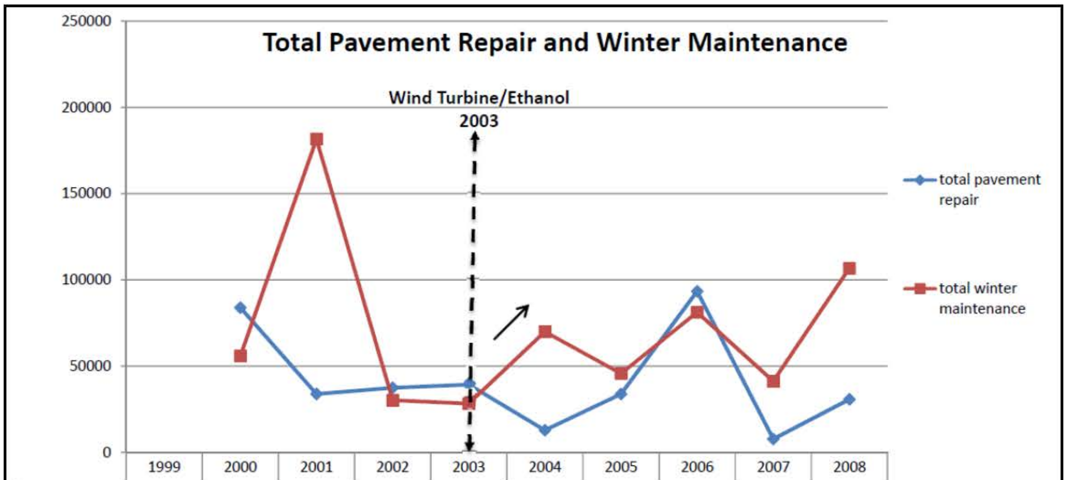
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
bridge maintenance 420	0	937	11,722	11,986	21,883	7,066	60,597	3,455	12,500	0



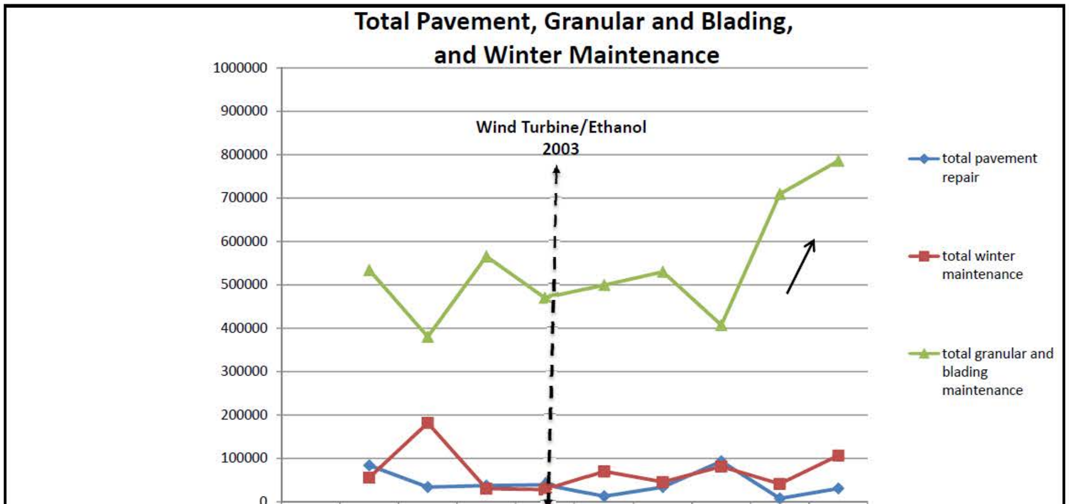
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total winter maintenance		55,848	181,629	30,209	28,232	69,930	45,652	81,210	41,229	106,695
total granular and blading maintenance		533,996	380,293	565,627	469,982	499,359	529,960	407,245	709,374	785,928



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
bridge maintenance	0	937	11,722	11,986	21,883	7,066	60,597	3,455	12,500	0
total winter maintenance		55,848	181,629	30,209	28,232	69,930	45,652	81,210	41,229	106,695



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair		83,908	33,857	37,423	39,287	12,812	33,825	93,395	7,732	30,732
total winter maintenance		55,848	181,629	30,209	28,232	69,930	45,652	81,210	41,229	106,695



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair		83,908	33,857	37,423	39,287	12,812	33,825	93,395	7,732	30,732
total winter maintenance		55,848	181,629	30,209	28,232	69,930	45,652	81,210	41,229	106,695
total granular and blading maintenance		533,996	380,293	565,627	469,982	499,359	529,960	407,245	709,374	785,928

APPENDIX C. NOTES FROM COUNTY ENGINEER INTERVIEWS

From County Interviews February 24, 2009, 1–3 p.m.

Present: Mary Kelley (Cerro Gordo), Dusten Rolando (Floyd/Chickasaw), Jim Hyde (Mitchell/Worth), Duane Smith (InTrans), and Bob Sperry (InTrans)

Jim Hyde stated that he is going to a much higher paving standard for his roads around these sites. For the 130+ towers for turbines, the contractor hauled in 550 c.y. of concrete for EACH base. He had a four-year old road that rutted badly (approximately two to three inches) and is effectively destroyed. These ruts hold a lot of standing water, and he anticipates future claims for crashes due to hydroplaning and the pulling effect of the ruts. He is now using a 10 million ESAL design for all future pavements and pavement rehabs. The industry is now talking of installing an additional 230 to 250 towers and turbines throughout the county.

Both Mitchell and Worth counties have implemented a TIF program to finance the turbine installations into an economic development area and are going to use the proceeds to vastly improve the area roads during the next few years. The two counties have planned over $15 million of work for the next few years.

Jim also acknowledged that cash flow from the casino had provided most of the financing for the paving in front of both the Worth and Mitchell County ethanol plants and the storage depot (one mile north of Manly). Copies of these construction cost summaries were provided to the research team. The gambling revenue is paid both as a weekly check and as a quarterly stipend from the casinos.

Jim's experience with wind farms has been different in each of his counties.

In Mitchell County, the general contractor had a full construction company on site to carry out all the tasks the turbine erection crew needed done. This construction company crushed their own rock for surfacing all roads and provided maintenance to the roads themselves.

In Worth County, county crews had to perform the necessary maintenance, and then the expenses were billed to (and reimbursed by) the owners' contractor. Copies of those billing were provided to the research team.

Most of Cerro Gordo's wind turbine farm was actually installed in 1998, with an additional 13 more added in 2003. Limited records were available for that early installation, but Mary Kelley did find a board resolution that stated that "…the applicant is responsible for all damages and required maintenance." She will look for receipts but doesn't believe they are still around. Most of the materials and equipment for the latest addition came in on U.S. 65.

The road to their new ethanol plant was a RISE project, at least 1½ miles from U.S. 65 to their north entrance. The remaining 1½ miles was at county expense (?), and was annexed into the city within one year. RISE funds ($764,000) were provided toward the $3.8 million total cost. Mary believes that there may have been a city/county agreement for dividing the expenses before the project began, as the city also had to run utilities to the site.

Regarding the pavement repair expenses spike in 2004, Mary believes it was due to construction damages by Alliant Energy for a new power plant. Alliant reimbursed $267,000 for that plus $42,000 for rock (applied by county). Cerro Gordo has rock stockpiles and does most of its hauling itself. The county has two quarries it owns (and therefore pay only crushing costs of approximately $3+ per ton) and also get material from two other quarries owned by Martin Marietta at $6+ per ton. They did have approximately $450,000 in receipts from FEMA in 2005, but most of this money was spent for ditch cleaning and rock. The spike in granular and blading in 2006 can be explained as using some of those dollars to buy more rock to replenish the county's stockpiles.

Mary was not sure as to the cause for the 2007 spike in bridge maintenance, except that the county programs several maintenance projects in one year (of several).

Jim stated that most of the reason for his 2005 bridge maintenance highs in both Worth and Mitchell Counties was due to concrete bridges needing overlays because of increasingly heavy salt usage. He was not aware of any problems to bridges due to wind farms or ethanol plants.

Dusten Rolando noted that his portland cement repair costs spiked because of long-needed maintenance and had nothing to do with the plant construction. However, currently, his pavement south of the plant is deteriorating badly due to all the heavy traffic. He believes it is because there is no joint reinforcing in the paving. Dusten thought his spike in blading/granular work in 2006 was not really attributable to the projects but was due to paying off the rock contract early because he had some money left at the end of the fiscal year. For the county's plant project, he also had done a RISE project ($1.3 million) that was funded by $312,000 in RISE funds, $100,000 by the ethanol company (VeraSun), and the remainder by the county's FM funds. For the wind farm project (40–50 Turbines), the construction company was very helpful; the company applied for permits for all new and existing driveways/extensions that were not planned to be removed. The contractor installed all that were needed for larger turning radii and later removed those that were not to remain. Minimal road maintenance was also provided, but Dusten wished to have the county perform this as it was legally responsible. Wiring for the farm goes into the substation at Charles City, and no problems were caused by this, as the contractor mostly bored under the roads.

Jim has some photos (which he will e-mail Duane) showing one of the large cranes and generators that was shipped in 1½ million pounds on 18 axles. The unit had rear steering, so it was able to maneuver relatively tight corners. However, it caused havoc on his asphalt road. Even though the road had 8½ inches of asphalt, the resulting ruts were over one inch in depth.

Dusten noted that his bridge maintenance costs had not risen since he has changed his accounting to charge it to "construction—code 320" on those applicable projects.

He also noted that the traffic traveling to his ethanol plant is taking some of the older roads (three to four inches of asphalt), and the roads are now beginning to fail (since 2007). Traffic is also using the shortest route (usually gravel roads) for delivery by semis, which generates a lot of complaints from residents about dust and gravel road damage. Because of deliveries from adjoining Chickasaw County farmers, road problems are beginning to show up there. (Semis avoid city streets).

Jim noted that for the new Mitchell County plant, the county estimates that 65% of grain is coming from the north as there are no other facilities to the east in the northern tier of Iowa counties or the southern tier of the Minnesota counties.

Dusten noted that farmers will not use the Avenue of the Saints but instead come in on local roads; he believes most go from the fields to the cooperatives, and then the cooperatives deliver the grain to the ethanol plants (always looking for the highest net price they can receive). The cooperatives still use the shortest route (not always paved) to make their deliveries. All agreed that this hauling trend seems to be a recent change from original practice and tends to condense the loads onto fewer roads.

Jim—Most ethanol product is shipped out via rail from these plants, so transportation needs are reduced; however, incoming traffic is still a big problem. North of Manly where an ethanol depot was built (by a private contractor?), there are over 300 semis per day of excess ethanol coming into the facility. Northwood is having a terrible time with all the truck traffic and materials being stored there as well.

A discussion of the feasibility of a (national?) pipeline system—Duane pointed out that previous studies have looked at the feasibility of a (national) pipeline system and that a new separate pipeline would be needed and that the amount of product to be shipped would be very small. Texaco looked into investing in Iowa's ethanol industry but discovered that all of Iowa's output together is smaller than their smallest current refinery. Pipeline is not a feasible alternative; depots, especially by rivers, will make more sense. Because rail seems to be most popular way to ship the final product out, connecting depots with barges makes sense.

Duane asked if all had heard about the "2030" plan, with its goal to replace 20% of our petroleum fuel needs with ethanol by the year 2030. This will require much more production, probably from different materials (switch grass, sugar cane, beets, etc.). What changes and new complications will this bring to the table? Jim remembered when sugar beets were grown extensively in NE Iowa for the sugar mills and believes it could be easily done again if prices made it a better alternative than the standard corn and beans. This alternative might disperse the delivering traffic back to its original pattern (from grower directly to plant) as the cooperatives would not be set up for this. New equipment will be needed to compact and haul the raw materials to the plant. Duane stated that a lot of research is currently going on at Iowa State University in that regard.

No one noted significant complaints about the plants or the wind farms; Jim said the early ones (especially Glenville, MN) had complaints of a "burnt toast" smell, but he hardly hears any complaints now. Dusten pointed out early complaints on the noise and aesthetics of the large number of turbine towers in those farms, but again, the early complaints seemed to quickly die away.

Jim gave specifics on revenues from the casino. The county gets $7,000 each week into general fund plus a quarterly stipend of $1 million; in addition, this year, each graduating student in the county will be given $7,000 to pursue some advance training/education.

Dusten and Mary agreed that most gravel roads show problems in the first year and that paved roads will begin showing problems in 1½ to 2 years after construction or the beginning operation of an ethanol plant or wind turbine farm. Dusten's most recent experience involved winter erection of the turbines, and he thought little damage was evident.

Jim—Iowa 105 north of Joyce is a good example of a road that was destroyed by the approximately 275 semis per day coming into that facility (mainly because they were paying a two to three cent premium for grain).

Mitchell County passed a "Road Preservation Ordinance" some time ago that allows the county to collect damages from individuals/companies that cause major road damage. It has been used successfully to collect $15,000 toward one repair. He anticipates a lot more damages with another 230 to 250 turbines coming.

Before coming to the meeting, Jim asked both of his Boards of Supervisors if they thought that these new plants and wind farms cost the county money. All agreed that they were sure they did. Mary and Dusten thought their boards would also support that statement. However, they also feel that the political pressure from landowners and large industries, as well as the need for more jobs in the county, would mean their continued support in favor of more.

Jim talked of his latest venture in forming economic development TIF areas to include all of the wind turbine towers and to raise revenue for road projects using that procedure. He commented that as long as less than 10 acres on each property is included, the owners have no "rebuttal rights." He had to write individual metes and bounds descriptions of the properties, and they need to be connected by road segments. Going through the process now—the Farm Bureau likes this as someone else is paying for roads! It also does not affect school revenues. An example of the amount of that is involved with this is:

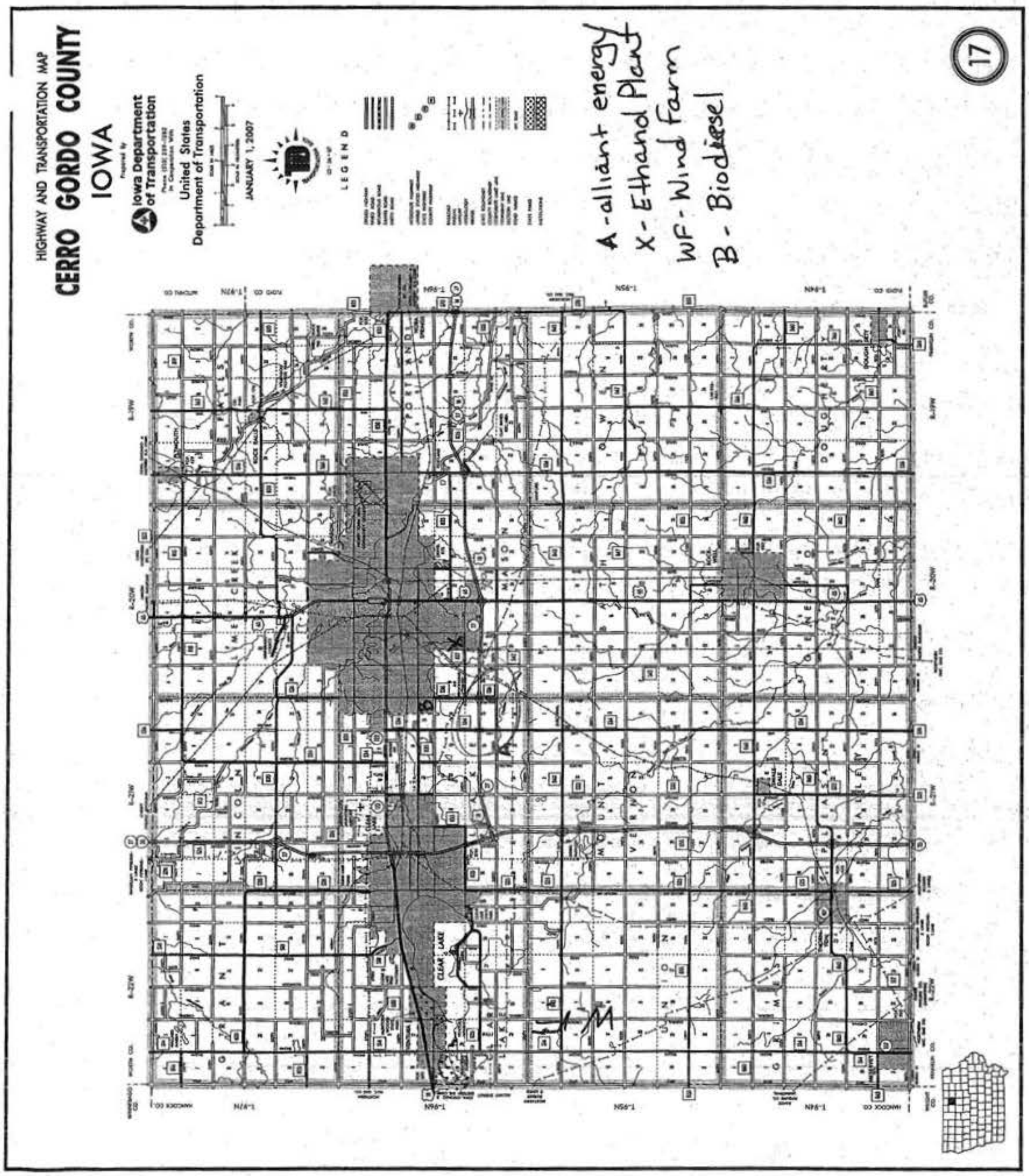
- $590 million total Mitchell County valuation
- $260 million first phase wind farm valuation
- $500 million second phase wind farm valuation

Jim believes that farmers are paid for the easement (20 years), a fee for the buried power lines, and a fee for each turbine on their land ($3,300/year for the 1.5 mw & $5,000/year for the 2 mw units.

The Worth County units are coming out of Spain (?) or of Holland. He believes that the blades are from the U.S.

All plants and wind farm locations were marked on county maps for future identification.

Cerro Gordo County Interview



Sperry, Robert B [CTRE]

From: Kelly, Mary [MKelly@co.cerro-gordo.ia.us]
Sent: Wednesday, February 25, 2009 11:17 AM
To: Sperry, Robert B [CTRE]
Subject: RE: Charts and Detailed Questions for February 24th Meeting in Mason City

Bob:

I did some additional fact checking. I did not find any receipts from the wind farm owner in the annual reports or in our records. I also checked the bridge maintenance and it looks like just normal maintenance, nothing which was caused from construction. Lastly, I checked further into receipts from Golden Grain (ethanol plant) and Mason City. It did not appear that there were any receipts from Golden Grain. It looks like the County paid the contractor and Mason City reimburse to the County $425,000 for the 240th Street project. It appears it went something like this. The project was split into 3 divisions: 1.5 miles participating in RISE, 1.5 miles non-participating and a water line. The total construction costs paid for the entire project was $2,785,000. RISE reimbursed the county for $589,000 and Mason City reimbursed the county $425,458. Clear as mud I suspect. If you have any questions, don't hesitate to contact me.

Mary Kelly
County Engineer
Cerro Gordo County
2716 South Federal Ave.
Mason City, IA 50401
Phone: 641-424-9037
Fax: 641-424-9058

From: Sperry, Robert B [CTRE] [mailto:rsperry@iastate.edu]
Sent: Thursday, February 19, 2009 3:58 PM
To: Kelly, Mary
Subject: Charts and Detailed Questions for February 24th Meeting in Mason City

Mary-
We have finished the expenditure graphs from the 1999-2008 Annual reports for your county,
and with those visuals, we have developed some additional questions to address with you next Tuesday.
The attachments include those questions, (as a place to start), and the graphs as .pdf files.
Please call me Friday AM if you have any trouble opening
Otherwise we look forward to visiting with you next Tuesday afternoon.
Thanks

Bob Sperry, P.E.
LTAP Local Roads Safety Liaison
2711 S. Loop Drive, Suite 4700
Ames, IA 50010
515-294-7311 Office
515-231-6902 Cell
rsperry@iastate.edu

Wind

PLANNING AND ZONING
Cerro Gordo County Courthouse
220 N Washington Ave Mason City, IA 50401-3254 (515) 421-3075
Tom Drzycimski, Administrative Officer FAX (515) 421-3088
Barbara Farghum, Administrative Assistant

June 10, 1998

Hawkeye Power Partners, LLC
503 Main Avenue
Clear Lake, IA 50428

Gentlemen:

Enclosed is the Draft Resolution I will be forwarding to the Board of Adjustment at their next meeting which is scheduled for June 23, 1998, at 7:30 p.m. at the Courthouse in the Board's meeting room.

At this time they may make changes or adopt as written. You are certainly welcome to attend this meeting if you have questions or comments on any of the conditions as proposed.

If you have any questions, please contact this office.

Sincerely,

Tom Dzyil.

Tom Drzycimski
Administrative Officer

TD/bf
Enc.

DRAFT

RESOLUTION

WHEREAS, Hawkeye Power Partners LLC is the lease holder of various parcels located in the following sections of land:

Sections 3, 4, 5, 8, 9, 10, 15, 16 and 17, Township 95 North, Range 22 West; and Sections 32 and 33, Township 96 North, Range 22 West of the 5th P.M. all in Cerro Gordo County, Iowa (see application for specific locations), and

WHEREAS, said lease holder and land owners have applied to the Board of Adjustment established by the Zoning Ordinance of Cerro Gordo County, Iowa, for a special use permit for the construction and operation of a 42-megawatt, 60 turbine, wind energy farm to generate electrical power in accordance with Article 20.2(J), and

WHEREAS, said real properties are located in A-1 Agriculture Districts under the Cerro Gordo County Zoning Ordinance, and

WHEREAS, said property is located within an area that will not conflict with future growth as designated on the Comprehensive Development Plan of Cerro Gordo County, Iowa, and

WHEREAS, said permit can be granted in keeping with the nature of the neighborhood, and the spirit of the Ordinance will be preserved, and

WHEREAS, a public hearing was held on May 26, 1998, as required by law.

NOW THEREFORE, BE IT RESOLVED by the Board of Adjustment of Cerro Gordo County, Iowa, that the Application of Hawkeye Power Partners LLC on the above described sections of land, be granted a Special Use Permit as requested subject to the following regulations and/or conditions:

1. This special use permit may be reviewed at any time in the future upon the request of the applicant or a majority of the Board of Adjustment members.

2. The provisions and/or regulations shall be minimum requirements and wherever the requirements of any other lawfully adopted rules, regulations or ordinances are at a variance, the most restrictive shall govern.

3. It is contemplated that from time to time during the operation of public utility structures and accessory equipment that conditions may arise which are not covered by the terms of this permit and which cannot be anticipated. In the event such conditions do arise, the Board of Adjustment of Cerro Gordo County, Iowa, may impose additional regulations to meet any new conditions. In addition, if said facility should, at any time, be operated in any manner

which violates the rules and regulations of any federal or state regulatory agency, then the Board of Adjustment may impose such other conditions so as to insure compliance with such rules and regulations.

4. This permit will be subject to revocation for operator's failure to comply with the provisions as herein set forth or such other provisions as may, from time to time, be imposed by the Board of Adjustment of Cerro Gordo County, Iowa, under the terms of this permit.

5. The applicant shall maintain and provide copies to the Zoning Administrator of all applicable state and federal permits prior to issuance of any Zoning Certificate.

6. The proposed use shall be constructed and operated in accordance with the application.

7. Transportation of heavy equipment for construction shall be limited to routes designated by the Cerro Gordo County Engineer. Dust control measures shall be taken by the applicant where deemed appropriate by the County Engineer.

8. Access permits for service roads shall be obtained from the Cerro Gordo County Engineer.

9. The applicant shall apply for a Zoning Certificate prior to the construction of the substation and each turbine.

10. The applicant shall apply for variances for meteorological towers once locations have been determined.

11. At the end of the project's useful life, equipment shall be removed from the site and foundations removed to a depth of four feet.

12. Turbines shall be no less than 267 feet from any existing principal or accessory structure (except occupied residences in which a 1,000 foot distance shall be required), any other turbine, or road right-of-way. This condition does not include base stations.

13. No more than 60 turbines shall be erected by the applicant unless otherwise authorized by the Board of Adjustment.

14. The project shall not adversely impact any duly established drainage district. The applicant shall repair damage to drainage structures directly caused by construction.

15. Costs of repair of damage to county roads or rights-of-way resulting from the construction phase of this project shall be the responsibility of the applicant.

16. In granting the special use permit, the Board of Adjustment recognizes that locations are not finalized. The applicant may alter the location of structures off the fence line or property line

or by moving them laterally. A location variation from the Application for Variances to Zoning District Requirements of more than 500 feet will require the approval of the Board of Adjustment.

17. The applicant shall comply with the provisions of the Cerro Gordo County Flood Plain Management Ordinance contained in the Cerro Gordo County Zoning Ordinance.

18. Applicant must take reasonable measures to correct deficiencies in radio and television reception in or near the project area which are shown to be caused by operation of the project.

19. Applicant shall take reasonable measures such as planting trees, installing awnings and the like to mitigate specific, adverse visual impacts such as reflections or shadows affecting occupied residences within or immediately adjacent to the project area.

BE IT FURTHER RESOLVED this permit will be subject to revocation for operator's failure to comply with the provisions as herein set forth or such other provisions as may, from time to time, be imposed by the Board of Adjustment of Cerro Gordo County, Iowa, under the terms of this permit.

Motion to approve said Application on May 26, 1998, was made by John Nelson and seconded by Gene Baker. Roll call vote taken resulted as follows:

Nelson - yes
Baker - yes
Berding - yes
Davis - yes
Boyle - yes

Motion to approve said Resolution was made ____________________ by ____________________ and seconded by ____________________ with the understanding all provisions of said Resolution are effective retroactive to May 26, 1998. Roll call vote taken resulted as follows:

____

Terry Boyle, Chairman, Board of Adjustment
Cerro Gordo County, Iowa

Cerro Gordo County Engineer

2716 So. Federal Ave., Mason City, Iowa 50401 (515) 424-9037 Fax (515) 424-9058

James D. Witt, P.E. & L.S.
Assistants: Mary Arndt and Steve Gooder
Administrative Assistant: Shelly M. Ciavarelli

September 14, 1998

Mr. Stephen F. Dryden, Project Manager
Cerro Gordo County Wind Farm
503 Main Avenue
Clear Lake, Iowa 50428

RE: Designated Haul Routes

Dear Mr. Dryden:

The following routes are recommended for equipment and material deliveries to the Wind Farm Sites:

B43; Cardinal between 190th St. and 230th St.; Dogwood between 190th St. and 230th St.; 190th St., 200th St., 210th St., 220th St., and 230th St. between Balsam and Eagle; 170th St. (B55) from the Hancock County Line east to S14; and S14 from B55 to B43.

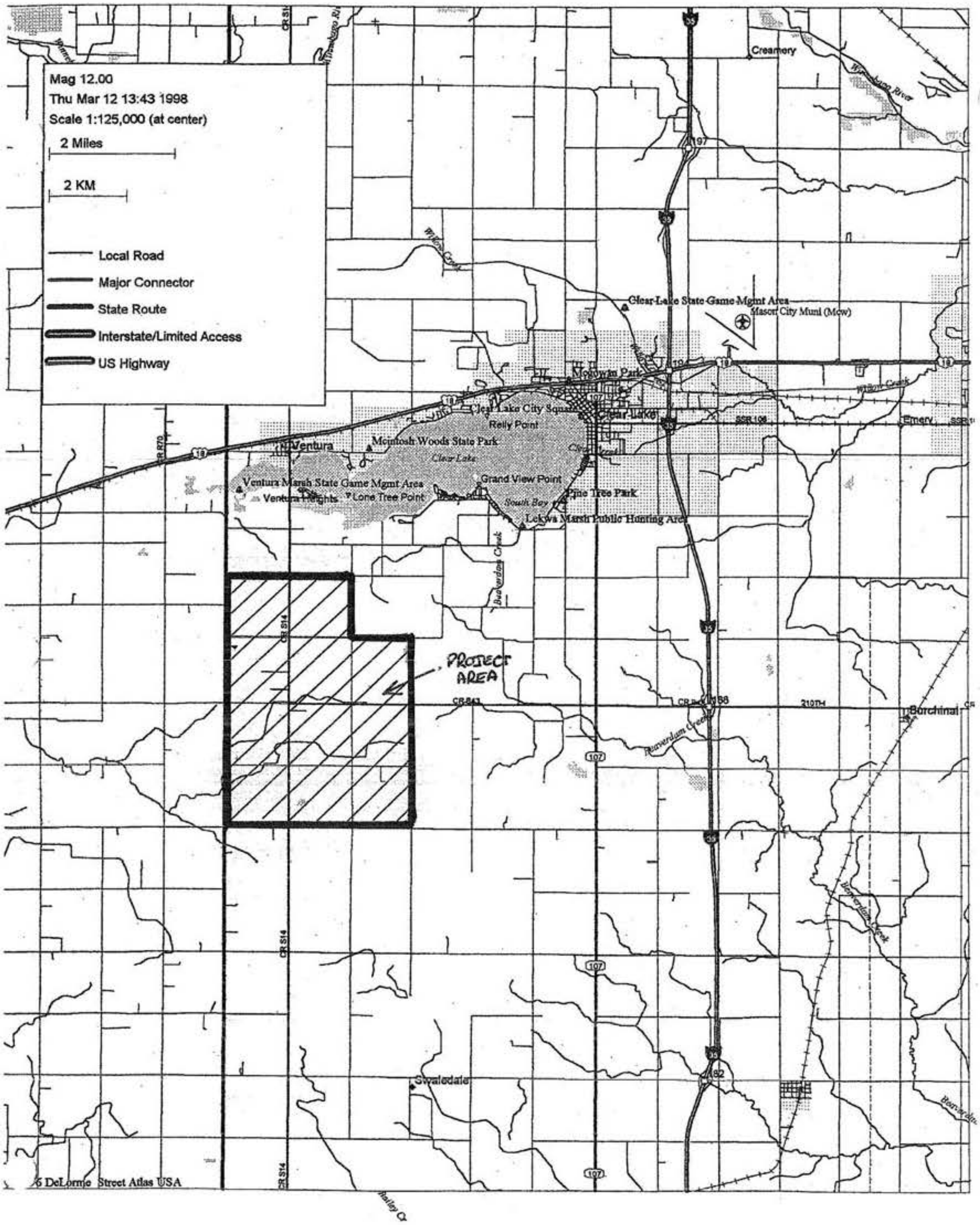
Please call if you have any further questions.

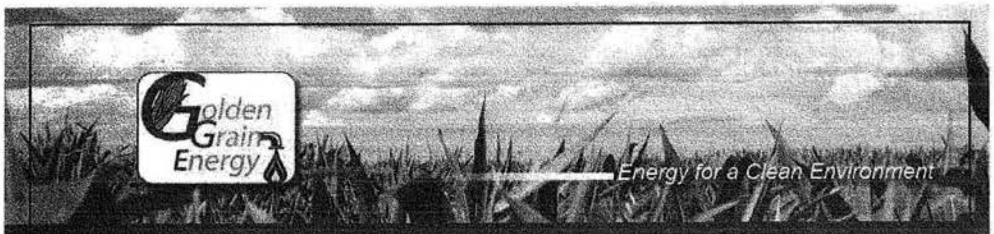
Sincerely,

James D. Witt

James D. Witt

C: File


Mag 12.00
Thu Mar 12 13:43 1998
Scale 1:125,000 (at center)
2 Miles
2 KM
Local Road
Major Connector
State Route
Interstate/Limited Access
US Highway
Creamery
Clear Lake State Game Mgmt Area
Mason City Muni (Mcw)
Clear Lake City Square
Relly Point
Clear Lake
Ventura
Mcintosh Woods State Park
Ventura Marsh State Game Mgmt Area
Ventura Heights
Lone Tree Point
Grand View Point
Pine Tree Park
South Bay
Lekwa Marsh Public Hunting Area
Emery
PROJECT AREA
Burchinal
210TH
Swaledale
DeLorme Street Atlas USA

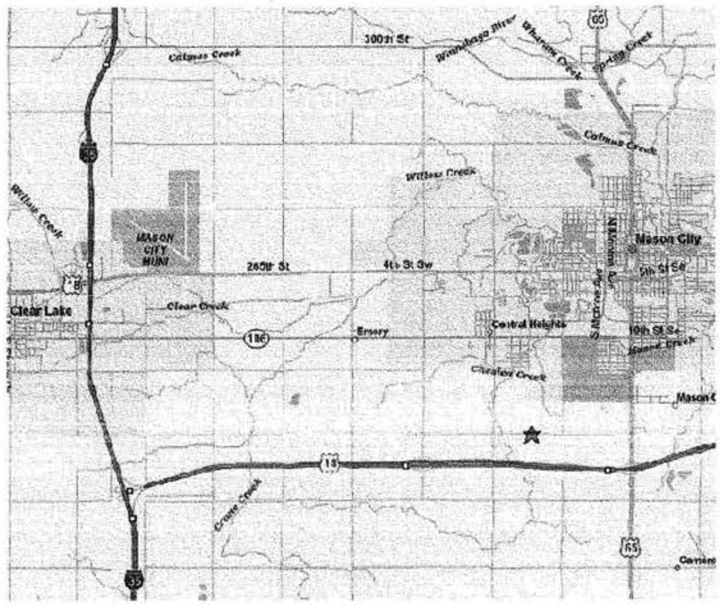


The Plant
Ethanol Information
Investor Relations
Grain Bids
Contact Us
Home

Directions/Hours

Map to Golden Grain Energy -

Click here for driving instructions



Hours of Operations:

Receiving Grain - 7AM to 3PM - Monday to Friday
Loading Modified & Dried Distillers - 7:00AM to 4:30PM - Monday to Friday

Address:

1822 43rd Street SW
Mason City, Iowa 50401

Directions:

- From Interstate 35: Get off on exit 190 (Highway 18), Go east to the first Mason City exit (# 183) Eisenhower (approx. 4 miles), Get off on the Eisenhower exit and go north (left), Go north (approx. ½ mile), Turn right (east) on 43rd Street, Go east to plant (approx. 2 miles)
- From Hwy 218: Hwy 218 turns into Hwy. 18 at Floyd, Go west to the second Mason City exit (# 186) Hwy 65/Rockwell, Go north (right) to 43rd Street (less than a mile), Turn left at 43rd Street (the Rose Bowl will be on the right side of the road), Go west to the plant (approx. 1 ½ miles)
- From Hwy 65 north of Mason City: Go south on Hwy 65 all the way through Mason City

MAPQUEST.

Sorry! When printing directly from the browser your directions or map may not print correctly. For best results, try clicking the Printer-Friendly button.

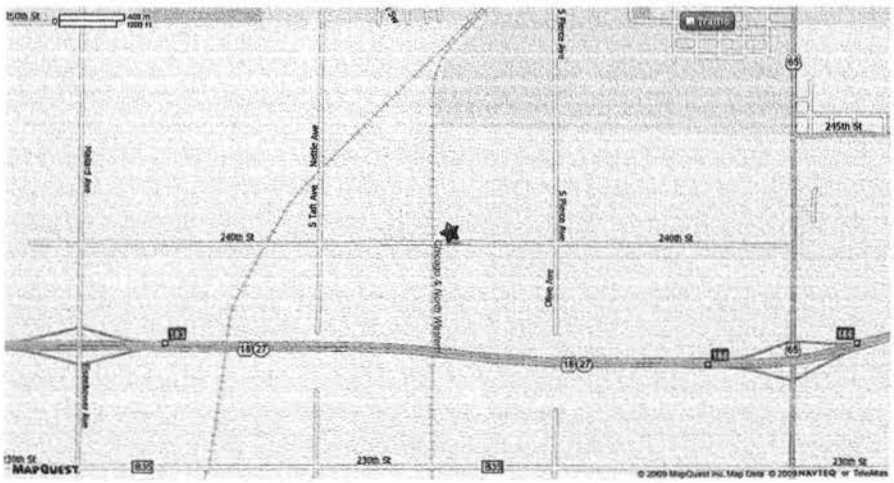
14542 240th St
Mason City, IA 504

NEW! Save Your Maps and Directions

Click the **Save** button to save your map.

You must have a My Places account to save maps.

Don't show this again Close



Kelly, Mary

From: Sperry, Robert B [CTRE] [rsperry@iastate.edu]
Sent: Tuesday, February 17, 2009 8:00 AM
To: drolando@floydcoia.org; engineer@worthcounty.org; Kelly, Mary
Cc: nadia@iastate.edu; desmith@isu.edu
Subject: General Bio Economy Interview Questions

Attachments: All Counties - Bio Economy Interview Questions.doc

All Counties - Bio Economy Int...

<<All Counties - Bio Economy Interview Questions.doc>> Mary, Dusten, and Jim-

First of all, thanks again for agreeing to be a part of this study and agreeing to meet with us next Tuesday at 1 PM in the Cerro Gordo County Engineer's Office. We appreciate your time in getting the proper information to us to make this a very thorough and useful research project.

Today, I am sending out some general questions that deal with all your counties, including the details of how your plant(s)/farms came into being and the costs associated with that. If you have any records of additional costs mentioned in the questions and can bring them with you (or locations where to find them) to the meeting next week, that would be very helpful.

In addition to filling these out, we also will be sending out this Friday (as Duane mentioned), copies of some graphs we made from your annual report data and a few specific questions relating to what we see there. Please review these also so we can discuss them at our meeting as well.

We also realize the group conversation Tuesday may bring up even more (and better (?) ideas than the information we are starting with, so please feel free to jot down and bring ANY notes you feel are pertinent or valuable to this study.

Thanks again - See you Tuesday afternoon.

Bob Sperry, P.E.
Local Roads Safety Liaison
2711 South Loop Drive, Suite 4700
Ames, IA 50010-8664
515-294-7311
rsperry@iastate.edu

Ethanol Plant - 2003
Wind Farm - 1998 | Expanded in 2003
Biodiesel Plant
Alliant Plant - 2004 | 2005

RISE

Bio Economy Interview Questions

for County Engineers

1. Was there an "up front" agreement with the company regarding possible road:
   a. construction costs- RISE projects?

   b. maintenance costs during construction, or
   - Engineering Costs of pre-permit inspections

   c. rebuilding/repair costs upon completion of construction?
   Minimum repair costs during wind farm construction at crossovers. Some from Hauling. But should have been off set by overweight permits

   -added lifetime maintenance on N21 PE

2. Did severe weather before or during the construction have a substantial effect on your expenses over all?
   FEMA event in 2004

3. From your perspective, are there discernible expenses. (maintenance or operational) that occur after the plant/farm is in and operational?
   Road grading on increased schedule

   Pavement marking on increased schedule due to traffic

   230th ST portion paved due to traffic
   230th moved up on paving list

Ethanol Plant
240th St.

Bio Economy Interview Questions

for County Engineers

1. Was there an "up front" agreement with the company regarding possible road:
   a. construction costs- RISE projects?
   Yes. See question #5
   b. maintenance costs during construction, or
   No
   c. rebuilding/repair costs upon completion of construction?
   No
2. Did severe weather before or during the construction have a substantial effect on your expenses over all?
   No
3. From your perspective, are there discernible expenses. (maintenance or operational) that occur after the plant/farm is in and operational?
   No

Bio Economy Interview Questions

for County Engineers

1. Was there an "up front" agreement with the company regarding possible road:
   a. construction costs- RISE projects?
      Wind Farm - No
      Alliant Plant -
      Ethanol Plant - RISE $ to assist in road const. from Hwy 65 to RR Xing
   b. maintenance costs during construction, or
      Wind Farm - Yes, resolution
   c. rebuilding/repair costs upon completion of construction?
      Windfarm - Yes, resolution

2. Did severe weather before or during the construction have a substantial effect on your expenses over all?

3. From your perspective, are there discernible expenses. (maintenance or operational) that occur after the plant/farm is in and operational?

4. Did (or does) plant or wind farm operation in your county affect impact neighboring counties?

?

a. Vice versa?

5. Were other traceable sources of funding (Farm to Market, LOST, Economic Development, RISE, TIF, Debt Service, etc.) provided you to help pay costs of getting plants/farms?

6. Were necessary road repairs due to construction/operation of the plant/farm postponed because of a lack of funds remaining in that fiscal year?

7. Was plant property annexed by a nearby town or tax abatements offered during the process, thereby reducing the county's revenues?

-Ethanol Plant Annexed After built + Roads improved using Engineering Services (County)

4. Did (or does) plant or wind farm operation in your county affect impact neighboring counties?

Possibly. The close proximity of this plant to at least two other plants would have one question the availability of enough corn in the area.

a. Vice versa?

Same as above

5. Were other traceable sources of funding (Farm to Market, LOST, Economic Development, RISE, TIF, Debt Service, etc.) provided you to help pay costs of getting plants/farms?

Yes. RISE funding was used to defray some of the paving cost. The County and City received a total of $764,706.00 toward a paving project totaling $3,794,248.17. The City installed a water main for the area for a total cost of $715,248.18 which was paid from their Enterprise Fund.

6. Were necessary road repairs due to construction/operation of the plant/farm postponed because of a lack of funds remaining in that fiscal year?

No

7. Was plant property annexed by a nearby town or tax abatements offered during the process, thereby reducing the county's revenues?

Yes, The City annexed both roads within a year after completion.

4. Did (or does) plant or wind farm operation in your county affect impact neighboring counties?

a. Vice versa?

5. Were other traceable sources of funding (Farm to Market, LOST, Economic Development, RISE, TIF, Debt Service, etc.) provided you to help pay costs of getting plants/farms?

Wind farms - Not readly - CGC already receives LOST no additional was provided.

6. Were necessary road repairs due to construction/operation of the plant/farm postponed because of a lack of funds remaining in that fiscal year?

7. Was plant property annexed by a nearby town or tax abatements offered during the process, thereby reducing the county's revenues?

No.

8. Were there any FEMA events (and subsequent dollars spent) that would skew the data from your annual reports?

FEMA EVENT 2004 - ROCK

9. Do you have any data about the effect that your facility had on traffic volumes?

- Traffic Study to be done this year

10. Would you have any GIS related data on maintenance operations (surfacing, blading, snow removal, etc) available?

11. Do you normally purchase surfacing material in a stockpile for two (or more) years at a time and pay in one fiscal year?

12. Do you believe the DOT transfers made in 2004/2005 produced any spikes in your maintenance costs?

Yes - old 107 Resurfacing

Old Highway 18 - Blow-outs, pavement markings, guardrail repairs

8. Were there any FEMA events (and subsequent dollars spent) that would skew the data from your annual reports?

No

9. Do you have any data about the effect that your facility had on traffic volumes?

No

10. Would you have any GIS related data on maintenance operations (surfacing, blading, snow removal, etc) available?

No

11. Do you normally purchase surfacing material in a stockpile for two (or more) years at a time and pay in one fiscal year?

12. Do you believe the DOT transfers made in 2004/2005 produced any spikes in your maintenance costs?

FEMA 1999, 2004

8. Were there any FEMA events (and subsequen
from your annual reports?

9. Do you have any data about the effect that yo

10. Would you have any GIS related data on maintenance operations (surfacing, blading, snow removal, etc) available?

This is tracked manually. It is available but would take some time.

11. Do you normally purchase surfacing material in a stockpile for two (or more) years at a time and pay in one fiscal year?

Yes

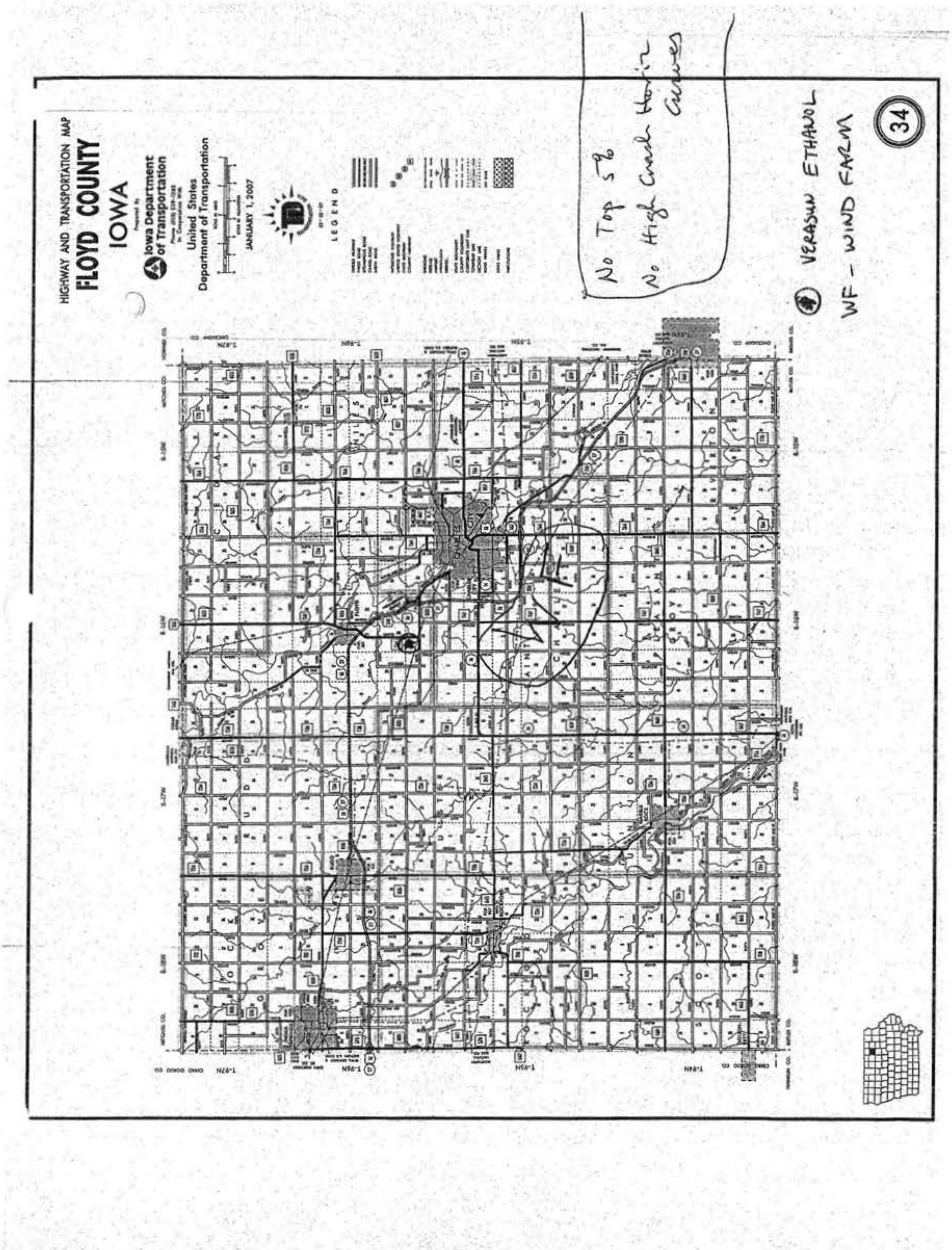
12. Do you believe the DOT transfers made in 2004/2005 produced any spikes in your maintenance costs?

No.

13. Have you had any material cost spikes, other than fuel and salt prices in 2008, that you believe might create "artificial" spikes that may need adjusting?

FEMA 2008 Rock used but not purchased

Floyd County Interview



Bio Economy Interview Questions

for County Engineers

1. Was there an "up front" agreement with the company regarding possible road:
   a. construction costs- RISE projects?

      RISE - Ethanol Plant committed $100,000 (TURNING LANE)

      RISE $312,000 , FM $ 1,100,000

      NO - PRIVATE AGREEMENT -

      - LETTER ONLY , THEN RISE

   b. maintenance costs during construction, or

      LOCAL QUARRY SUPPLIER , SUPPLIED ROCK

      TO GRAVEL ROADS ONLY USED AS HAUL ROADS

      ALSO DUST CONTROL COSTS ON HAUL ROADS.

   c. rebuilding/repair costs upon completion of construction?

      NONE

2. Did severe weather before or during the construction have a substantial effect on your expenses over all?

   - NO -

3. From your perspective, are there discernible expenses. (maintenance or operational) that occur after the plant/farm is in and operational?

   ETHANOL PLANT ROADS (PCC) BREAK UP AND

   WEARING DOWN ROCK

4. Did (or does) plant or wind farm operation in your county affect impact neighboring counties?

NOT SURE. DON'T THINK SO FOR WIND FARM.
ETHANOL PLANT, YES, MORE ROADS SHOWING EFFECT IN CHICKASAW COUNTY ROADS.

a. Vice versa?

NO.

5. Were other traceable sources of funding (Farm to Market, LOST, Economic Development, RISE, TIF, Debt Service, etc.) provided you to help pay costs of getting plants/farms?

FM + RISE FOR ETHANOL FOR ROAD CONSTRUCTION

6. Were necessary road repairs due to construction/operation of the plant/farm postponed because of a lack of funds remaining in that fiscal year?

NO.

7. Was plant property annexed by a nearby town or tax abatements offered during the process, thereby reducing the county's revenues?

ETHANOL 90 % REDUCTION FOR 12 YEARS ON INCREASED TAX VALUES.

8. Were there any FEMA events (and subsequent dollars spent) that would skew the data from your annual reports?

ICE STORM 2007 FOR WINTER WORK

9. Do you have any data about the effect that your facility had on traffic volumes?

NA

10. Would you have any GIS related data on maintenance operations (surfacing, blading, snow removal, etc) available?

NO

11. Do you normally purchase surfacing material in a stockpile for two (or more) years at a time and pay in one fiscal year?

NO, SOMETIMES PAY FOR FOLLOWING YEARS ROCK RESURFACING AT END OF PREVIOUS FISCAL YEAR DEPENDING ON BALANCE.

12. Do you believe the DOT transfers made in 2004/2005 produced any spikes in your maintenance costs?

A SMALL BIT, BUT NOT MUCH.

13. Have you had any material cost spikes, other than fuel and salt prices in 2008, that you believe might create "artificial" spikes that may need adjusting?

NOTHING ELSE.

Bio Economy Interview Questions

for Floyd County Engineer

1. Confirm operational dates: Wind Turbine Farm in 2007? Ethanol plant in 2007?

We have looked at your county's annual reports from 1999-2008 to get a starting point for data collection and the questions below are based on looking at those reports (graphs are enclosed). Hopefully these questions will generate conversation from which we can gain your perspective, as well as any data.

2. Are there other costs records that you or the county auditor would have available that would add to our knowledge of total actual expenses?

   ??

3. There appears to be a spike in your pavement repair expenses in 2007. Was part or all of this attributable to construction damage for, or grain transportation to, the new plant(s)/farm?

   NO, FM RESTRICTED AND CONTRACTOR CLOSE WORKING ON ANOTHER PROJECT IN CHICKASAW. MEASURED AREA AND TOOK QUOTE TO REPAIR PCC WITH PATCHES ON 4 MILE STRETCH

4. There also appears to be a spike in bridge maintenance in 2005 - during construction?

   NO, JUST CONCENTRATED ON SMALLER BRIDGE REPAIRS, REDECKING,

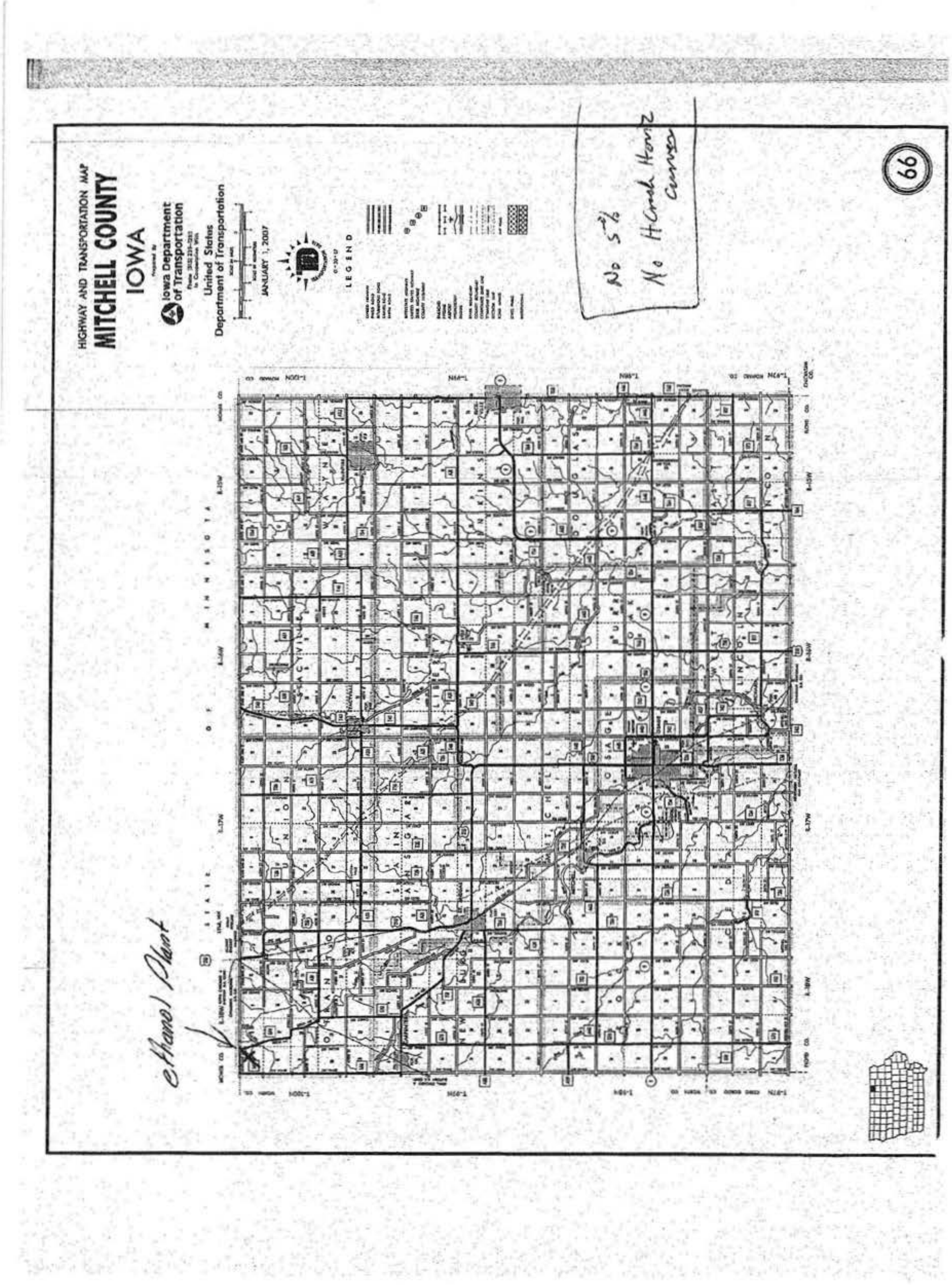
5. There also appears to be a spike in granular surfacing/blading in 2006; was there a major stockpile purchase or severe winter with lots of road repairs that may have skewed that expense?

   NO, AVERAGE IS BOUT SAME, DEPENDING ON BUDGET YEAR CONTRACT ROCK PAID PRIOR TO START OF NEXT FISCAL YEAR.

6. Winter maintenance was very high in 2001 and was escalating in 2007. Severe winter in area 2001? Possible causes/explanation for 2007? Severe winter also?

SEVERE WINTER, LOTS OF SNOW, CONSTANT WINTER ADDED UP TO ADDED COSTS FOR 2001 and 2007 + 2008

Mitchell County Interview



Bio Economy Interview Detail Questions

for Mitchell County Engineer

1. Confirm operational dates: Wind Turbine Farm in 2008? Ethanol plant in 2008?

We have looked at your county's annual reports from 1999-2008 to get a starting point for data collection and the questions below are based on looking at those reports (graphs are enclosed). Hopefully these questions will generate conversation from which we can gain your perspective, as well as any data.

2. Are there other costs records that you or the county auditor would have available that would add to our knowledge of total actual expenses?

NO

3. There appears to be spike in your bridge maintenance in 2005 - in advance of any planning (?) or construction. Would this be typical of anything?

Not related to wind farm or ethanol.

4. Also granular surfacing & blading seem to have spiked in 2006 – Hard winter before? Stockpile purchase?

Winter weather and spring break up.

5. Pavement repairs have risen steadily 2005 – 2008 – Normal deterioration or preparation for coming facilities?

Normal deterioration - heavy salt use in winter.

6. High winter maintenance in 2001 – Severe winter in area?

YES

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MITCHELL COUNTY PRESS-NEWS

REPRINTS

In this section
Census Bureau to start hiring in Mitchell County
Shared superintendent discussed at joint meeting

Wind farm in Mitchell County now fully operational

by David Namanny, Press-News Editor

Horizon Wind Energy, the Texas company that owns and operates the Pioneer Prairie Wind Farm near McIntire in northern Mitchell County, announced last week that all turbines on the farm are now in full operation, pumping electricity onto the grid.

This means that the blades are now spinning on the 122 turbines to go up so far. Over 200 megawatts of energy are being produced at any one time.

This is just the first phase of the amazing $600 million project in Mitchell County and southern Minnesota. Ground was first broken last spring on the installation of 122 Vestas V82 wind turbines in northern Mitchell County.

The second phase of the project, to begin in a few months, will add 60 Vestas V82 wind turbines in the western part of the site into Howard County. The second phase should be completed by this summer.

"The first 122 wind turbines are now operational and producing electricity," explained Pioneer Prairie Project Manager Teran Smith. "We are connected to the main power grid that runs southwest to northwest and delivered through a substation north of Adams, Minnesota."

The electricity being produced is not sold to any one company as of yet.

"We hope to have a contract soon, but if we don't by this spring, we will be a merchant power facility, selling our energy to a daily marker," said Smith. "This is a new concept for wind energy, but we expect it will grow and become common in the future as the United States reduces its dependence on foreign oil."

All the land the turbines sit on around McIntire is leased on contract for the life of the wind farm from local farmers and property owners. While land is leased from property owners, even property owners within the project boundaries without a turbine on their land may also be compensated if affected by the project.

Horizon Wind Energy, owned by EDP Renováveis, is the fourth largest wind energy producer in the world. With the Pioneer Prairie project and two others going online, including The 201 MW Meridian Way Wind Farm, located in north central Kansas in Cloud

Osage native called to duty for Obama inauguration

Sacred Heart celebrates Catholic Schools Week

New Chinese Restaurant coming to Osage

Wind farm in Mitchell County now fully operational

Dorsey part of the new "CRC community"

Mitchell County Supervisors will apply for federal road funding

County and the 102.9 megawatt (MW) Rattlesnake Road Wind Farm located near the city of Arlington in Gilliam County, Oregon, the company has now fully commissioned over 500 megawatts since December of 2008.

"Horizon Wind Energy celebrates the commercial operations of the Meridian Way Wind Farm, the Rattlesnake Road Wind Farm, and the first phase of the Pioneer Prairie Wind Farm. These wind farms mark our entry into two additional states, Kansas and Iowa; Horizon is proud to contribute to the clean energy future in regions with such promising wind resources," said Antonio Martins da Costa, Chairman and CEO of Horizon Wind Energy. "In addition, we are proud to start the commercial operation of our second wind farm in Oregon; we now have more than 200 megawatts operating in the state and are continuing to research new opportunities with several hundred megawatts under development."

Martins da Costa continued, "We thank our Meridian Way customers, The Empire District Electric Company, and Westar Energy and our Rattlesnake Road customer, Pacific Gas and Electric Company (PG&E), as well as the landowners and communities in Kansas, Oregon and Iowa for their partnerships and enthusiasm to produce local, clean renewable energy."

Iowa has long been a leader in renewable energy, setting a renewable energy requirement in 1983 of 105MW for its two investor-owned utilities.

This, combined with Iowa's strong wind resource, access to transmission, and community acceptance helped launch many large-scale projects in the late 1990s and early 2000s.

In 2001, Iowa established a voluntary goal of 1,000MW of wind generating capacity by 2010.

As of third quarter 2008, the American Wind Energy Association ranked Iowa number three in wind power in the United States with over 1300 MWs of existing projects installed, and is ranked tenth in terms of potential capacity.

Now fully operational, the Pioneer Prairie Wind Farm will prevent the annual emission of 900,000 tons of carbon dioxide, a contributor to climate change; 3.5 million pounds of nitrogen oxide, which causes smog; and nearly 6 million pounds of sulfur dioxide, which causes acid rain.

In addition, the Wind Farm will displace 48,000 pounds of mercury each year. The environmental benefits are equivalent to taking 90,000 cars off of the road.

About Horizon Wind Energy

Horizon Wind Energy develops, constructs, owns and operates wind farms throughout North America. Based in Houston, Texas with over 20 offices across the United States, Horizon has developed more than 2,000 megawatts (MW) and operates over 1,500 MW of wind farms.

Horizon is owned by EDP Renováveis S.A. ("EDPR"), a global leader in the renewable energy sector. EDPR has undergone exceptional development in recent years. Its installed capacity increased four-fold between 2005 and 2007, becoming the fourth largest wind energy producer in the world. EDPR is listed on the Euronext Lisbon Stock Exchange.

Energias de Portugal, S.A. ("EDP"), the parent company of EDPR, is a vertically-integrated utility company, headquartered in Lisbon, Portugal. Through its various constituent businesses, EDP holds significant electricity and gas operations in Europe, Brazil, and the United States.

For more information, visit www.horizonwind.com and www.edprenovaveis.com.

Story created Jan 27, 2009 - 12:54:44 CST.

E-mail this story Back to Index Printer Friendly Version

ESTIMATE COUNTY ROAD WORK

MITCHELL COUNTY, IOWA

Road Cost

Project Number:	RC-CO66(42)--9A-66
Date of last estimate:	none
Date of this estimate:	10/29/2007
Payable to:	Concrete Foundations, Inc.
Address	: P.O. Box 363 New Hampton, IA 50659
Estimate No.	1
Sheet No.	1

Final

ITEM NO.	DESCRIPTION	UNIT	UNIT PRICE	SUM OF PREVIOUS ESTIMATES QUANTITY	SUM OF PREVIOUS ESTIMATES AMOUNT	TOTALS THIS DATE QUANTITY	TOTALS THIS DATE AMOUNT	THIS ESTIMATE QUANTITY	THIS ESTIMATE AMOUNT
1	Construction of Natural Subgrade for Pavement, Base Course, Pavement Widening, or Subbase.	mile	$ 3,000.00000			1.068	$ 3,204.00	1.068	$ 3,204.00
2	Granular Shoulder, Type B	ton	$ 11.00000			939.250	$ 10,331.75	939.250	$ 10,331.75
3	Standard or Slipform Portland Cement Concrete Pavement, QM-C, Class 3 Durability, 8 Inch.	sy	$ 24.95000			14250.000	$ 355,537.50	14250.000	$ 355,537.50
4	PCC Pavement Samples	lump	$ 500.00000			0.000	$ -	0.000	$ -
5	Railroad Approach Section	sy	$ 75.00000			67.200	$ 5,040.00	67.200	$ 5,040.00
6	Safety Closure	each	$ 50.00000			5.000	$ 250.00	5.000	$ 250.00
7	Painted Pavement Markings Waterborne or Solvent Based	sta	$ 28.00000			172.260	$ 4,823.28	172.260	$ 4,823.28
8	Traffic Control	lump	$ 2,000.00000			1.000	$ 2,000.00	1.000	$ 2,000.00
9	Flaggers	day	$ 250.00000			1.000	$ 250.00	1.000	$ 250.00
10	Mobilization	lump	$ 7,500.00000			1.000	$ 7,500.00	1.000	$ 7,500.00
11	Price Adjustment (Proposed QM-C to Actual Non QM-C)	cy	$ (1.00000)			3307.000	$ (3,307.00)	3307.000	$ (3,307.00)
12	Price Adjustment (Class M Mix)	sy	$ 10.00000			219.010	$ 2,190.10	219.010	$ 2,190.10
			TOTALS		$ -		$ 387,819.63		$ 387,819.63
			Previous total retained------			Total retained------	xxx	Less 3% retained--	xxx
	Grand Total and Paid Retainage (enter only at FINAL)					Grand Total---	$ 387,819.63	Paid Retainage---	xxx

I hereby certify that the several items and amounts listed herein are correct. 10 - 29 2007 X James E Hyde — County Engineer

I hereby certify that the several items and amounts listed herein are correct. 20 X — Contractor

Due this estimate-- $ 387,819.63

Ethanol Plant-Station-2

ESTIMATE COUNTY ROAD PROJECT WORK

WORTH COUNTY, IOWA

Date of last Estimate JULY 30, ~~19~~ 2007

Date of this Estimate Sep. 5, ~~19~~ 2007

Payable to Concrete Foundations, Inc.

Address P.O. Box 363 New Hampton, IA 50659

Project No. LP-1-08

Estimate No. 2- FINAL

Sheet No. 1 OF 1

Item Nos.	ITEMS	TOTAL CONTRACT PRICE	RATES	SUM OF PREVIOUS ESTIMATE Quantity	SUM OF PREVIOUS ESTIMATE Amount	TOTALS THIS DATE Quantity	TOTALS THIS DATE Amount	THIS ESTIMATE Quantity	THIS ESTIMATE Amount	ACTUAL AMOUNT PAID
1	Construction of Subgrade	1977 98	4004 00	0.494	1977 98	0.494	1977 98	-	-	—
2	Granular Shoulders	4730 00	11 00	–	–	1,442.48	15,867 28	1,442.48	15,867 28	15,867 28
3	Slip-form Paving, PCC	158762 06	25 26	6,600	166,716 00	6,692.0	169,039 92	92.0	2,323 92	2,323 92
4	PCC Samples	500 00	LS	LS	500 00	LS	500 00	–	–	–
5	RR Approach Sections	2025 00	75 00	–	–	27	2,025 00	27	2,025 00	2,025 00
6	Safety Closure	100 00	50 00	–	–	0	0	–	–	–
7	Painted Pavement Markings	2446 92	28 00	–	–	90.37	2,530 36	90.37	2,530 36	2,530 36
8	Traffic Control	2000 00	LS	–	–	LS	2,000 00	LS	2,000 00	2,000 00
9	Flaggers	1250 00	250 00	–	–	3	750 00	3	750 00	750 00
10	Mobilization	6500 00	LS	LS	6,500 00	LS	6,500 00	–	–	–
	TOTALS	190291 96			175,693 98		201,190 54			25,496 56

I hereby certify that the several items and amounts listed herein are correct.

September 5, ~~19~~ 2007

J.E. HYDE P.E.

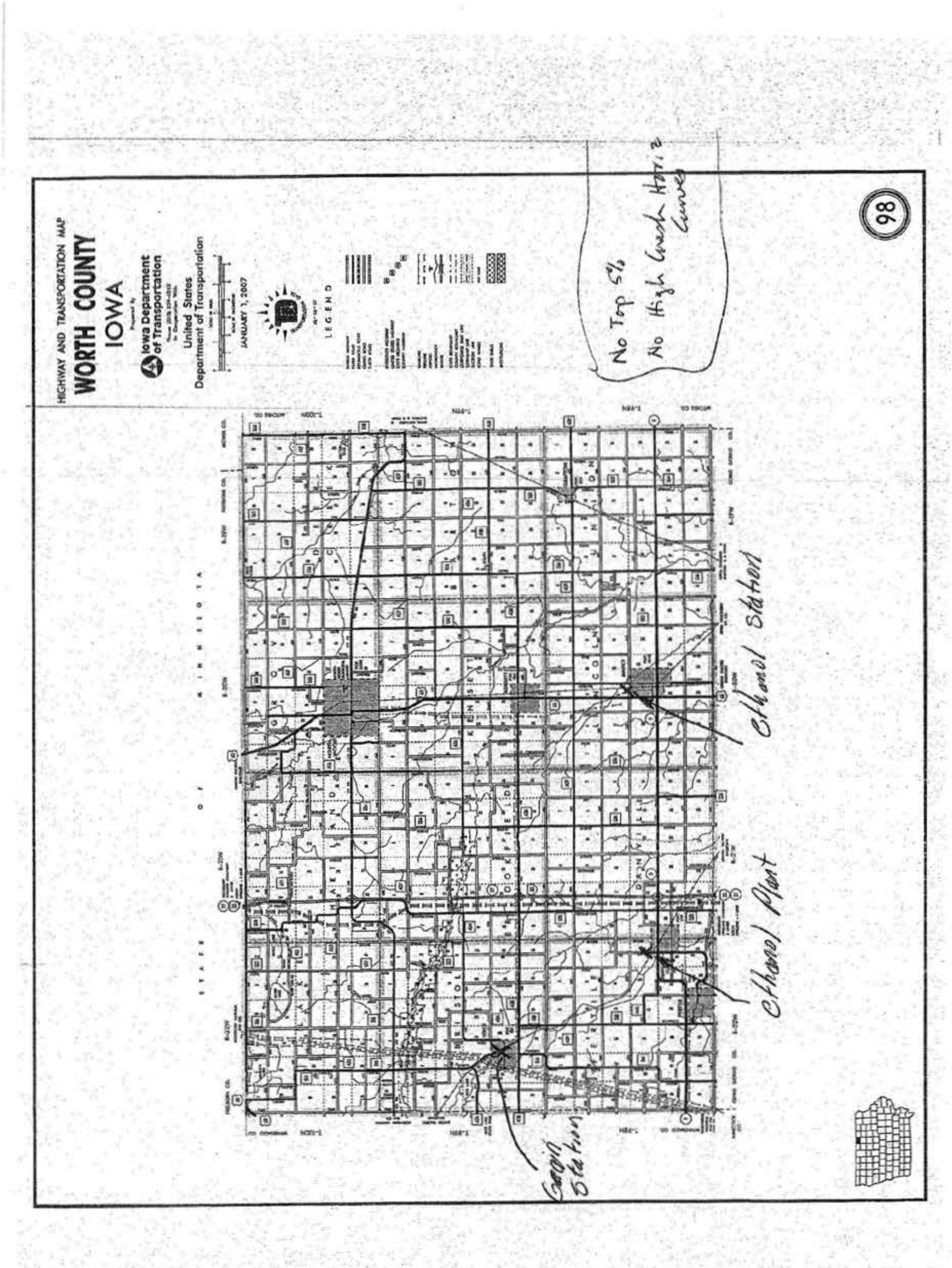
County Engineer.

Casino funds paid for this

PLUS ~~Less~~ 5% Retained $ 5270.82

Due this Estimate $ 30,767.38

Worth County Interview



Bio Economy Interview Questions

for Worth County Engineer

1. Confirm operational dates: Wind Turbine Farm in 2003? Ethanol plant in 2003?

We have looked at your county's annual reports from 1999-2008 to get a starting point for data collection and the questions below are based on looking at those reports (graphs are enclosed). Hopefully these questions will generate conversation from which we can gain your perspective, as well as any data.

Phase 1 Wind farm Aug.-Oct. 2001, Phase 2 Jan.- April 2008, Phase 3 Dec. 2008

2. Are there other costs records that you or the county auditor would have available that would add to our knowledge of total actual expenses?

   NO

3. There appears to be an upward trend from 2004 and peaking in 2006, in your pavement repair expenses. Was part or all of this attributable to construction damage for, or grain transportation to, the new plant(s)/farm?

   Grain transportation to ethanol and Grain facility in Joice , Ia.

4. There also appears to be a spike in bridge maintenance in 2005 – Is this related to the plant construction or raw material transporting?

   NO, Worth County did some maintenance overlays.

5. There appears to be an upward trend in granular and blading from 2006-2008. Could this be related to the plant and farm?

   Possibly

6. That trend, when combined, granular, blading, and winter maintenance also is repeated from 2006 to 2008. _____All grain is moved with semis and it does appear to increase the need for rock and blading.

____
____
____
____

7. Is the spike in winter maintenance in 2001 from a severe winter for the entire area?
_____________Yes____
____
____
____

Ethanol Plant -1

ESTIMATE COUNTY ROAD PROJECT WORK

WORTH COUNTY, IOWA

Project No. RC-C098(33)--9A-98

Estimate No. 2- FINAL

Sheet No. 2 OF 2

Date of last Estimate OCTOBER 22, XX 2003

Date of this Estimate NOVEMBER 17, XX 2003

Payable to WICK'S CONSTRUCTION, INC.

Address PO BOX 428 DECORAH, IA 52101

Item Nos.	ITEMS	TOTAL CONTRACT PRICE	RATES	SUM OF PREVIOUS ESTIMATE		TOTALS THIS DATE		THIS ESTIMATE		ACTUAL AMOUNT PAID
				Quantity	Amount	Quantity	Amount	Quantity	Amount	
14	MOBILIZATION	10,000.00	LS	LS	10,000.00	LS	10,000.00			10,000.00
15	SEEDING AND FERTILIZING	1500.00	1500.00							
16	ADDITIONAL SAW CUT						1,948.00		1,948.00	1,948.00
	3% RETAINED ESTIMATE 1				-5,366.73		5,366.73			
	TOTALS				173,524.22		222,003.18		48,478.96	222,003.18

I hereby certify that the several items and amounts listed herein are correct.

NOVEMBER 17, XX 2003

County Engineer.

Less 5% Retained $

Due this Estimate $ 48,478.96

THE ANCHOR PRESS, NORTHWOOD, IA.

ESTIMATE COUNTY ROAD PROJECT WORK

WORTH COUNTY, IOWA

Project No. RC-C098(33)--9A-98

Estimate No. 2 - FINAL

Sheet No. 1 OF 2

Date of last Estimate OCTOBER 22, XX 2003 — Payable to WICK'S CONSTRUCTION, INC.

Date of this Estimate NOVEMBER 17, XX 2003 — Address PO BOX 428 DECORAH, IA 52101

Item Nos.	ITEMS	TOTAL CONTRACT PRICE	RATES	SUM OF PREVIOUS ESTIMATE		TOTALS THIS DATE		THIS ESTIMATE		ACTUAL AMOUNT PAID
				Quantity	Amount	Quantity	Amount	Quantity	Amount	
1	MODIFIED SUBBASE	4018.00	41.00	98	4018.00	98	4018.00			4018.00
2	GRANULAR SHOULDERS, TYPE A	4950.60	11.10			487.81	5414.69	487.81	5414.69	5414.69
3	SHOULDER CONSTRUCTION, EARTH	5805.00	135.00			66.67	9405.00	66.67	9405.00	9405.00
4	STANDARD OR SLIP-FORM PORTLAND	137,136.45	28.05	4889	137,136.45	5622.33	157,706.45	733.33	20,570.00	157,706.45
	CEMENT CONCRETE PAVEMENT, QM-C,									
	CLASS 3 DURABILITY, 8 IN.									
5	STANDARD OR SLIP-FORM PORTLAND	22,711.50	31.50	721	22,711.50	721	22,711.50			22,711.50
	CEMENT CONCRETE PAVEMENT, QM-C,									
	CLASS 3 DURABILITY, 9 IN.									
6	PCC PAVEMENT SAMPLES	300.00	LS	LS	300.00	LS	300.00			300.00
7	SUBDRAIN, LONGITUDINAL, (SHOULDER)	2047.50	6.50			315	2,047.50	315	2,047.50	2,047.50
8	SUBDRAIN OUTLET, RF-19E	400.00	200.00			2	400.00	2	400.00	400.00
9	RAILROAD APPROACH SECTION, PCC	2025.00	75.00	27	2,025.00	27	2,025.00			2,025.00
10	PAINTED PAVEMENT MARKINGS,	2435.04	38.00			73.08	2,777.04	73.08	2,777.04	2,777.04
	WATERBORNE									
11	PAINTED SYMBOLS AND LEGENDS,	300.00	150.00			2	300.00	2	300.00	300.00
	WATERBORNE									
12	TRAFFIC CONTROL	2700.00	LS	LS	2,700.00	LS	2,700.00			2,700.00
13	FLAGGERS	250.00	250.00			1	250.00	1	250.00	250.00
	TOTALS									

I hereby certify that the several items and amounts listed herein are correct.

________________, 19________________

County Engineer.

Less 5% Retained $________

Due this Estimate $________

THE ANCHOR PRESS, NORTHWOOD, IA.

Wind Farm Phase I

Fiscal 02

Aug - Oct. 2001

Blades + TRK.	= 4,875.00
Rock.	= 6,907.91
Total	= 11,782.91

Dep. 2/28/02

Billed & Paid

Wind Farm Phase II

Iberdrola

Fiscal 08

Jan - 08

Rock. = 9,070.34

TRK. + Blade = 5,087.50

Total Rock = 16,158.06

Total TRK+Blade = 10,012.50

Total 26,170.56

March - 08

Rock. = 2,725.78

TRK. + Blade = 1,700.00

April - 08

Rock. = 4,361.94

TRK + Blade = 3,225.00

Wind Farm Phase III

Rock. 44,996.98

TRK. + Blade 24,605.00

Total = 69,601.98

In progress

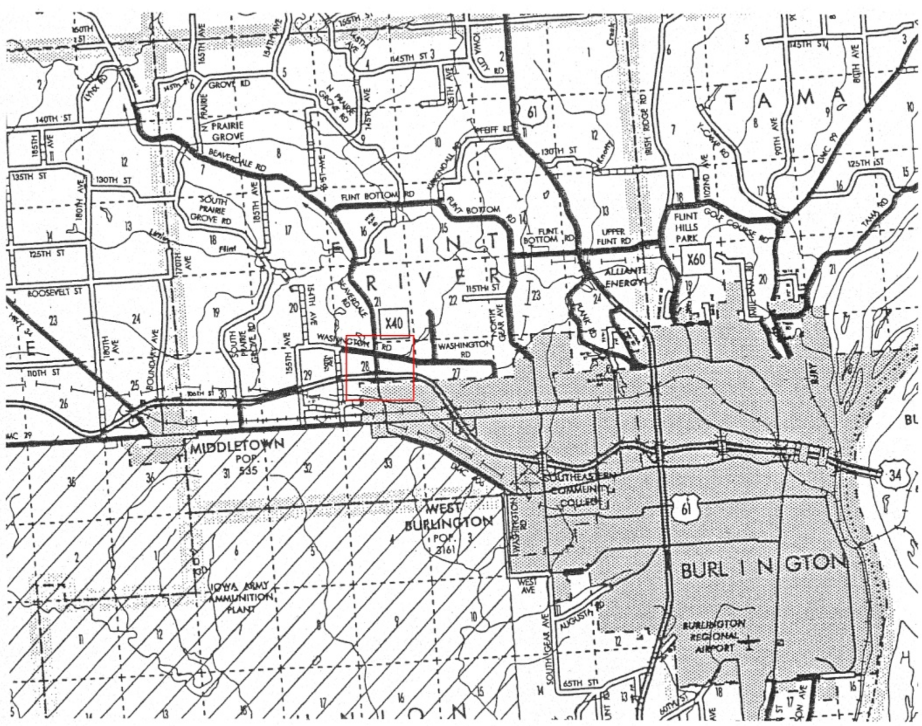
Des Moines County Interview Notes July 9, 2009 Gateway Center

Present: Brian Carter (Des Moines County Engineer), Duane Smith (InTrans), Bob Sperry (InTrans)

Meeting commenced at 10:05 a.m. in patio area.

Duane provided Brian a general overview of the research project objectives, those areas of the state reviewed to date, and the need to get a SE Iowa perspective.

Brian pointed out that Des Moines County had received a RISE grant for a paving project of one mile of PCC north of old U.S. 34 up to Beaverdale Road, which was already paved. The plant is located in the middle of that mile, and the new road provides access from either end via a paved connection. Brian will send information on the construction costs and on the split between grants and agencies needed to fund it. He did indicate that, although the plant is located outside the Burlington city limits, the city had provided a portion of the funds needed to get the plant to come to their area.



Old US 34 had been resurfaced before being transferred to the county's jurisdiction just a few years ago, so it was, and still is, in pretty good condition. The new road paving project was 10-inch thick PCC, which is thicker than Brian normally would use (eight or nine inches) on his other roads. Traffic prior to plant construction had caused the deterioration of another county route, Washington RD. This route runs east and west along the north end of the new plant road and was formerly a road under state jurisdiction. Knowing the plant was coming, it had been scheduled for needed rehabilitation work and was completed about the same time as the plant became operational. Therefore, this segment of roadway is still in good condition, despite the increased loading from the ethanol plant traffic. As a part of the initial interagency agreement, the county Board of Supervisors also agreed to pay for the construction of an interchange at the south end of the new road off U.S. 34. This work was done entirely at their expense, an investment of $642,000.

Because of all this relatively new construction, little deterioration has been noted from the increasing traffic since the plant began operating in 2004. However, a growing trend seem to be that truck traffic from the north gets off U.S. 61, travels west on Flint Bottom Road to Beaverdale Road, and then comes south to the plant. These two county roads seem to be the most vulnerable to the truck increase, although no damage has yet become apparent on either.

There has been a large effect on the county's gravel roads, especially in conjunction with the soft roads last spring and summer that were weather-related. In reviewing the expenditure analysis graphs for his county, Brain's feeling was that none of the spikes shown for pavement repair, winter maintenance, or bridge maintenance had any correlation to the plant operation. Although he felt it was directly correlated with the expenditure for granular surfacing, the fact that the county had some severe winter/spring weather the last two seasons had also been a major factor. He does anticipate a bridge on Beaverdale Road that will need quicker replacement because of the plant operation. He has just had bridge inspections done on several of his bridges, and this bridge will require posting for one-lane traffic to avoid posting a weight limit. Brian emphasized that the expenditures do not represent what needs to be spent to repair all damages, but he can spend only what he has.

Brian has not seen a big transition in haul routes (more from elevators) and, in fact, noted that there has been a lot of storage bin construction activity in his area in the past few years. He believes that many producers try to hold their saleable crop longer to get the highest price, and because of their own lack of storage, the elevators have remained fuller, thus limiting their additional capacity. Therefore, area product still comes in from all directions. He did agree that the semi-truck is the norm for transporting crop on most area operations. One other item of interest was that the ethanol plant would take wetter corn (up to 17% moisture) without a penalty, so in the (past) wet seasons, local farmers could take it there to avoid either docking or drying charges.

In an effort to entice the plant to come to this location, the Board of Supervisors not only agreed to the expenses of the road work and the interchange construction but also agreed to a tax abatement that allows no taxes to be collected during the first 10 years of operation and then limits taxes by using only 10% of the valuation for taxing during the next 10 years. No additional funds from other sources have been granted to the road department for additional maintenance costs incurred. Brian feels that the political attitude toward this type of "economic growth" has not changed and that his Board would do the same today, except for not allowing as much of a tax break for 20 years. Their agreement has been interpreted to apply that break to only the original construction, so some slight funding is possible from the few outbuildings built within the last few years plus a major expansion that was just completed, doubling the plant's production capacity.

The research team discussed design standards, and Brian has not really had to face that issue yet because many of his roads were resurfaced just prior to the plant opening. Brian did do his last road using cold in-place recycling in addition to just resurfacing to try to build in more strength. He currently has no fixed ESAL requirements but will be analyzing it closely when he prepares for work on the Beaverdale Road.

Because Brian farms with his father, we asked if he had any insight into the future of alternate materials, such as switch grass, corn stalks, cobs, or wood fiber. He thought many in the area used no-till farming techniques and that they would be very slow to begin selling off their stalks now used for crop nutrients.

Brian did not believe that a pipeline would be a feasible method of transportation due to cost. The county has a landfill and had considered selling some of the methane it produced to the ethanol plant but abandoned the idea once it explored some potential construction costs.

Fire Services is a problem for many rural ethanol plants that are protected by volunteer departments. The departments are simply not equipped to handle an ethanol fire, especially a large one that is possible at a plant site.

The Des Moines County Engineer provided Pre-paving costs.

Interchange R.O.W.	$31,403.00	
Interchange Grading	$63,919.74	
Interchange Paving	$600,000.00	*no W. Burl. agreement yet
TOTAL	**$695,322.74**	

* these numbers do not include any West Burlington participation in paving ramps and road

103rd St. R.O.W.	$93,587.00	
103rd St. Grading	$265,169.25	*W. Burl. will reimb. Sec. Rd. for $85,710.47
103rd St. Paving	$919,000.00	*no W. Burl. agreement yet
TOTAL	**$1,277,756.25**	

* if paving project is started and completed this spring as currently planned, Sec. Rd. Dept. most likely will have to take out a loan and do a budget amendment prior to end of fiscal year because the grant reimbursements (and hopefully W. Burl. reimb.) will most likely not be received prior to the end of the fiscal year

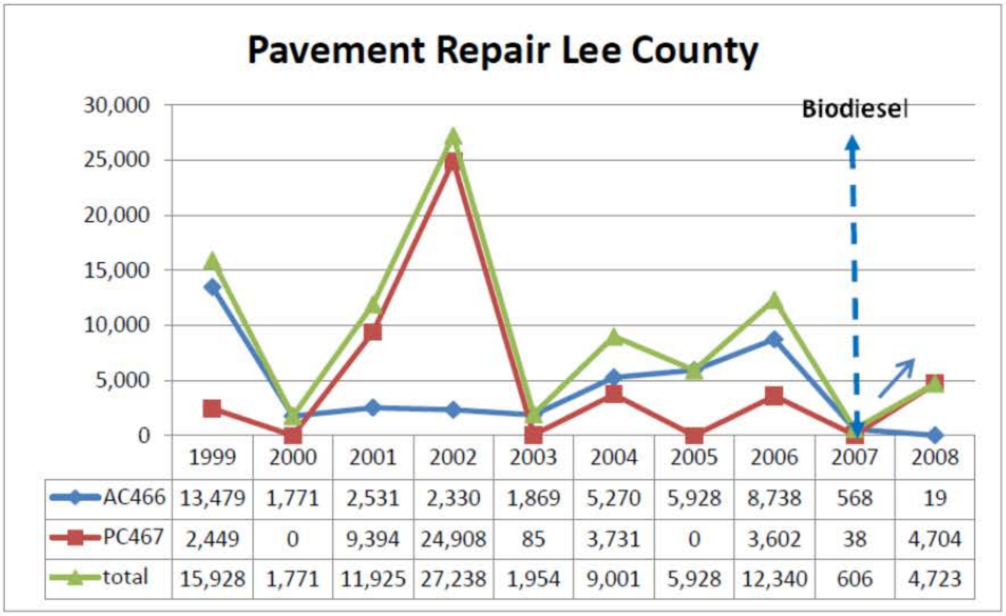
RISE Grant	$500,000.00	*must be split 50/50 between ramps & road
EDA Grant	$500,000.00	*not officially allocated yet (9/11/03)
TOTAL	**$1,000,000.00**	

Post-paving Costs provided by Des Moines County Engineer

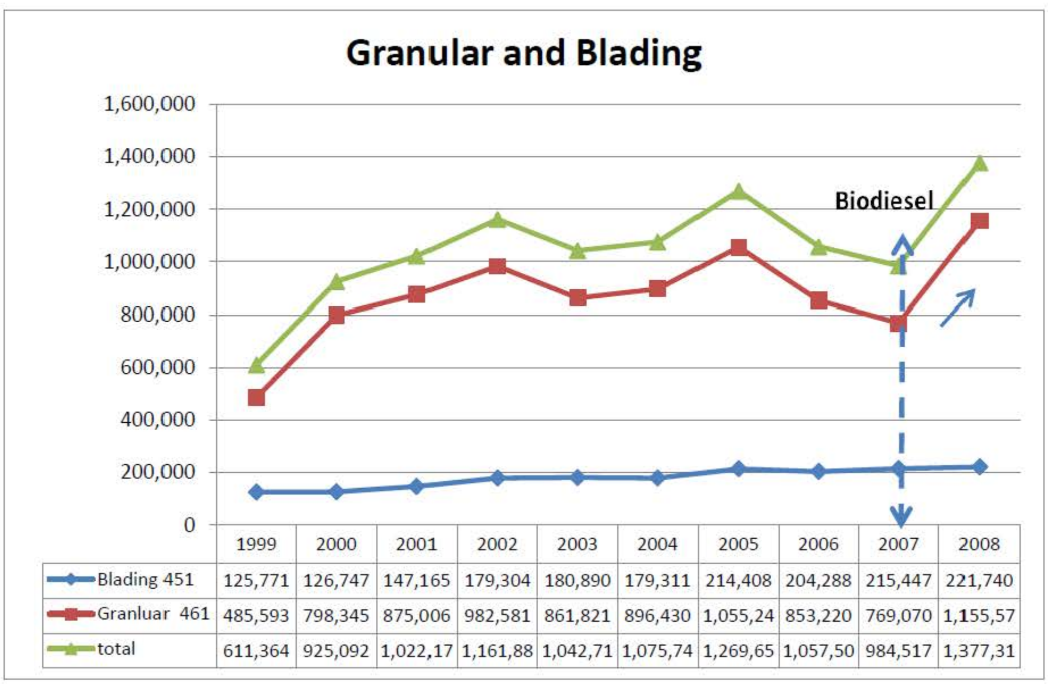
Beaverdale Interchange			Des Moines County	West Burlington	BADCO	TOTAL
Interchange R.O.W.			$31,403.00	$31,403.00	$31,403.00	$94,209.00
Interchange Grading			$63,919.74	$63,919.74	$0.00	$127,839.48
*includes consultant fees						
Interchange Paving			$642,029.26	$0.00	$0.00	$642,029.26
103rd St. (Ethanol Road)			Des Moines County	West Burlington		TOTAL
103rd St. R.O.W.			$73,687.50	$19,900.00		$93,587.50
103rd St. Grading			$238,365.59	$94,710.47		$333,076.06
*includes consultant fees						
103rd St. Paving			$714,353.90	$135,140.78		$849,494.68
*includes consultant fees						
TOTALS			$1,763,758.99	$345,073.99	$31,403.00	**$2,140,235.98**
GRANTS						
RISE Grant		$500,000.00				
EDA Grant		$500,000.00				
	TOTAL	**$1,000,000.00**				

APPENDIX D. MAINTENANCE COST FOR LEE AND DES MOINES COUNTIES

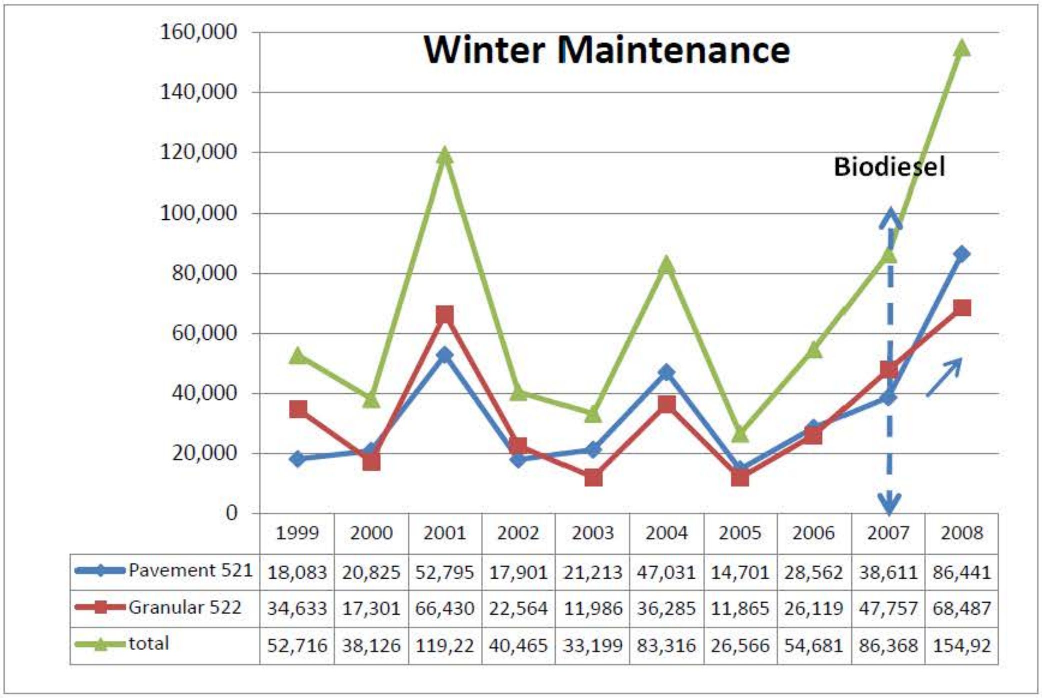
Lee County

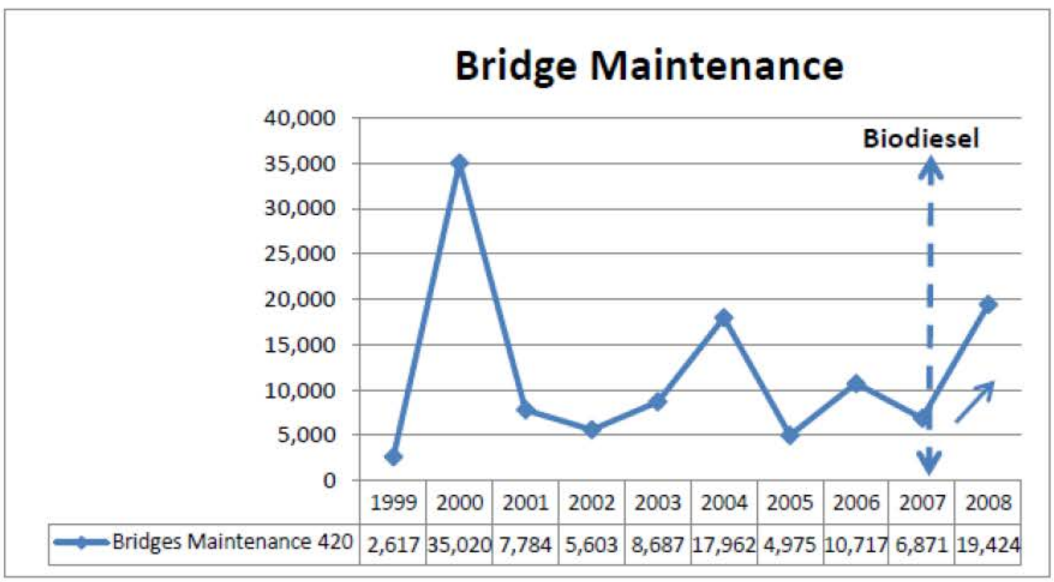


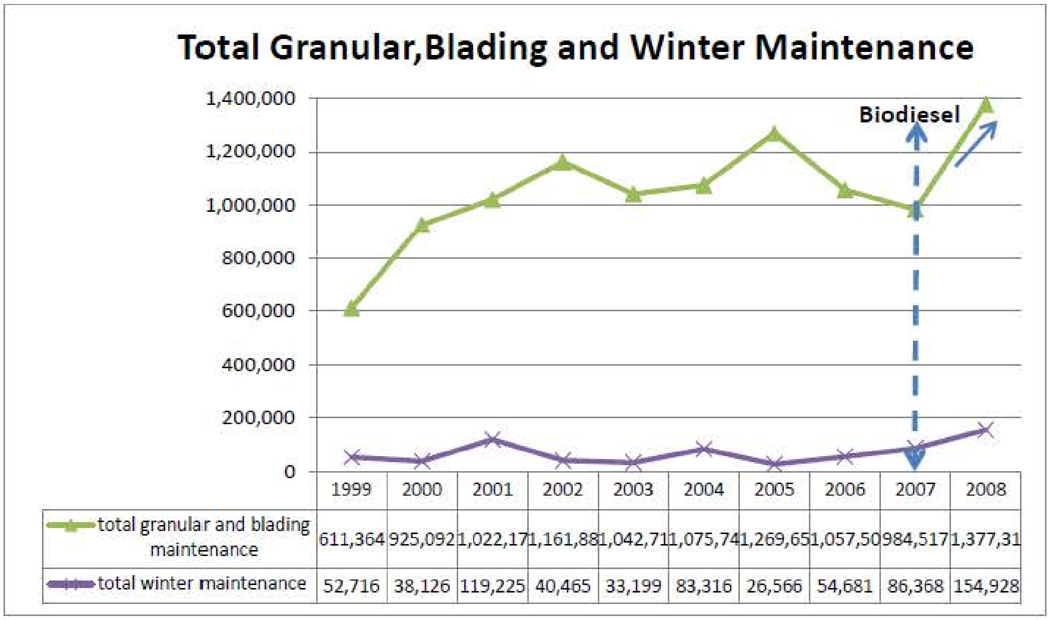
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AC466	13,479	1,771	2,531	2,330	1,869	5,270	5,928	8,738	568	19
PC467	2,449	0	9,394	24,908	85	3,731	0	3,602	38	4,704
total	15,928	1,771	11,925	27,238	1,954	9,001	5,928	12,340	606	4,723

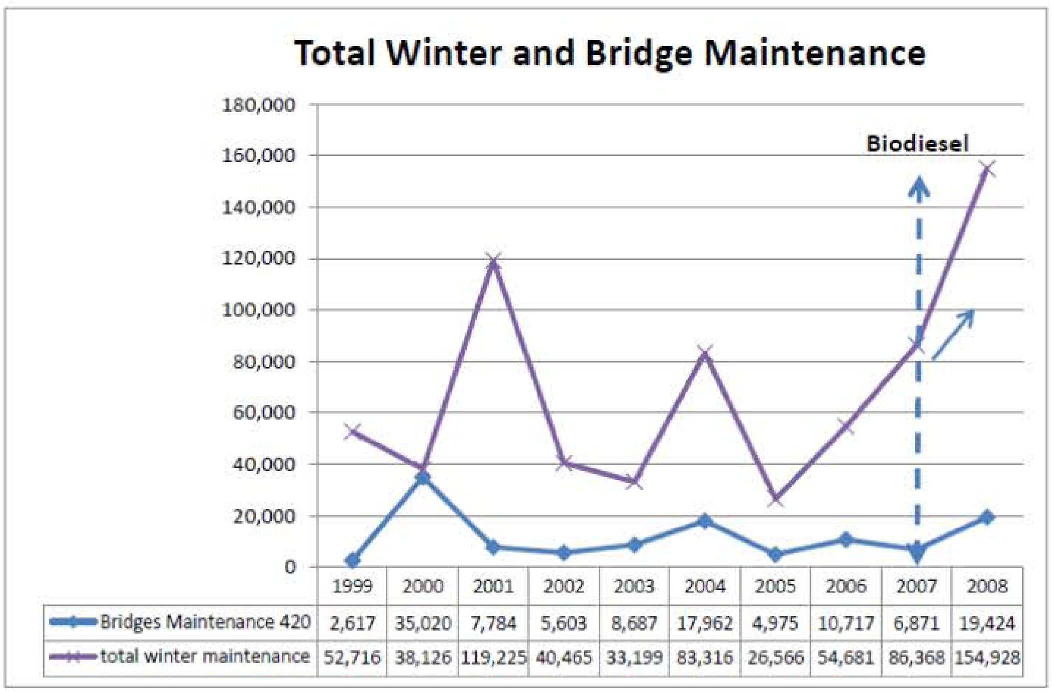


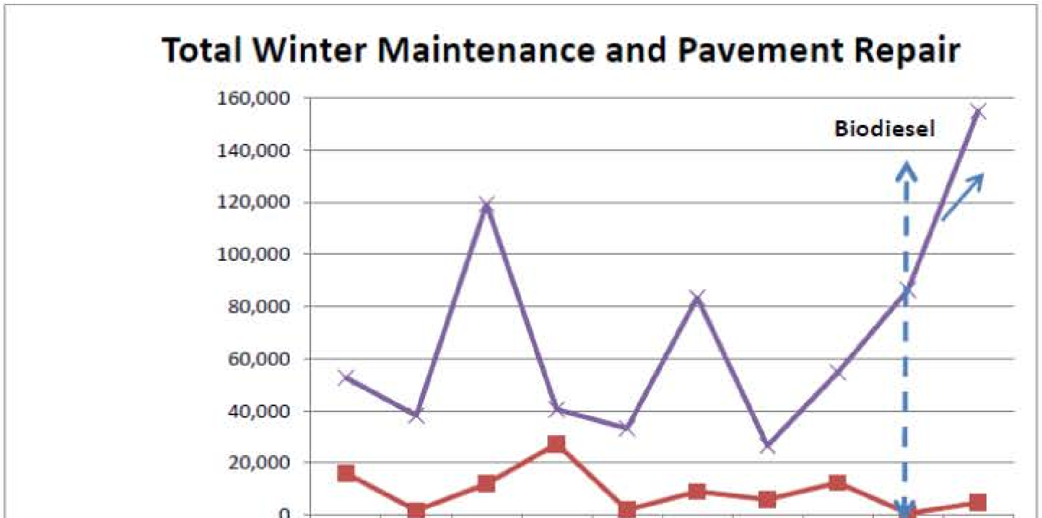
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Blading 451	125,771	126,747	147,165	179,304	180,890	179,311	214,408	204,288	215,447	221,740
Granluar 461	485,593	798,345	875,006	982,581	861,821	896,430	1,055,24	853,220	769,070	1,155,57
total	611,364	925,092	1,022,17	1,161,88	1,042,71	1,075,74	1,269,65	1,057,50	984,517	1,377,31


Winter Maintenance
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Biodiesel
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Pavement 521 18,083 20,825 52,795 17,901 21,213 47,031 14,701 28,562 38,611 86,441
Granular 522 34,633 17,301 66,430 22,564 11,986 36,285 11,865 26,119 47,757 68,487
total 52,716 38,126 119,22 40,465 33,199 83,316 26,566 54,681 86,368 154,92

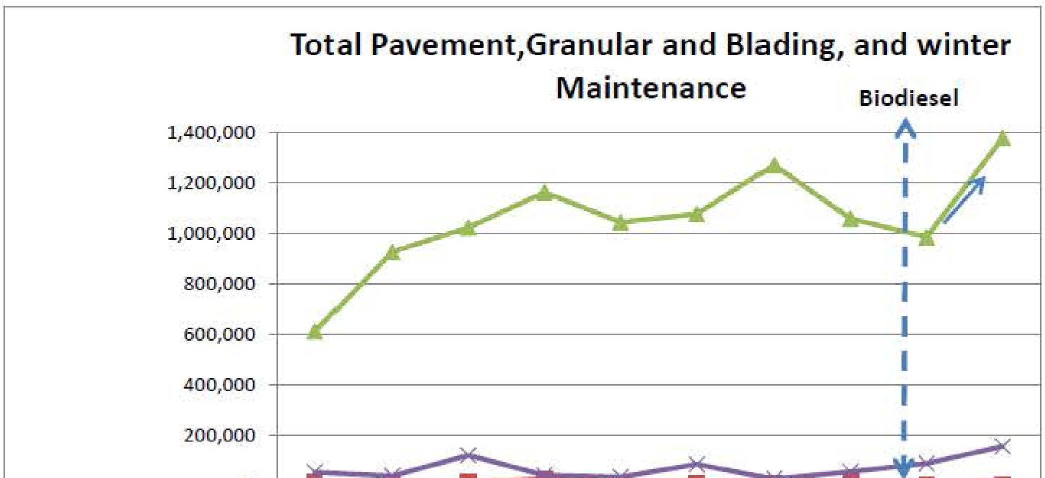

Bridge Maintenance
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Biodiesel
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Bridges Maintenance 420 2,617 35,020 7,784 5,603 8,687 17,962 4,975 10,717 6,871 19,424


Total Granular,Blading and Winter Maintenance
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Biodiesel
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
total granular and blading maintenance 611,364 925,092 1,022,17 1,161,88 1,042,71 1,075,74 1,269,65 1,057,50 984,517 1,377,31
total winter maintenance 52,716 38,126 119,225 40,465 33,199 83,316 26,566 54,681 86,368 154,928


Total Winter and Bridge Maintenance
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Biodiesel
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Bridges Maintenance 420 2,617 35,020 7,784 5,603 8,687 17,962 4,975 10,717 6,871 19,424
total winter maintenance 52,716 38,126 119,225 40,465 33,199 83,316 26,566 54,681 86,368 154,928

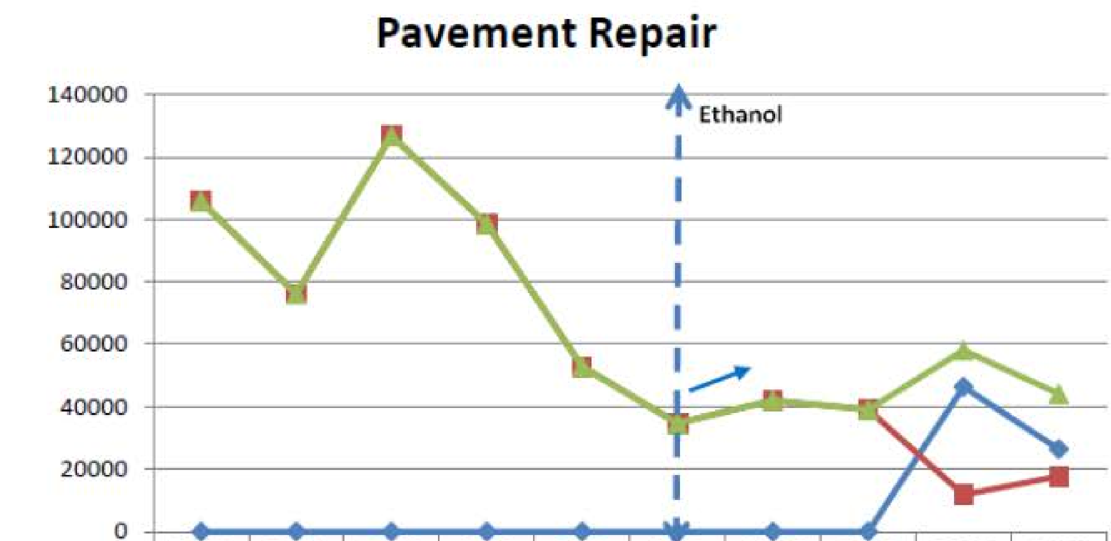


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair	15,928	1,771	11,925	27,238	1,954	9,001	5,928	12,340	606	4723
total winter maintenance	52,716	38,126	119,225	40,465	33,199	83,316	26,566	54,681	86,368	154,928

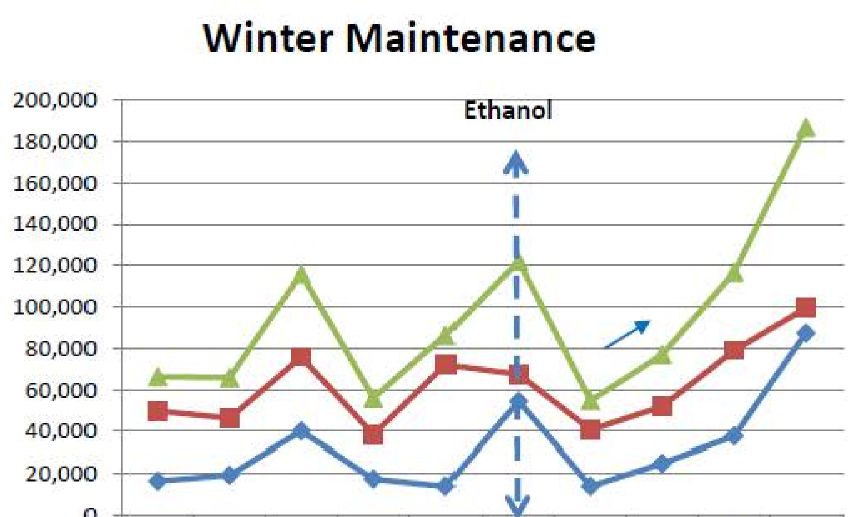


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair	15,928	1,771	11,925	27,238	1,954	9,001	5,928	12,340	606	4723
total granular and blading maintenance	611,364	925,092	1,022,17	1,161,88	1,042,71	1,075,74	1,269,65	1,057,50	984,517	1,377,31
total winter maintenance	52,716	38,126	119,225	40,465	33,199	83,316	26,566	54,681	86,368	154,928

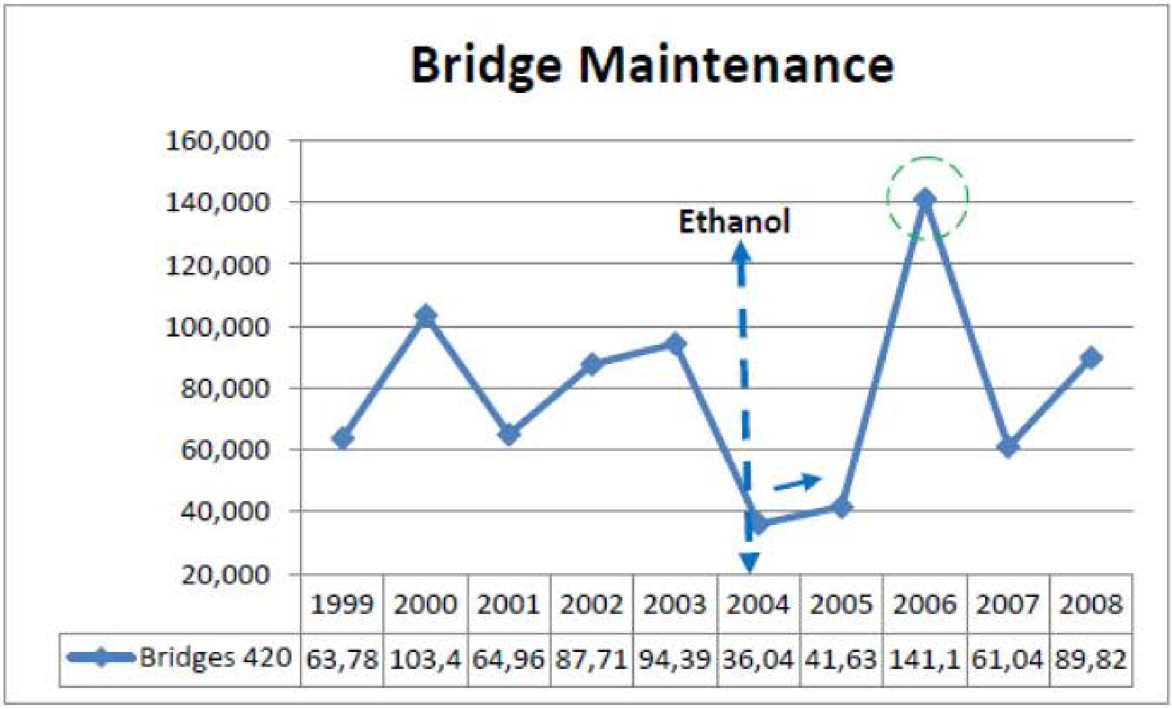
Des Moines County

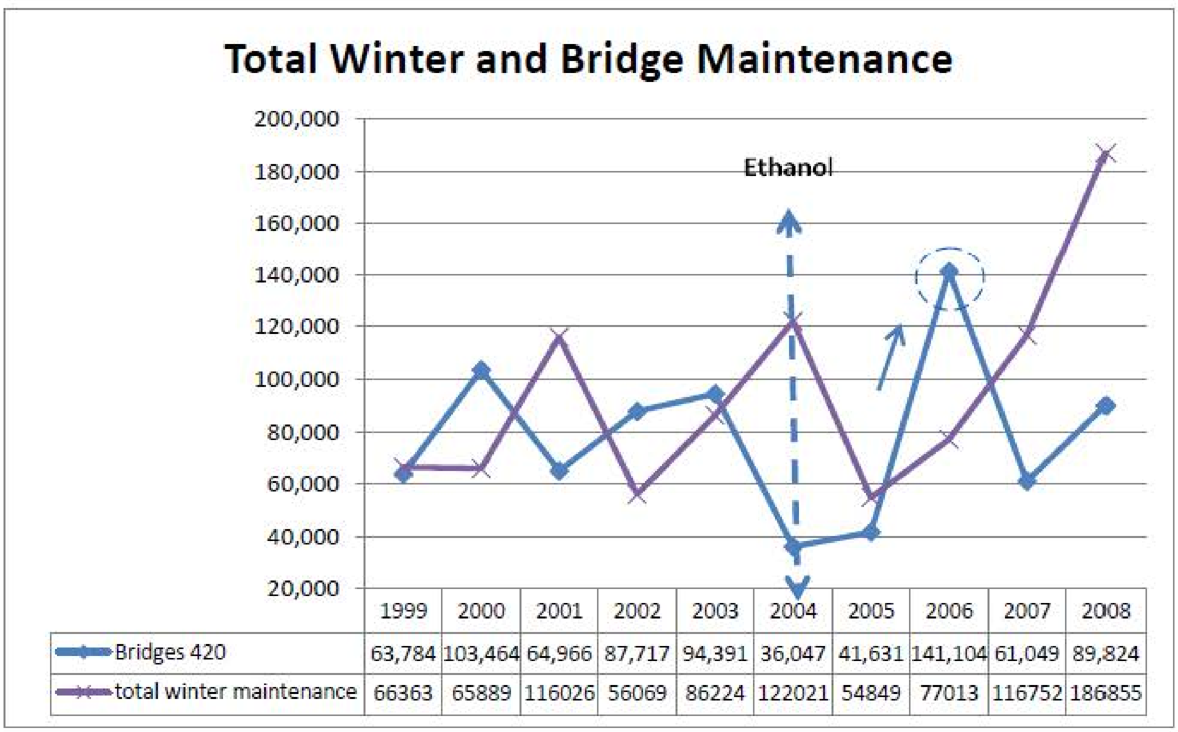


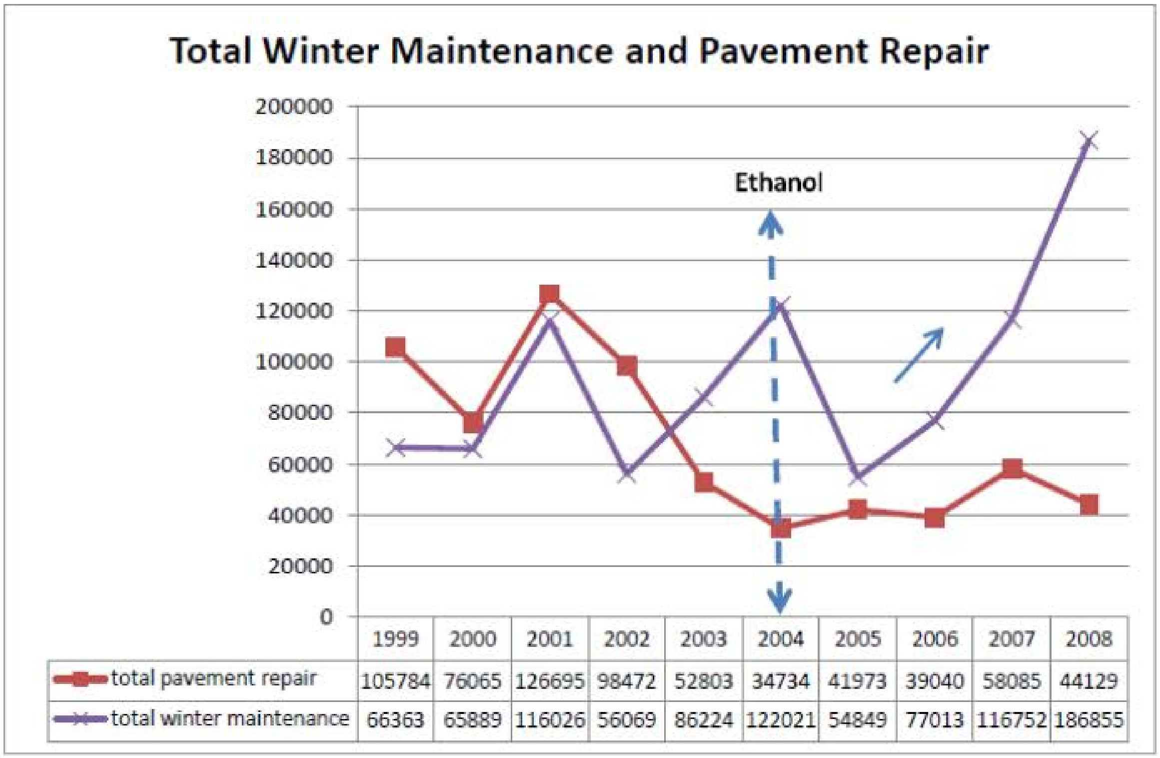
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AC 466	0	0	0	0	0	0	0	0	46,329	26,453
PC 467	105,784	76,065	126,695	98,472	52,803	34,734	41,973	39,040	11,756	17,676
total	105784	76065	126695	98472	52803	34734	41973	39040	58085	44129



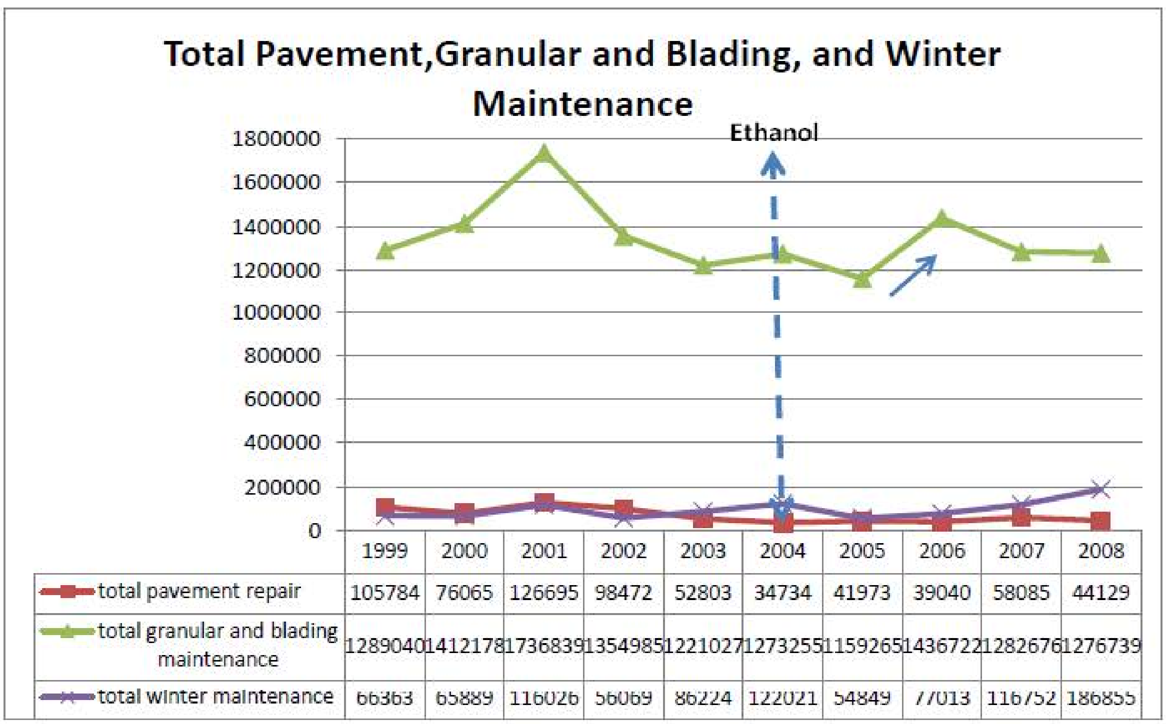
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Plow snow / spread sand/salt 521	16,604	19,475	40,195	17,530	14,200	54,574	14,113	25,072	37,743	87,420
Plow & blade snow only 522	49,759	46,414	75,831	38,539	72,024	67,447	40,736	51,941	79,009	99,435
total winter maintenance	66,363	65,889	116,026	56,069	86,224	122,021	54,849	77,013	116,752	186,855


Bridge Maintenance
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
Ethanol
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Bridges 420 63,78 103,4 64,96 87,71 94,39 36,04 41,63 141,1 61,04 89,82


Total Winter and Bridge Maintenance
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
Ethanol
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Bridges 420 63,784 103,464 64,966 87,717 94,391 36,047 41,631 141,104 61,049 89,824
total winter maintenance 66363 65889 116026 56069 86224 122021 54849 77013 116752 186855



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair	105784	76065	126695	98472	52803	34734	41973	39040	58085	44129
total winter maintenance	66363	65889	116026	56069	86224	122021	54849	77013	116752	186855



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
total pavement repair	105784	76065	126695	98472	52803	34734	41973	39040	58085	44129
total granular and blading maintenance	1289040	1412178	1736839	1354985	1221027	1273255	1159265	1436722	1282676	1276739
total winter maintenance	66363	65889	116026	56069	86224	122021	54849	77013	116752	186855

APPENDIX E. IMPACT CALCULATOR SUPPLEMENTAL MATERIAL

Table E.3. Important constants and assumptions used in the impact calculator

	Ethanol (corn)	*Biodiesel (soybean)*
1 bushel of produce yields	2.7 gallons	1.4 gallons
1 bushel weighs	56 lbs	48 lbs
Typical truck weighs	1200 bushels	900 bushels
Typical fuel truck hauls	9000 gallons	9000 gallons
Typical truck ESAL	2.3	2.3

Annual ESAL Calculator = =365*([U*a]+[V*b*Q]+[W*b*R]), where

a = number of single unit trucks
b = number of single or multiple trailer trucks with 4 axles and above (combo units)
Q = Multiplier for number of single unit trailer trucks*
R = Multiplier for number of multiple unit trailer trucks*
U = Effective ESAL for single unit trucks (0.4)
V = Effective ESAL for single unit trailer trucks (1.0)
W = Effective ESAL for multiple unit trailer trucks (1.75)

* Iowa DOT lumps single and multiple unit trailer trucks together at road section information level but splits them at the statewide level.

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Washington State Department of Transportation (WSDOT) *Pavement Guide Interactive*, Module 4, 2005.

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Conley, S.P. 2006. *What is Biodiesel?* Retrieved from Purdue Extension http://www.ces.purdue.edu/extmedia/ID/ID-337.pdf.

The Soy Transportation Coalition and the United Soybean Board, 2009. *Heavier Semis: A Good Idea?* Retrieved from Informa Economics Inc, http://www.soytransportation.org/whatsnew/semiweightlimitreportjJune09.pdf.

APPENDIX F. COUNTY STANDARD SPECIFICATIONS: LINN COUNTY, IOWA

COUNTY STANDARD SPECIFICATIONS

LINN COUNTY, IOWA

Prepared by the office of the Linn County Engineer
1888 County Home Road, Marion, Iowa

Adopted	Resolution
04/25/2007	2007-4-53

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SECTION 1 GENERAL PROVISIONS

It is intended that the design criteria and construction specifications incorporated in this document be required limits for the development of plans for construction of proposed rural subdivision streets in Linn County, Iowa. Any request for a variance from these requirements must be made in writing by the developer or his engineer to the Linn County Engineer. A variance must be granted in writing from the County Engineer or by resolution of the Linn County Board of Supervisors to be effective.

A professional engineer registered in the State of Iowa shall certify plans submitted for review. Linn County applies Iowa Department of Transportation "Standard Specifications for Highway and Bridge Construction" to subdivision projects. Details not covered by D.O.T. specifications may be in accordance with Statewide Urban Design and Specifications (SUDAS). Projects reviewed by cities and towns shall have plans reviewed by the town or city with jurisdiction.

Those platting lots shall bring adjacent secondary roads to current county standards prior to final acceptance of the plat or in lieu thereof, provide a road agreement to bring the adjacent road(s) into conformance. The impact to adjacent secondary roads shall be determined by the Linn County Engineer and shall be included in the road agreement.

SECTION 2 CONSTRUCTION PLANS

2.1 PLAN PREPARATION

Preliminary improvement plans may be submitted as prepared D size (22"x34" or 24"x36") drawings or half size (11"x17"). Scales for drawings shall be 1" = 100' or less for plan views and 1" = 10' or less for profile. Sufficient details will be shown so that the plans are clear, and the designer's intent is understandable.

All essential features shall be shown, including but not limited to: drainage, bench marks, survey corners, reference ties, lot corners, center line, station marks at one-hundred (100) feet intervals, stations at lot corners, fences, culverts, horizontal curves, curve data, hydraulic data, traffic volumes, typical roadway cross-section, utility locations, drainage easements, street names, subdivision name, owner, design engineer, plan certification and location for reviewed drawings to be sent.

2.2 PLAN SUBMITTAL

Two sets of preliminary plans and cross-sections shall be submitted to the Linn County Engineer's Office, 1888 County Home Road, Marion, Iowa 52302. One set will be reviewed and returned to the design engineer. Plans shall be submitted prior to consideration of the final plat.

2.3 PLAN APPROVAL

Three (3) sets of corrected plans are to be returned to the Linn County Engineer's Office. If no further corrections are necessary, one set of plans will be returned to the design engineer. If corrections are necessary, three (3) sets of corrected plans are to be resubmitted until approval is obtained.

As condition of final plan approval, the developer shall file an affidavit with the Soil Conservation Service stating that the proposed activity will not exceed the established soil loss limits as prescribed by the Code of Iowa. If more than one acre of site is exposed to erosion, the developer must obtain a permit from the Iowa Department of Natural Resources and submit an erosion control plan.

Final approval must be secured before any construction begins.

SECTION 3 STREETS - GENERAL

3.1 GENERAL LAYOUT OF STREETS

The general layout of proposed streets shall conform to the requirements found in the Unified Development Code, Article 4, Sec. 8B § 8,9,10 & 11.

3.2 INTERSECTIONS - ALIGNMENT

Proposed streets shall be laid out to intersect other streets at nearly right angles when practicable. A deviation of as much as 10° from being orthogonal may be allowed. Proposed street alignments shall have a sixty (60) foot tangent section approaching all intersections.

Intersections shall not be located closer than two hundred (200) feet to other intersections on the same alignment.

3.3 INTERSECTIONS - GRADES

Proposed roads intersecting existing roads shall have a minus 1% to 2% profile tangent for a minimum of twenty-five (25) feet from the intersection. The intent of this provision is to lessen surface water problems at intersection and to reduce surface flow from side roads onto through roads.

3.4 SIDEWALKS

Where sidewalks are required see page 24 for details of sidewalk ramp details at intersections.

SECTION 4 ROAD CLASS AND DESIGN ELEMENTS

4.1 CLASSIFICATION A ROAD – MAJOR ARTERIAL

This classification is considered a major county artery. It carries through traffic across the county, traffic between communities, and traffic between other major arterial roads. These roads are intended to ultimately receive high type pavement and carry the bulk of the traffic on the Secondary System. Table 4.1 divides major arterial roads by traffic volume into three subclasses for design purposes.

SUBCLASSIFICATION OF MAJOR ARTERIAL	TRAFFIC COUNT, AADT	
	CURRENT	20 YEARS
A-1	Over 750	1000 to 2000
A-2	250 to 750	400 to 1000
A-3	50 to 250	100 to 400

TABLE 4.1 - SUBCLASSIFICATION OF MAJOR ARTERIAL ROADS

4.2 CLASSIFICATION B ROAD – MINOR ARTERIAL

This classification serves as a minor arterial from the rural subdivision streets and collector roads. It is generally one to six miles in length and connects its service roads with the major arterial system. Generally these roads have smaller traffic volumes than major arterial roads. These roads are intended for ultimate improvement to an intermediate dust free surface or high type pavement. A rural subdivision street could fall into this classification at the discretion of the County Engineer. Table 4.2 shows the subclassification of this road type based upon traffic volume.

SUBCLASSIFICATION OF MINOR ARTERIAL	TRAFFIC COUNT, AADT	
	CURRENT	20 YEARS
B-1	250 to 750	400 to 1000
B-2	50 to 250	100 to 400

TABLE 4.2 - SUBCLASSIFICATION OF MINOR ARTERIAL ROADS

4.3 CLASSIFICATION C AND D ROAD – COLLECTOR ROADS AND RURAL SUBDIVISION STREETS

These are considered service roads for rural areas and residential subdivisions. They may connect to major arterial roads, minor arterial roads or collector roads. These roads are intended for local use and low traffic volumes. Rural collector roads (C) are generally rock surfaced. Rural subdivision streets (D) are required to receive high type surfacing as indicated in Section 9.2.

4.4 CLASSIFICATION E ROAD - PRIVATE ROADS

These are private service roads that access agricultural lands or five or fewer private lots. These roads generally have traffic volumes less than 50 vehicles per day. These private roads are intended to ultimately receive high type surfacing as indicated in Section 9.2.

Conservation Subdivisions shall be classified as private roads. See Table 6.6 for design specifications.

4.5 CLASSIFICATION F ROAD - PRIVATE LANE

When private lanes are proposed in a subdivision, the Linn County Engineer must approve them as an exception.

All private lanes shall be improved giving due regard to the extent and character of the area to be served. The layout of the proposed private lane shall be such that no provision can be made to allow extension of the lane outside of the proposed platted area. Private lanes are intended to serve agricultural property or one or two private lots. They may also be used to serve existing lots at the discretion of the County Engineer.

The recommended width of the traveled surface is twenty-two (22) feet. The roadway shall be surfaced full width with crushed stone at a rate of 5000 tons to the mile to provide a reasonable all weather access to the proposed lots. The width of the rock surface shall not be less than sixteen (16) feet. The use by emergency vehicles shall be accounted for in the design of this type facility. The County Engineer may require verification by the owner's engineer in writing that the lane is designed for emergency access.

SECTION 5 ROAD RIGHTS-OF-WAY

5.1 RIGHT-OF-WAY WIDTHS

Rights-of-way widths for proposed public streets shall not be less than sixty-six (66) feet. Right-of-way widths for proposed private lanes shall not be less than forty (40) feet. Wider rights-of-way may be required by reason of the topography and geometrics to insure that the essential features of the street are contained. At intersections attention shall be given to ditch drainage to insure uninterrupted flow. It may be necessary to provide additional right-of-way to provide for such drainage.
The minimum requirements for right-of-way widths for the various road classifications are shown in Table 5.1.

CLASSIFICATION	ROAD CLASSIFICATION	MINIMUM R.O.W. REQUIRED EACH SIDE OF CENTERLINE
A	Major Arterial Road	60 ft.
B	Minor Arterial Road	50 ft.
C	Collector Road	40 ft.
D	Rural Subdivision Street	33 ft.
E	Private Road	33 ft.*
F	Private Lane	20 ft.

TABLE 5.1 – RIGHT-OF-WAY WIDTHS

*Right-of-way width on private Conservation Subdivision street may be reduced to 20' where terrain allows

5.2 EXISTING STREETS

Additional right-of-way adjacent to existing streets shall be dedicated to Linn County for subdivisions contiguous to existing county right-of-way. See table 5.1 for the minimum widths required for rights-of-way on various road classifications.

SECTION 6 GEOMETRIC DESIGN FOR SUBDIVISION STREETS

6.1 GENERAL

A Policy on Geometric Design of Highways and Streets, (AASHTO), Statewide Urban Design and Specifications (SUDAS), and local construction practices have been used as references in formulating the recommendations and specifications contained in this section. It is advised that prior to the preliminary platting of a proposed subdivision the developer and his engineer confer with the Linn County Engineer to establish the specific design criteria for the proposed streets.

6.2 DESIGN TRAFFIC VOLUMES

Streets shall be designed for average annual daily traffic (AADT) volumes as determined by acceptable procedures and as approved by the County. The procedure shall take into account the size of the proposed subdivision, a twenty (20) year projection of further development, and land use patterns. A guide for predicting traffic volumes shall be to use an average of 10 vehicles per day per household along the proposed road.

6.3 DESIGN SPEED

Geometric design features shall be consistent with a design speed selected as appropriate for traffic volumes and terrain factors. Table 6.1 shall be used to determine design speed.

TYPE OF TERRAIN	**MAJOR ARTERIAL OR MINOR ARTERIAL**		**COLLECTOR, RURAL SUBDIVISION STREET, OR PRIVATE ROADS**		**PRIVATE LANE**
	Over 750 AADT	Under 750 AADT	250 AADT to 400 AADT	50 AADT to 250 AADT	Under 50 AADT
Level	60 mph	50 mph	40 mph	30 mph	30 mph
Rolling	50 mph	40 mph	30 mph	30 mph	20 mph
Hilly	30 mph	30 mph	20 mph	20 mph	20 mph

TABLE 6.1 - DESIGN SPEED

Long sight distances and gentle slopes characterize level terrain. Natural slopes in this terrain are generally thirty (30) feet per mile or less and are best typified by the flat farm areas of central Linn County. C Ave. Ext. north of County Home Road is in level terrain.

Rolling terrain is characterized by moderate sight distances and good drainage. Natural slopes in this terrain are generally 30 to 80 feet per mile. It is best typified by rolling fields of south and southeastern Linn County. Mount Vernon Road between Highway 13 and the city of Mount Vernon is in rolling terrain.

Hilly terrain is characterized by limited sight distances and fast drainage. Natural slopes in this terrain are generally greater than 80 feet per mile. The steep pastures of northeastern Linn County best typify it. Matsell Park Road is in hilly terrain.

6.4 STOPPING AND CORNER SIGHT DISTANCE

Minimum stopping sight distance is shown in table 6.2. For calculating stopping sight distance the height of eye shall be 3.5 feet and height of object shall be 2.0 feet.

Design Speed, mph	**20**	**25**	**30**	**40**	**50**	**60**
Stopping Sight Distance						
Minimum stopping sight distance, ft	115	155	200	305	425	570
K* value for:						
Crest vertical curve	7	12	19	44	84	151
Sag vertical curve	17	26	37	64	96	136

*Rate of vertical curvature, K, is the length of curve per percent algebraic difference in intersecting grades (A). K=L/A

TABLE 6.2 - MINIMUM STOPPING SIGHT DISTANCE

Design Speed, mph	**Minimum Corner Sight Distance at Intersection, ft***
60	650
50	515
40	415
30	310
25	260
20	210

*NOTE: Corner sight distance measured from a point on the minor road at least fifteen (15) feet from the edge of the major road and measured from a height of eye 3.5 feet on the minor road to a height of object 4.25 feet on the major road.

TABLE 6.3 - CORNER SIGHT DISTANCE

6.5 GRADES

Minimum ditch grades shall be 0.5% to allow positive flow. Target ditch grades should be 1% or higher. Maximum profile grades are shown in Table 6.4 .

Type of Terrain	**Design Speed, mph**					
	20	25	30	40	50	60
Level	8	7	7	7	6	5
Rolling	11	10	10	9	8	6
Hilly	13	11	11	10	9	

TABLE 6.4 - MAXIMUM PROFILE GRADES, %

6.6 ALIGNMENT

The alignment of proposed subdivision streets shall take into account the extension of adjacent streets and should consider the existing topography to minimize earthwork and erosion control.

Curves should be designed with as large a radius as possible. Superelevation should be used except for rural subdivision streets. Table 6.5 shows the recommended superelevation requirements.

Design Speed, mph	Maximum E, ft/ft	Minimum Radius, ft	Runoff, ft
50	0.06	849	150
40	0.06	509	125
30	0.04	302	100
25	0.03	209	75

TABLE 6.5 - SUPERELEVATION REQUIREMENTS

6.7 CROSS SECTION

The roadway cross section may be either the open or closed ditch type. The closed ditch, curb and gutter type will be considered where it is the continuation of a similar type facility or where it provides obvious advantage to the roadway.

6.8 INTERSECTION

The minimum radius to the shoulder line for open ditch cross sections and to the back of curb for closed ditch cross sections shall be seventy-five (75) feet at intersection with major arterial, fifty (50) feet minor arterial roads and thirty-five (35) feet at intersections with all other road classes. See Figure 11.

SECTION 7 DRAINAGE

7.1 OPEN DITCH DESIGN

All surface drainage in the open ditch type construction shall be carried through suitable culverts to natural drainage outlets. The minimum crossroad culvert shall be 24" diameter. All crossroad pipe shall be unclassified Group 1. Metal pipe shall be Specification 4141.02 A, C or D. The minimum gage shall be 14. The minimum entrance culvert shall be 15" diameter, 24' length and 16 gage. All culverts shall meet Iowa Department of Transportation's Standards. Where ditches do not have good positive drainage, drain tile may be required.

7.2 CLOSED DITCH DESIGN

Surface drainage in the closed ditch type construction may not be carried more than six-hundred (600) feet on the pavement. An adequate storm sewer shall be installed to carry the water beyond this point. Catch basins or flumes shall be provided to carry water from the pavement to the storm sewer. A suitable outfall structure shall be provided. Catch basins shall be constructed of reinforced concrete and shall be similar to the Iowa Department of Transportation's Standards or SUDAS Standards.

DESIGN SPECIFICATIONS FOR CLASSIFICATION A, B, C, D, E & F ROADS IN LINN COUNTY, IOWA

DESIGN ELEMENT	ROAD CLASSIFICATION						
	MAJOR ARTERIAL			MINOR ARTERIAL		COLLECTOR RURAL SUBDIVISION STREET & PRIVATE ROAD***	PRIVATE LANE
	A-1	A-2	A-3	B-1	B-2	C, D & E	F
Design Speed, mph	50-60	45-55	40-50	45-55	40-50	25-40	20-40
Stopping Sight Distance, ft	475-650	400-550	325-475	400-550	325-475	150-325	125-325
Max. Horiz. Curve	7° - 5°	9½° - 6°	12° - 7°	9½° - 6°	12° - 7°	27½°-12°	45° - 12°
Max. Grade	7% - 5%	8% - 6%	9% - 6%	8% - 6%	9% - 6%	11% -9%	13%-9%
Pavement Width, ft	24	24	22	22	22	30	NA
Min. Length Curve, ft	600	550	480	550	480	100-210*	100
Shoulder Width, ft	8	6	4	6	4	1	NA
Bridge Width (New), ft	40	34	30	34	30	24	24
Design Load Bridge (New)	HS-20	HS-20	HS-20	HS-20	HS-20	HS-20	HS-20
Foreslope	4:1	3:1	3:1	3:1	3:1	3:1	2:1
Nominal Minimum Ditch**	5'x10'	4'x6'	4'x3'	4'x6'	4'x3'	2'x2'	2'x2'
Bridge Width (Exist.), ft	24	24	24	24	24	20	NA
Design Load Bridge (Exist.), ft	H-15	H-15	H-15	H-15	H-15	H-15	H-15
Distance to Obstruction (clear zone) From Edge of Pavement, ft	30	16	16	16	14	10	10

TABLE 6.6 - DESIGN SPECIFICATIONS

*Delta Angle Less than 30° - minimum curve length of 100'

*Delta Angle 30° or greater shall have a minimum curve length of 210'

**Minimum depth 2.0' - Average depth of 4.0'

***Specifications apply to private Conservation Subdivisions except pavement width

(see page xx for Conservation Subdivision Typical Sections)

Page 7

7.3 STORM SEWERS

Storm sewers shall be a minimum of fifteen (15) inches diameter concrete pipe. They shall be laid out to meet proper design practice and to provide adequate cover. Sections of storm sewer that are placed through the roadway shall be designed for that purpose.

7.4 NATURAL DRAINAGE PRESERVED

Natural drainage courses and waterways within any subdivision shall be preserved as far as is practicable. Surface water entering or leaving the platted property shall be picked up and outlet at existing locations and without harm to contiguous properties.

7.5 DRAINAGE FACILITIES - DESIGN

Drainage facilities shall be designed in accordance with accepted engineering principles. The upstream area, which contributes to the waterway or storm sewer, shall be considered improved and built up for hydraulic calculations.

SECTION 8 UTILITIES

8.1 GENERAL

All underground utilities to be placed under pavement shall be completed prior to surfacing or shall be bored under the pavement after surfacing. No cuts in the pavement for utilities shall be allowed. Utilities with obstructions shall be placed to conform to the obstruction distance as shown in Table 6.6.

SECTION 9 MINIMUM SURFACING REQUIREMENTS

9.1 GENERAL

After the grading has been completed, the project shall be inspected and approved prior to placing any surfacing materials. See Section 8 for underground utility requirements.

9.2 SURFACE TYPES

Subdivision streets shall be surfaced to conform to Figures 1 through 10. The intent is to provide an AASHTO structure number of 4.0 for the pavement system. The typical layer coefficient for H.M.A. (asphalt) surface course is 0.44/inches of thickness, H.M.A. intermediate and base course is 0.40/inches of thickness, P.C.C. (concrete) is 0.50/inches of thickness and rock is 0.11/inches of thickness. Other materials may be proposed such as engineering fabric, fibers and meshes with appropriate information to confirm structure numbers.

H.M.A mix shall be determined by job mix or as approved by the County Engineer. Typically a 1/2" 1,000,000 ESAL, PG 64-22 mix is used with 6% target asphalt content.

P.C.C. mix shall be approved by the County Engineer. A Classification C-4 concrete with Class 2 coarse aggregate shall be the minimum acceptable.

Classification F roads shall be surfaced with crushed stone at a minimum rate of 5,000 ton/mile.

The above pavement surface types are the minimum that may generally be approved. If a road is determined to require a higher type of pavement than is provided by the minimum standard, the County Engineer shall determine the required pavement in accordance with accepted criteria in the Farm-to-Market design guides and the Secondary Road Plan set forth by the Iowa Department of Transportation.

9.3 TRENCH TREATMENT

In cut areas where excavation is 2' or greater an additional six (6) inches of grade shall be removed and six (6) inches of macadam stone base or rolled stone base shall be placed. See Figures 1 through 10.

SECTION 10 EROSION CONTROL

10.1 GENERAL

Upon completion of the surfacing work, the right-of-way area shall be fine graded and dressed in a workmanlike manner. Areas disturbed during construction shall be prepared, seeded and fertilized. Other erosion control work may be required to meet the conditions as determined by the County Engineer. This work may include silt fence, sod, rock flumes, hay check dikes, rock dikes, jute mesh, mulching, and removal of all trees and brush within the right-of-way.

TYPE	RATE	DATES OF APPLICATION
Bluegrass, Kentucky 70% Ryegrass, Perennial (Fineleaf Variety) 10% Fescue, Creeping Red 20%	4 lbs per 1000 sq. ft.	March 1 to June 1
A commercial mixture may be used if it contains a high percentage of similar blue grasses; it may contain Creeping Red Fescue		August 10 to September 30

Number 15-15-15 fertilizer will be placed at a rate of 650 lbs. per acre or the equivalent.

Temporary seeding may be needed to prevent erosion until the permanent seeding can be sown. The Linn County Engineer will approve the type of seeding.

NOTE: Dates for permanent seeding may be adjusted depending on the weather conditions with prior approval from the Engineer.

The Engineer may require mulch when conditions indicate its use. Rate shall be 1-1/2 tons per acres of straw or hay.

TABLE 10.1 – PERMANENT SEEDING REQUIREMENTS

SECTION 11 ENTRANCES

11.1 GENERAL

Entrances shall be placed in accordance with Linn County specifications at no cost to Linn County. Entrances shall require a permit from the County Engineer's Office prior to placement. Entrance surfacing shall be a minimum of fifteen (15) tons of crushed stone. No entrance culvert headwalls are allowed within the right-of-way and no construction within the county right-of-way is allowed without a permit.

Design Speed, mph	25	30	35	40	45	50	55
Minimum Entrance Sight Distance, ft*	150	200	225	275	325	400	450

*Sight distance is measured at the centerline of the entrance from the edge of the road with a height of eye of 3.5 feet at the entrance to a height of object of 4.25 feet on the road.

These are minimum requirements and are based upon passenger vehicles. Additional analysis may be necessary for commercial driveways with heavy truck use.

TABLE 11.1 - MINIMUM ENTRANCE SIGHT DISTANCE

Minimum distances from the centerline of the road intersection to the centerline of driveway are listed below in Table 11.2.

Rural Subdivision Street	125'
Collector Road	150'
Minor Arterial Road	200'
Major Arterial Road	200'

TABLE 11.2 – LOCATION OF ENTRANCES NEAR ROAD INTERSECTIONS

11.2 SURFACE WIDTH

The minimum size entrance culvert shall be fifteen (15) inches in diameter with a minimum of one (1) foot cover. The county will approve culvert size. Entrance drives shall be surfaced from the right-of-way line to the edge of the pavement to a maximum surface width of sixteen to twenty four (16 - 24) feet for residential use and sixteen to thirty (16 - 30) feet for commercial, industrial, or joint accesses. Entrance drive widths shall be measured at the right-of-way line.

SECTION 12 SIGNING

12.1 GENERAL

Signing shall be placed in conformance with the State requirements under the Manual on Uniform Traffic Control Devices (MUTCD) and County signing requirements prior to acceptance of the road.

12.2 TYPE AND LOCATION OF SIGNS

Regulatory, warning, street and private road signs shall be placed as determined by the County from the final plat for the subdivision. The number and location of signs shall be per County requirements.

12.3 COST OF SIGNING

The developer shall deposit with the County Engineer's Office an amount to cover the cost of the required signs. Signs will be furnished and placed by the County. The County on the basis of cost of material and an installation charge will determine the cost of the signing. This information will be available at the County Engineer's Office and will be updated from time to time to reflect changes in costs.

SECTION 13 INSPECTION AND CERTIFICATION

13.1 GENERAL

The Linn County Engineer's Office shall be provided forty-eight (48) hours notice prior to required inspections of the various phases of construction. It shall be the developer's responsibility for all staking of construction work to be done.

13.2 ASSURANCE SAMPLING AND INSPECTION OF PAVEMENT

The County shall take samples of paving materials. These samples shall be used to determine quality and specification compliance. Minimum samples required are:

1) Macadam Stone - 1 for each 2000 ton
2) Choke Stone - 1 for each 1000 ton
3) Surface or Shoulder Stone - 1 for each 1000 ton
4) H.M.A. Concrete Extraction - 1 for each 1000 ton
5) Portland Cement Concrete - 1 beam for each 3000 sq. yds.
6) Depth samples of all pavements - 1 per 1000 lineal feet of pavement. It will be the developer's responsibility to conduct additional depth checks to insure proper construction.

If a sample fails, additional samples may be taken at the request of the developer for an additional fee. Inspection fees are listed in Section 14.

13.3 GRADING AND DRAINAGE

The County inspector will make a visual inspection of the grading and drainage work near its completion. This inspection shall be documented in the project file. It is the developer's responsibility to verify the geometric measurements to insure the contractor's compliance with the plans and specifications before paving operations begin. The County may require proof rolling of completed grade to assure adequate support for the paving operation. Proof rolling shall be done with a loaded tandem truck as approved by the County Engineer.

13.4 SURFACING INSPECTION - PAVING

The County shall inspect the paving operation and completed pavement to assure compliance with the plans and specifications.

13.5 EROSION CONTROL AND SEEDING OPERATION

The County shall make a visual inspection of the erosion control and seeding operation. It is the developer's responsibility to document the proper type and quantity of seed and fertilizer used. It is the developer's responsibility to place permanent seeding on dates shown in Table 10.1. Permanent seeding is normally completed as soon after construction completion as possible. The road will not be accepted until the erosion control has been completed or money has been deposited with the County Engineer to cover the estimated cost of erosion control work. Construction shall conform to the developer's approved erosion control plan.

13.6 CORRECTIONS AND PENALTIES

Roads will not be accepted into the Secondary Road System until all deficiencies are corrected or an appropriate penalty is paid. See the Iowa Department of Transportation specifications and instructional memorandums for procedures used to determine penalties. Penalty costs are listed in Tables 13.1, 13.2, and 13.3.

13.7 SURVEY CORNERS

Lot corners and section corners along road projects shall be documented. A record of corners and ties shall be filed with the County Engineer.

Asphalt Density	
Quality Index No.	**Penalty Cost Per Ton**
0.36+	$0.00
0.17 to 0.35	$0.50
0.0 to 0.16	$1.60
Any negative Value*	$2.70

See IDOT Specification 2303.04 for quality control

*The County Engineer may require some correction in addition to penalty in the case of a negative value.

TABLE 13.1 - PENALTIES FOR DENSITY DEFICIENCY

Asphalt Content	
Deviation from Intended Asphalt Content (%)	**Penalty Cost Per Ton**
0.0 - 0.20	$0.00
0.21 - 0.40	$0.10
0.41 - 0.50	$0.20
0.51 - 0.60	$0.40
0.61 - 0.70	$0.60
0.71 - 0.80	$0.90
0.81 - 0.90	$1.20
0.91 - 1.00	$1.60
> 1.00*	

Note: % asphalt is based on 6.0% without job mix.

% asphalt shall be determined by tank sticking monitored by Engineer. Plant shall provide sufficient records to verify asphalt usage.

*The County Engineer shall require corrective action at this value.

TABLE 13.2 - PENALTY FOR ASPHALT CONTENT DEFICIENCY

Penalty for Pavement Thickness on H.M.A. or P.C.C. Pavement

H.M.A. Pavement (Design Depth - Actual Depth)	**Price Adjustment Per Ton**
1/4"	$2.00
1/2"	$4.00
≥ 3/4"	$6.00 + corrective action as per Engineer

P.C.C. Pavement (Design Depth - Actual Depth)	**Price Adjustment Per CY**
1/4"	$2.50
1/2"	$5.50
3/4"	$9.00
≥ 1"	$13.00 + corrective action as per Engineer

TABLE 13.3 - PENALTY FOR PAVEMENT THICKNESS

SECTION 14 INSPECTION FEES

14.1 GENERAL

The fees shown in the following sections are intended to reimburse the County for costs of inspection services. The total fee is due prior to final acceptance of the road into the Secondary Road System.

14.2 PLAN REVIEW

1)	1/4 mile	$ 100.00
2)	1/2 mile	$ 126.40
3)	1 mile	$ 152.80
4)	over 1 mile	$ 140.00 + 0.02/ft.

14.3 SAMPLE INSPECTION

1)	Macadam Stone	$ 40.00 / 2000 ton
2)	Choke Stone	$ 40.00 / 1000 ton
3)	Surface or Shoulder Stone	$ 40.00 / 1000 ton
4)	P.C.C. Beam	$ 10.00 / 3000 s.y.
5)	H.M.A. Thickness & Density or P.C.C. Thickness	$ 50.00 / 1000 l.f.

14.4 GRADING

1)	Field Review Earth Work	$ 100.00 / project

14.5 FIELD INSPECTION

1)	Pipe Inspection - Crossroad	$ 1.10 / l.f.
2)	Pipe Inspection - Storm	$ 0.30 / l.f.
3)	Tile (Other than french drain)	$ 0.05 / l.f.
4)	Curb and Gutter	$ 0.50 / l.f.
5)	Surface Inspection	$ 1.20 / l.f.
6)	Erosion Control	$ 50.00 / project
7)	Acceptance of Public Road	$100.00 / project

SECTION 15 ACCEPTANCE AS A PUBLIC ROAD

15.1 GENERAL

When the developer has completed all County requirements and has submitted all documentation and certifications required, he shall request in writing to the Board of Supervisors that the County accept the streets into the Linn County Secondary Road System. The deposit of $100.00 with the County Engineer's Office for the acceptance fee and filing four (4) year maintenance bond for the facility completes the developer's requirements. The County Engineer shall issue a Certificate of Completion when all work has been inspected and approved, noting any special conditions or items that may be delayed. Delay of erosion control work is one such item. The Certificate of Completion shall be notice to the developer that the resolution of acceptance of the road by the Board of Supervisors is prepared and under consideration.

If the developer has filed an escrow account with the County, he may request that sufficient funds be released by the County Engineer to pay any and all claims for labor or materials furnished to the project. It shall be the developer's responsibility to furnish to the County Engineer a "Waiver of Lien" form from contractors, suppliers and engineers that he has hired before funds are released. Upon completion and acceptance of the road and payment of all fees the County Engineer shall forward the resolution of acceptance to the Board of Supervisors for final passage.

SECTION 16 OTHER PROVISIONS

16.1 EFFECTIVE DATE

These specifications shall become effective upon their approval by the Board of Supervisors. They shall pertain to all proposed road construction for which construction plans have not been approved as of the date of the adopting resolution.

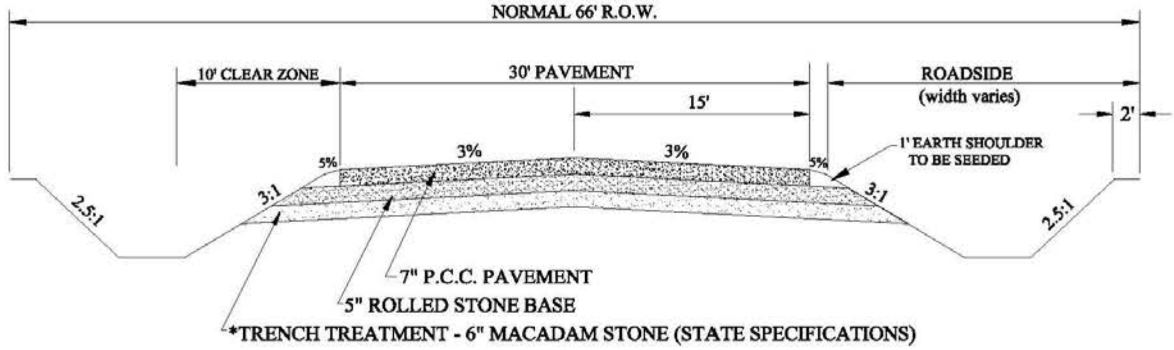

FIGURE 1. TYPICAL MINIMUM P.C.C. PAVEMENT - OPEN DITCH SECTION

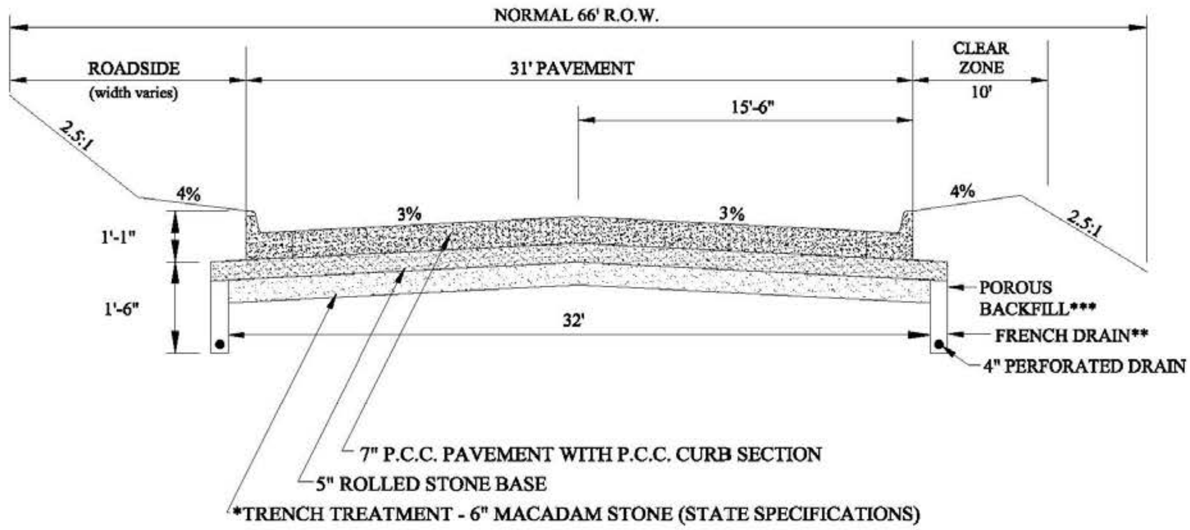

FIGURE 2. TYPICAL MINIMUM P.C.C. PAVEMENT - CLOSED DITCH SECTION

NOTES: * TRENCH TREATMENT SHALL BE REQUIRED FOR ALL CUT AREAS 2' OR GREATER IN DEPTH OF CUT.

** 1.5' DEPTH x 1' WIDTH

*** MATERIAL SHALL BE APPROVED BY THE LINN COUNTY ENGINEER PRIOR TO USE.

COUNTY STANDARD SPECIFICATIONS

LINN COUNTY, IOWA

revision date: April 2007

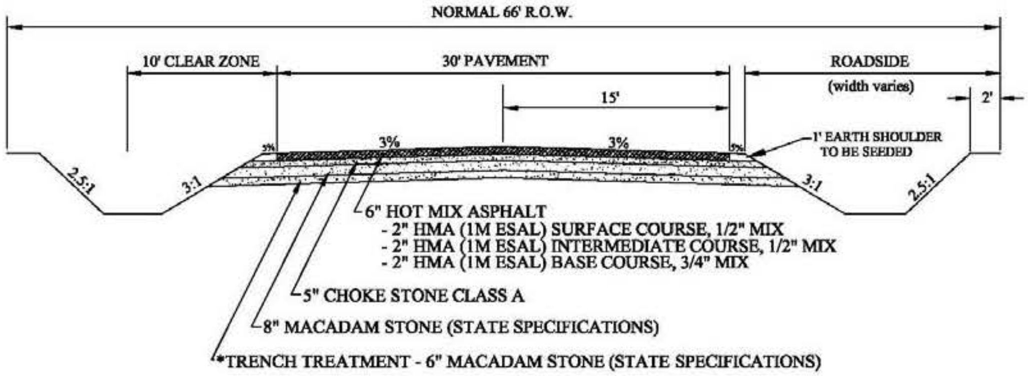

FIGURE 3. TYPICAL MINIMUM H.M.A. PAVEMENT, MACADAM STONE BASE - OPEN DITCH SECTION

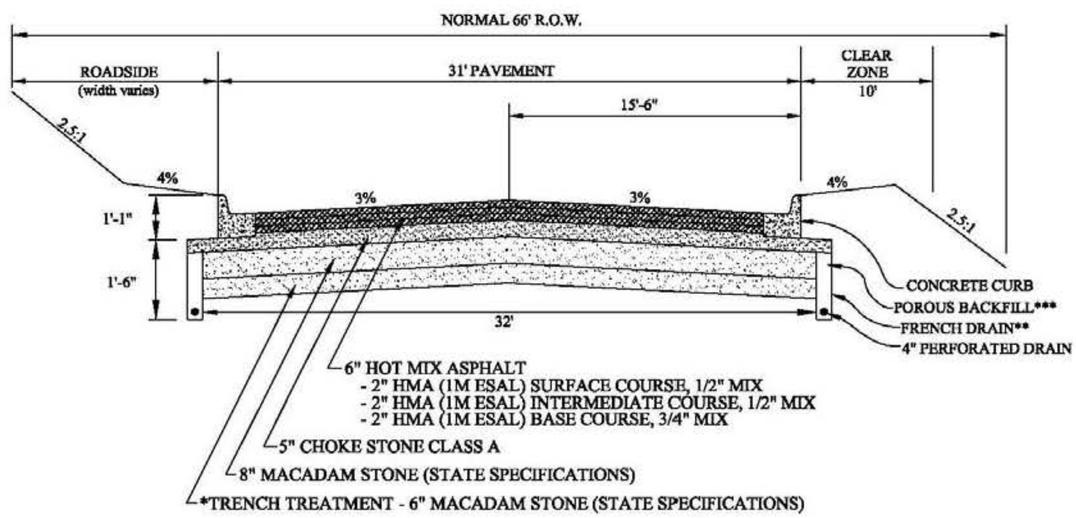

FIGURE 4. TYPICAL MINIMUM H.M.A. PAVEMENT, MACADAM STONE BASE - CLOSED DITCH SECTION

NOTES: * TRENCH TREATMENT SHALL BE REQUIRED FOR ALL CUT AREAS 2' OR GREATER IN DEPTH OF CUT.

** 1.5' DEPTH x 1' WIDTH

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COUNTY STANDARD SPECIFICATIONS

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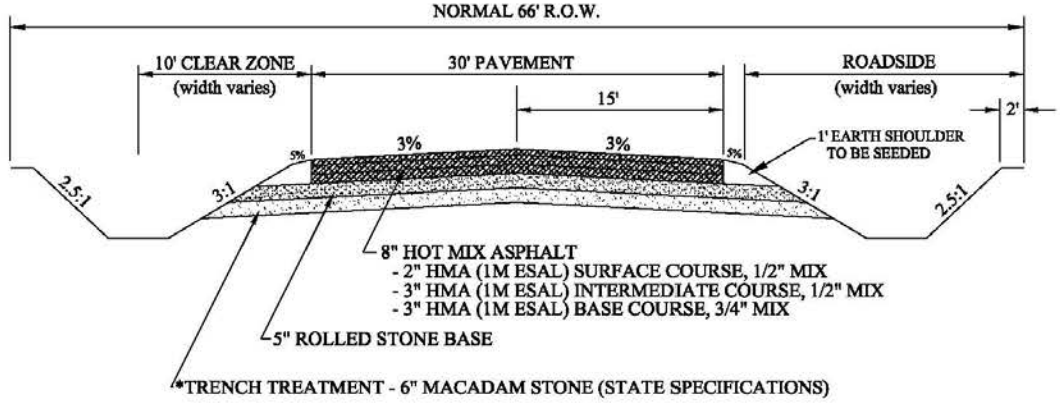

FIGURE 5. TYPICAL MINIMUM H.M.A. PAVEMENT, ROLLED STONE BASE - OPEN DITCH SECTION

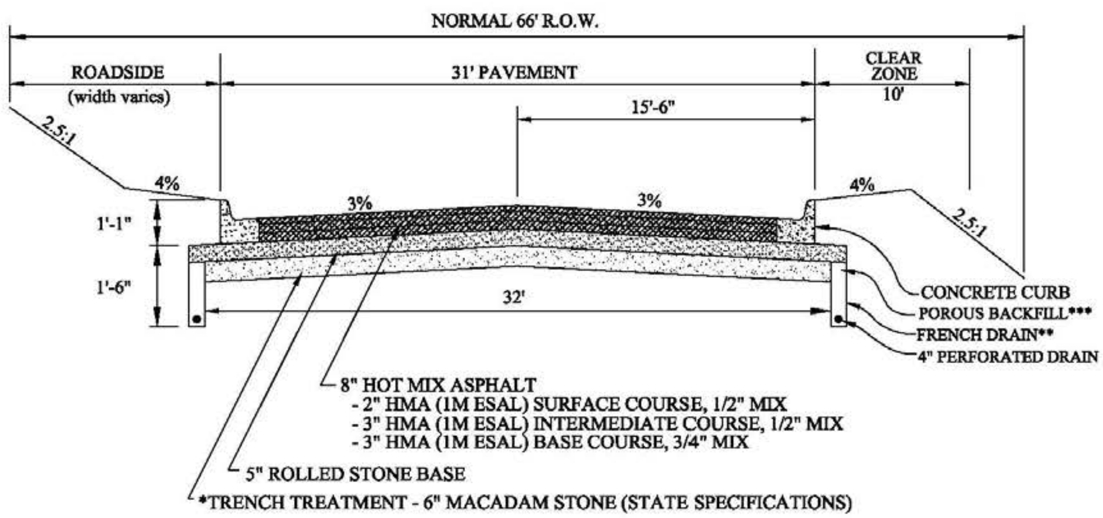

FIGURE 6. TYPICAL MINIMUM H.M.A. PAVEMENT, ROLLED STONE BASE - CLOSED DITCH SECTION

NOTES: * TRENCH TREATMENT SHALL BE REQUIRED FOR ALL CUT AREAS 2' OR GREATER IN DEPTH OF CUT.

** 1.5' DEPTH x 1' WIDTH

*** MATERIAL SHALL BE APPROVED BY THE LINN COUNTY ENGINEER PRIOR TO USE.

COUNTY STANDARD SPECIFICATIONS

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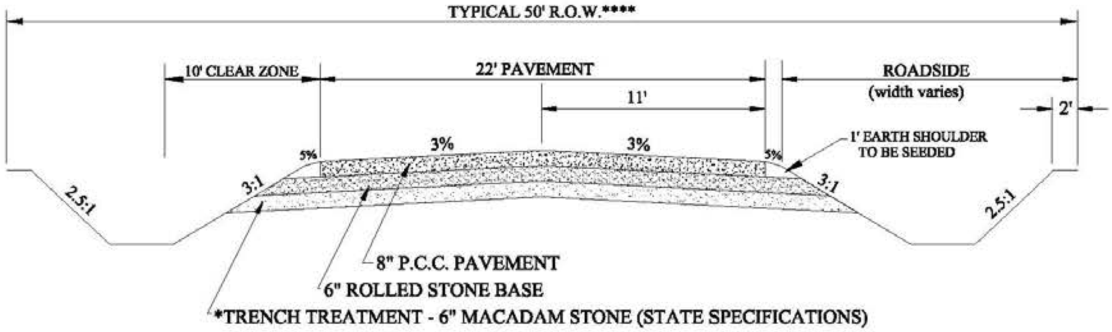

FIGURE 7. CONSERVATION SUBDIVISION: TYPICAL MINIMUM P.C.C. PAVEMENT - OPEN DITCH SECTION

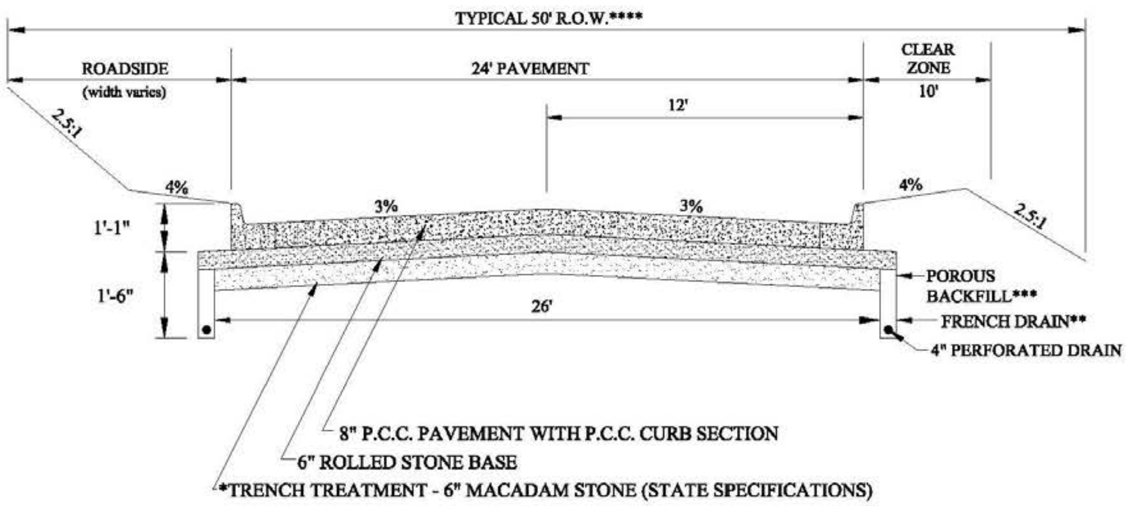

FIGURE 8. CONSERVATION SUBDIVISION: TYPICAL MINIMUM P.C.C. PAVEMENT - CLOSED DITCH SECTION

NOTE: * TRENCH TREATMENT SHALL BE REQUIRED FOR ALL CUT AREAS 2' OR GREATER IN DEPTH OF CUT.

** 1.5' DEPTH x 1' WIDTH

*** MATERIAL SHALL BE APPROVED BY THE LINN COUNTY ENGINEER PRIOR TO USE.

**** VARIANCES MAY BE SUBMITTED IN WRITING TO LINN COUNTY ENGINEER & WILL BE INDIVIDUALLY REVIEWED.

COUNTY STANDARD SPECIFICATIONS

LINN COUNTY, IOWA

revision date: April 2007

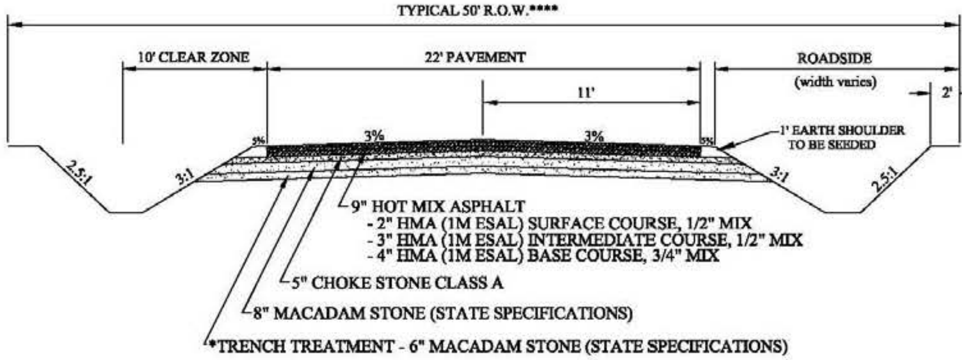

FIGURE 9. CONSERVATION SUBDIVISION: TYPICAL MINIMUM H.M.A. PAVEMENT - OPEN DITCH SECTION

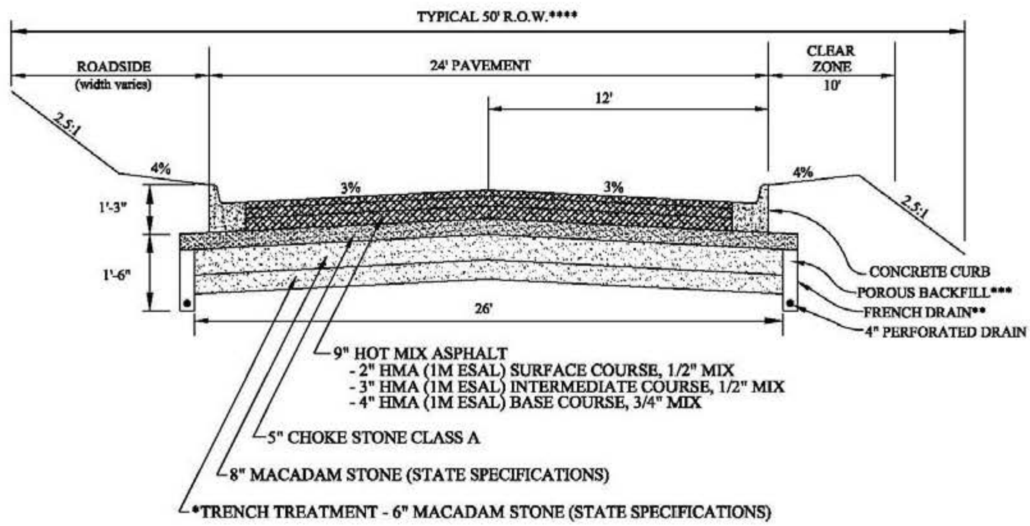

FIGURE 10. CONSERVATION SUBDIVISION: TYPICAL MINIMUM H.M.A. PAVEMENT - CLOSED DITCH SECTION

NOTE: * TRENCH TREATMENT SHALL BE REQUIRED FOR ALL CUT AREAS 2' OR GREATER IN DEPTH OF CUT.

** 1.5' DEPTH x 1' WIDTH

*** MATERIAL SHALL BE APPROVED BY THE LINN COUNTY ENGINEER PRIOR TO USE.

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COUNTY STANDARD SPECIFICATIONS

LINN COUNTY, IOWA

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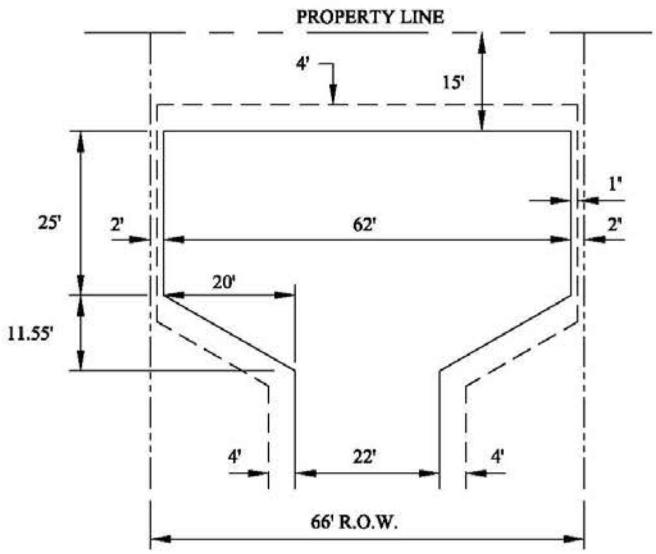


FIGURE 11. TYPICAL MINIMUM HAMMERHEAD

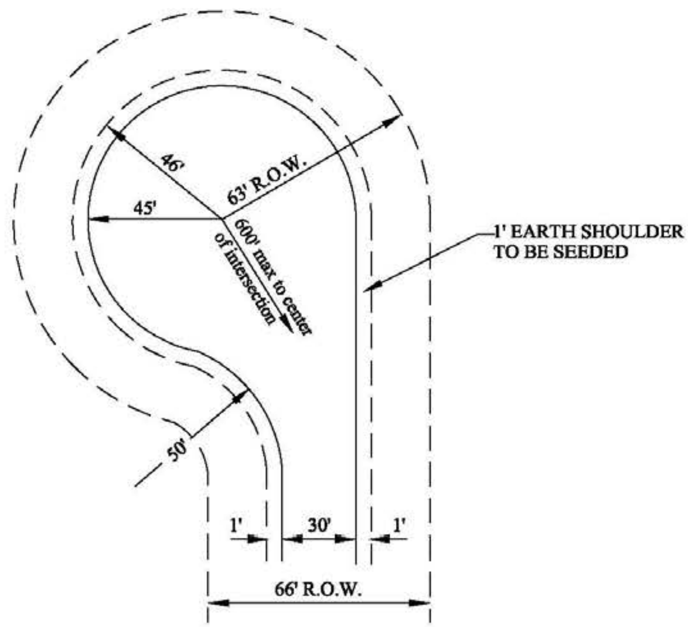


FIGURE 12. TYPICAL MINIMUM CUL-DE-SAC

COUNTY STANDARD SPECIFICATIONS LINN COUNTY, IOWA
revision date: April 2007

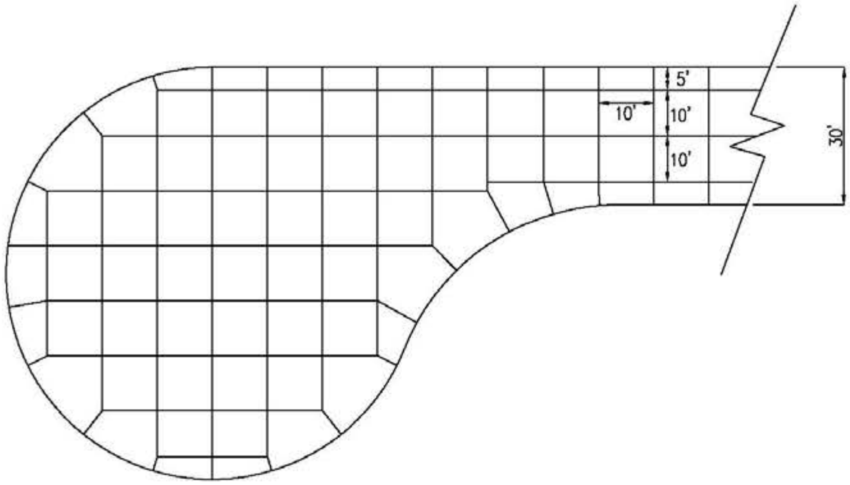
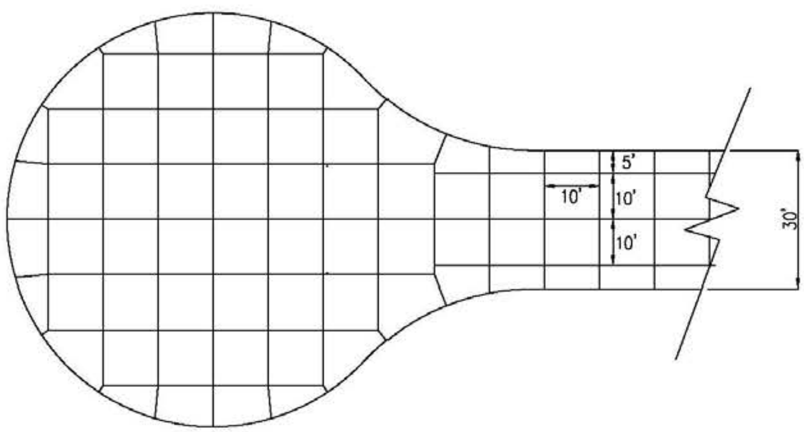
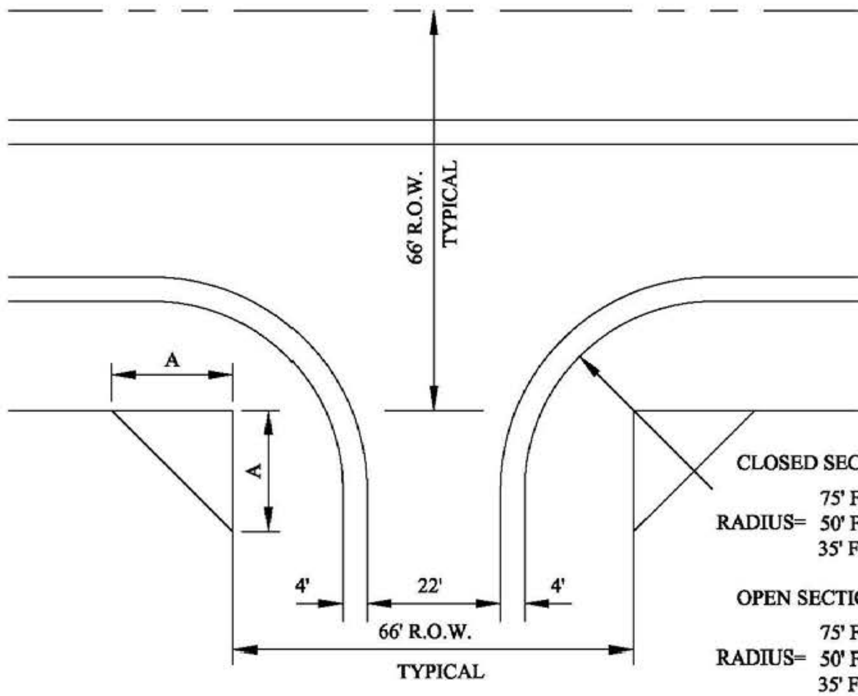


FIGURE 13. ASYMMETRIC (PREFERRED) CUL-DE-SAC LAYOUT AND JOINT LOCATIONS



COUNTY STANDARD SPECIFICATIONS
LINN COUNTY, IOWA
revision date: April 2007

FIGURE 14. CUL-DE-SAC LAYOUT AND JOINT LOCATIONS



CLOSED SECTION

RADIUS= 75' FOR INTERSECTIONS MAJOR ARTERIAL ROAD
50' FOR INTERSECTIONS MINOR ARTERIAL ROAD
35' FOR INTERSECTIONS AND FOR OTHER ROAD CLASSIFICATIONS

OPEN SECTION

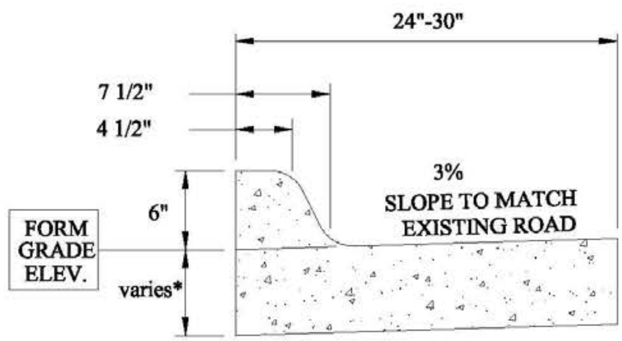
RADIUS= 75' FOR INTERSECTIONS MAJOR ARTERIAL ROAD
50' FOR INTERSECTIONS MINOR ARTERIAL ROAD
35' FOR INTERSECTIONS AND FOR OTHER ROAD CLASSIFICATIONS

FIGURE 15. TYPICAL MINIMUM INTERSECTION REQUIREMENTS

DAYLIGHT CORNERS MINIMUM (A)

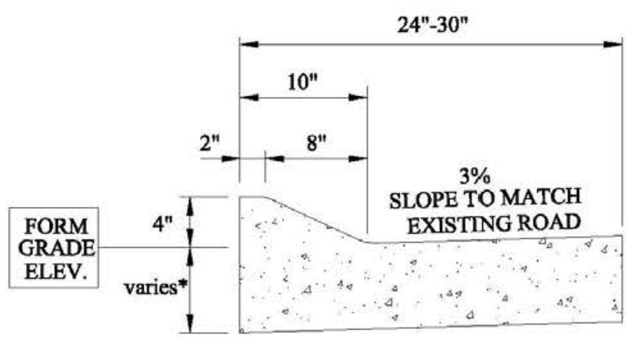
MAJOR ARTERIAL: 80 FEET
MINOR ARTERIAL: 50 FEET
COLLECTOR: 30 FEET
RURAL SUBDIVISION STREETS: 25 FEET

COUNTY STANDARD SPECIFICATIONS
LINN COUNTY, IOWA
revision date: April 2007



NOTE: ALL RADII TO BE 3"

FIGURE 16. TYPICAL 6" P.C.C. CURB

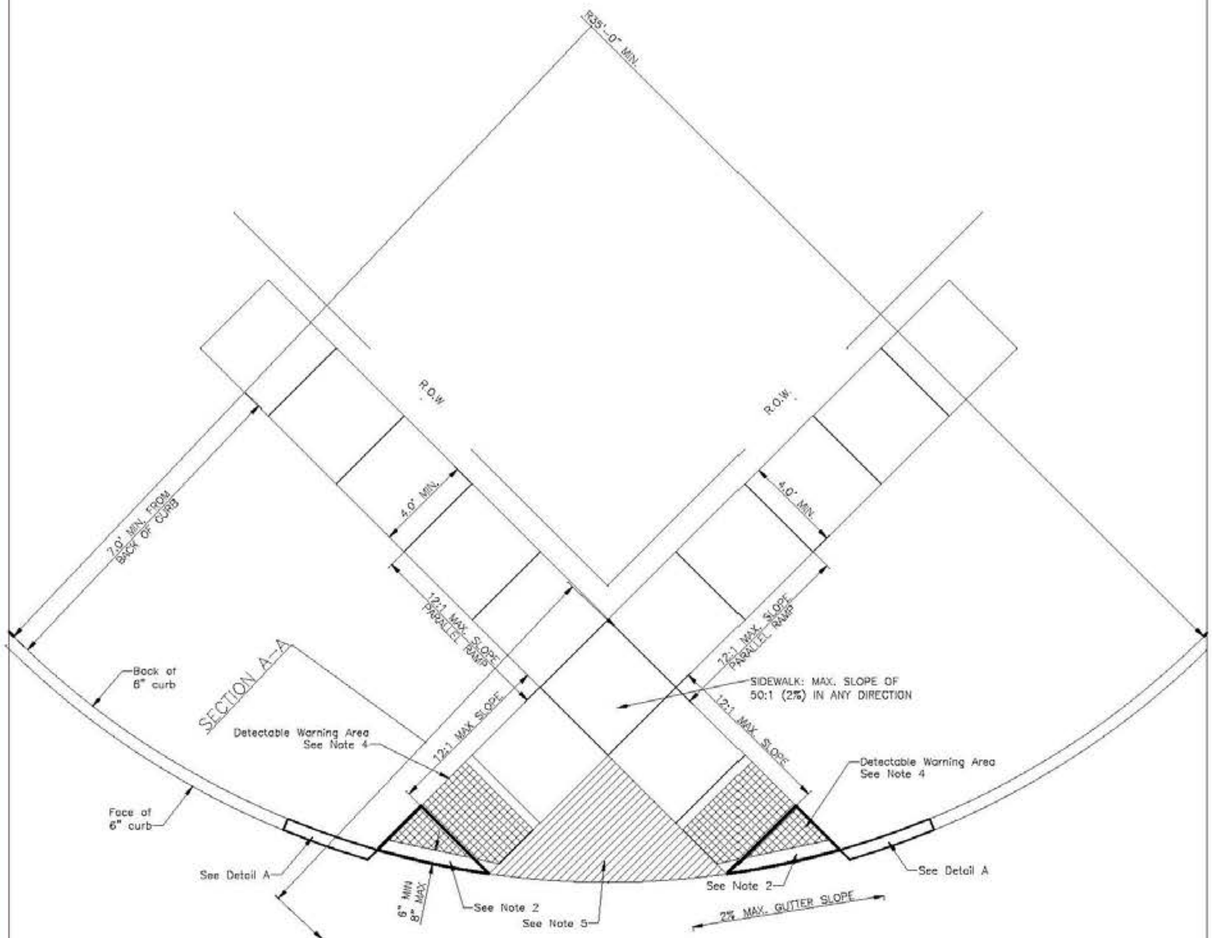


NOTE: ALL RADII TO BE 3"

FIGURE 17. TYPICAL 4" P.C.C. MOUNTABLE CURB

NOTES: * IF ADJACENT PAVEMENT IS P.C.C., APRON DEPTH SHALL EQUAL PAVEMENT DEPTH. IF ADJACENT PAVEMENT IS H.M.A., APRON DEPTH SHALL BE THE GREATER OF PAVEMENT DEPTH OR 8".

COUNTY STANDARD SPECIFICATIONS
LINN COUNTY, IOWA
revision date: April 2007



NOTES

1. COMBINATION RAMP: IF NORMAL SIDEWALK ELEVATION CANNOT BE ACHIEVED WITH RAMP BETWEEN STREET & LANDING DUE TO LIMITED RAMP LENGTH, A COMBINATION RAMP MUST BE PROVIDED TO MAKE UP THE ELEVATION DIFFERENCE. THE LENGTH OF PARALLEL RAMP MAY VARY: HOWEVER , IT SHALL NOT BE REQUIRED TO EXCEED 15', REGARDLESS OF THE RESULTING SLOPE.

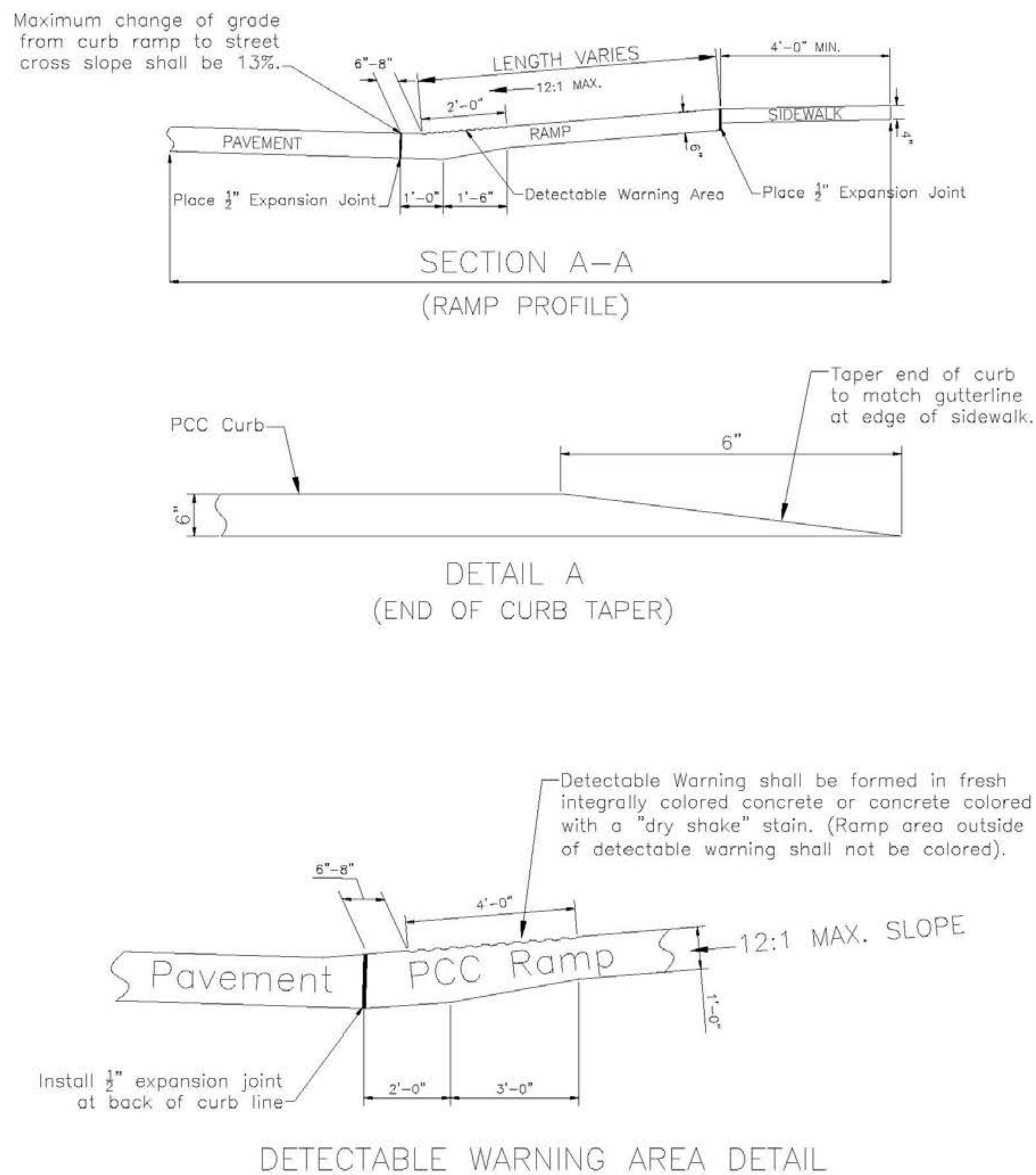
2. UNLESS CURB RAMP IS ALIGNED PERPENDICULAR TO THE STREET RADIUS, AN AREA OF SPECIAL SHAPING MUST BE PROVIDED AT THE BOTTOM OF THE RAMP. THIS AREA SHALL ALLOW THE GRADE BREAK AT THE BOTTOM OF THE RAMP TO BE PERPENDICULAR TO THE RAMP AND SHALL PROVIDE A SMOOTH TRANSITION TO THE GUTTERLINE FOR WHEELCHAIR ACCESS. NO CURB LIP ALLOWED IN THIS AREA. MAXIMUM CROSS SLOPE SHALL BE 2%.

3. PROVIDE A ½" EXPANSION JOINT AT THE BACK OF CURB. WHEN SPECIFIED, PROVIDE KT-2 OR BT-3 JOINT BETWEEN THE SIDEWALK RAMP AND STREET PAVEMENT AND PLACE ½" EXPANSION JOINT AT THE TOP OF THE RAMP.

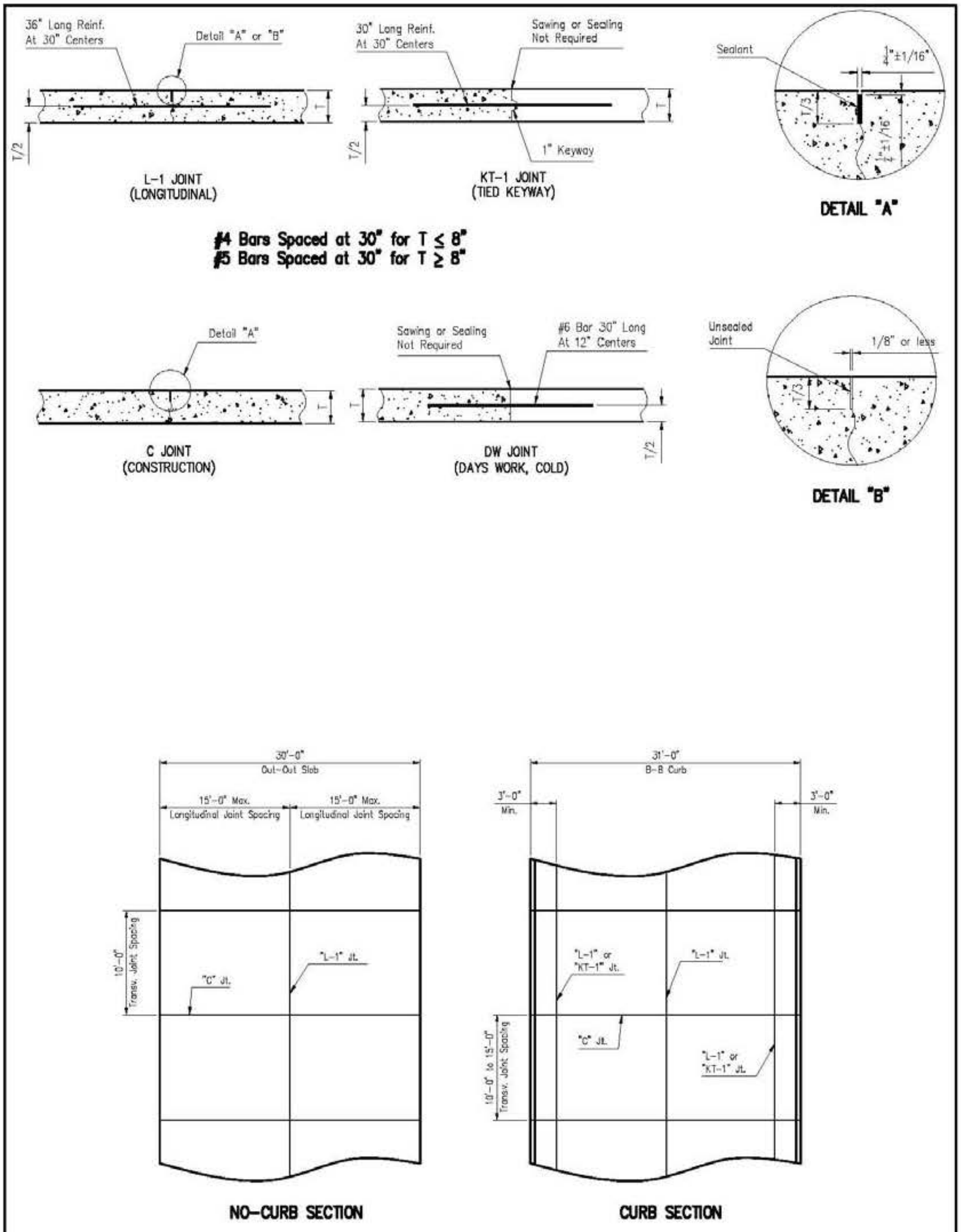
4. PROVIDE 24" WIDTH DETECTABLE WARNING ACROSS FULL WIDTH OF RAMP. DETECTABLE WARNINGS SHALL BE SET BACK 6"-8" FROM THE BOTTOM OF RAMP. DETECTABLE WARNING SHALL BE FORMED IN FRESH, INTEGRALLY COLORED CONCRETE OR CONCRETE COLORED WITH A "DRY SHAKE" STAIN. (RAMP AREA OUTSIDE OF DETECTABLE WARNING SHALL NOT BE COLORED). DETECTABLE WARNING SURFACES SHALL CONTRAST VISUALLY WITH THE ADJCENT WALKING SURFACES EITHER LIGHT ON DARK OR DARK ON LIGHT.

5. PLACE 4" PCC IN AREA BETWEEN SIDEWALKS.

REVISION DATE: April 2007	FIGURE 18. SIDEWALK RAMP DETAIL WITHIN INTERSECTION RADIUS	COUNTY STANDARD SPECIFICATIONS



REVISION DATE: April 2007	FIGURE 19. SIDEWALK RAMP DETAIL WITHIN INTERSECTION RADIUS	**COUNTY STANDARD SPECIFICATIONS**



P.C.C. TYPICAL JOINT LAYOUT

REVISION DATE: April 2007 | FIGURE 20. TRANSVERSE AND LONGITUDINAL JOINTS | COUNTY STANDARD SPECIFICATIONS

RESOLUTION

2007-4- 53

WHEREAS, the Linn County "Standard Specifications, Design Criteria and Construction Specifications for Rural Subdivision Improvements" adopted in 1988 and last amended March 2, 2005 has been analyzed and amended by the Linn County Engineer, and

WHEREAS, the Linn County Board of Supervisors have reviewed and approved the amended "County Standard Specifications" and

WHEREAS, the new specifications and fees shall apply to all developments that are approved after April 25, 2007 unless an approved preliminary plat has been filed.

NOW THEREFORE BE IT RESOLVED that the Linn County "County Standard Specifications" as amended are hereby adopted and that the Linn County Engineer is authorized to collect the fees set forth in Section 14.

Moved by Supervisor Houser

Seconded by Supervisor Langston

that the above resolution be adopted this 25th day of April, 2007 by a vote of 3 aye 0 nay and 0 abstain.

BOARD OF SUPERVISORS
LINN COUNTY, IOWA

Lu Barron
Chairperson

Linda Langston
Vice Chairperson

James M. Houser
Supervisor

ATTEST:

Joel Miller by Rebecca Shoop, Deputy
Linn County Auditor

Linn County Secondary Road Department Platting Conditions

The Linn County Secondary Road Department determines whether the road system is adequate for the needs of the proposed development and what system improvement is necessary to meet the development needs. The overall task is to protect the taxpayer's interest in the secondary road system and its efficiency, while allowing growth.

This is a general guideline to explain what and why Secondary Road conditions are placed on typical developments during the platting process. Development conditions are addressed on a case by case basis and generally require a discussion between the Secondary Road Department and the developer to create a road agreement to address the development needs.

Conditions placed upon development cases include, but are not limited to, the following:

Section 1. Access
Section 2. Road Right-of-Way
Section 3. Affect of Use on Structure and Efficiency of Existing Road System
Section 4. Obstructions Within the Road Right-of-Way
Section 5. Road Design

Table 1, below, illustrates the types of conditions required for typical developments.

Type of Development	Entrance	Signing		Dedication of	*Road Agreement		Construct Roads as
	Permit	E-911	Street Signs	Right-of-Way	Road	Tree	per County Standard Specs.
Residential Parcel Split	X	X		X		X	
Minor Subdivision, 3 lots or less	X	X	X	X	X		
Major Subdivision, 4 lots or more	X	X	X	X	X		X
Minor Boundary Change	X	X		X		X	
Minor Site Plan	X	X	X	X	X	X	X
Preliminary Plat							X
Final Plat	X	X	X	X	X	X	X
Cluster/Conservation Subdivision	X	X	X	X	X	X	X
Rural Village Extension Development	X	X	X	X	X	X	X
Conditional Use Permit	X	X			X	X	X
Variance					X	X	
Rezoning				X	X		X

TABLE 1: CONDITIONS FOR TYPICAL DEVELOPMENT CASES

*A road agreement is a signed and recorded document between the developer and the Linn County Secondary Road Department. Road agreements generally include responsibilities for the developer regarding road participation, trees and obstructions within the right-of-way, access issues, and dust control. See Sections 2, 3 & 4 for more information on road agreements.

Section 1. Access

Access is the responsibility of the developer/owner.

Parcels are generally allowed one access point. With proper justification, a second access may be approved. Examples of justification for a second entrance include the following:

- Waterways that divide a property
- Location of septic systems
- Layout of buildings
- Land use

Most secondary roads were not constructed to serve as residential streets or commercial access. Generally, the developer is expected to construct roads within the property to serve the lots created. Constructing lots along county roads other than subdivision streets is discouraged. This development process is called stripping and is contrary to county platting regulations.

Location and approval for all accesses is limited by the classification of the road and the configuration of the parcel. Access requirements or restrictions may be included in a road agreement.

Existing entrances shall be checked for compliance with County Standards. The field check includes drainage, side slopes, sight distance, distance from intersections and other entrances, obstructions or headwalls, surfacing, and number of accesses.. An entrance permit is required if the driveway needs to be modified. The permit states what is required to bring the entrance to County Standards.

Section 2. Road Right-of-Way

Dedication of road right-of-way is required for most cases. Right-of-way is defined as the full extent of land acquired for road purposes, whether by deed, easement, statute, patent, court order, or prescriptive use.

The amount of right-of-way to be dedicated is determined by the road classification, topography, future project needs, road alignment, etc. The development process offers the opportunity to cure drainage issues, obstructions, and design needs.

A general guideline used to determine the minimum amount of right-of-way required for various road classifications is shown below in Table 2. Road classification definitions may be found in the County Standard Specifications. Additional right-of-way may be needed because of terrain or drainage structures. Encroachments or easements may be required to accommodate utilities or blend the development to the roadway beyond the right-of-way.

ROAD CLASSIFICATION	MINIMUM R.O.W. REQUIRED EACH SIDE OF CENTERLINE
Major Arterial Road	60 ft.
Minor Arterial Road	50 ft.
Collector Road	40 ft.
Rural Subdivision Street	33 ft.
Private Road	33 ft.
Private Lane	20 ft.

Table 2 – Minimum Right-of-Way Widths

Daylight corners are to be dedicated as road right-of-way for parcels at road intersections. Minimum daylight corners are shown in Figure 1, page 3. These are provided to improve sight distance and drainage at intersections.

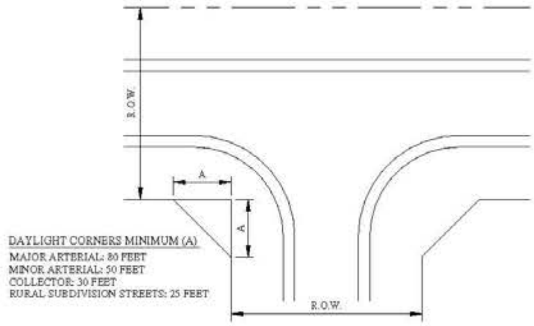


Figure 1: Minimum Daylight Corners

Section 3. Affect of Use on Structure and Efficiency of Existing Road System

Depending on the type of development, the Linn County Engineer will determine the suitability of the secondary road to serve the needs of the development. The amount of improvement and developer participation will depend on the overall affect of the use on the road system.

Once the amount of participation is determined, a road agreement will be drafted for review and sent to the developer. The developer may contact the Secondary Road Department regarding questions about the road agreement. After payment for the road agreement or establishment of an escrow account, the Secondary Road Department will schedule the improvements specified in the road agreement.

The amount and type of traffic generated by a development determines the level of participation. Level and type of participation is in accordance with road needs and traffic.

The Linn County Engineer uses the following guidelines for the type of surfacing versus traffic count.

Traffic Count (AADT)*	Surfacing
Up to 199	Gravel – Rock Base
200 to 399	Sealcoat or Safety Chloride
400 to 699	Sealcoat
700 and Above	Full-Depth Pavement (asphalt or concrete)

**Annual average daily traffic is the total volume of vehicle traffic in both directions of a road for a year divided by 365 days. Traffic counts are based on the latest Iowa Department of Transportation (IDOT) count which is updated every four years and represents A.A.D.T. based upon traffic engineering principles and spot field information.*

Traffic generation of a development is based upon intended use. Residential use is expected to generate 8-10 vehicles per day. Commercial use is expected to generate 10 veh/day or more based upon traffic engineering guidelines. Developments that generate a very low (10 vpd or less) amount of traffic will have a level of participation shown below in Table 3. This level of participation mitigates the affect of the access use on the secondary road surfacing and access control needs. It requires that the road accessed is structurally adequate, geometrically adequate and drained properly.

Existing Road Surface	Type of Participation	Minimum Cost
Rock	annual dust control at entrance + 3" rock (300' min.)	$225/year + $3.00/ft ($900)
Seal Coat	single seal coat at entrance (500' min.)	$2.50/ft or $1,250
Pavement	3" overlay (asphalt) at entrance (100' min)	$15.00/ft or $1,500

Table 3: For Very Low Traffic (10 vpd or less) Levels of Participation

Developments with 2 to 5 lots generate a (20 to 50 veh/day) low amount of traffic and will have a level of participation shown below in Table 4.

Existing Road Surface	Type of Participation	Minimum Cost
Rock	annual dust control + 6" rock (frontage or 600' min.)	$450/year + $6.00/ft ($3,600)
Seal Coat	double seal (frontage or 900' min.)	$5.00/ft or $4,500
Pavement	3" overlay (asphalt) at entrance (300' min.)	$15.00/ft or $4,500

Table 4: Levels of Participation for Low Traffic (20-50 vpd)

Developments with 10 to 15 lots generate a moderate (100 to 150 veh/day) amount of traffic will have a level of participation. Developments with 10 to 15 buildable lots fall into this category. Examples of higher levels of participation are shown below in Table 5.

Existing Road Surface	Type of Participation	Minimum Cost
Rock	double seal coat w/tack frontage + 6" rock (1,500' min.)	$13.00/ft or $19,500
Seal Coat	2" overlay (asphalt) (1,500' min.)	$13.50/ft or $20,250
Pavement	4" overlay (asphalt) frontage (1,000' min.)	$20.00/ft or $20,000

Table 5: Levels of Participation for Moderate Traffic (100-150 vpd)

Developments with 25 or more buildable lots or businesses that generate a high level of traffic (min. 250 veh/day) have a level of participation shown below in Table 6.

Existing Road Surface	Type of Participation	Minimum Cost
Rock	double seal coat w/tack + 10" rock base + distance to hard surfaced road (2,500' typ.)	$17.00/ft or $52,500
Seal Coat	3.5" overlay (asphalt) frontage (2,500' min.)	$17.50/ft or $43,750
Pavement	4" overlay (asphalt) frontage (2,500' min.)	$20.00/ft or $50,000

Table 6: Levels of Participation for High Traffic (250 vpd min.)

All estimated (minimum) costs in Tables 3 through 6 are based on current (2007) costs for construction. Each development is unique and the information shall be used for budget purposes only.
Type and volume of traffic are not the only factors to be accounted for in determining needed road improvements for a development. The volume of traffic on the intersected secondary road may influence the improvements needed.

The County may require the developer to provide traffic analysis to determine the need for traffic signals, turn lanes, additional signs, and other traffic controls deemed appropriate.

Section 4. Obstructions Within the Road Right-of-Way

An obstruction is described as a structure, growth, or other object or material placed/planted within the road right-of-way that impedes drainage, obstructs visibility of drivers, increases the risk of injury during collisions with the object, or interferes with normal road maintenance activities.

Typical obstructions include, but are not limited to, the following items:

- Trees, shrubs, bushes
- Headwalls
- Fence
- Agricultural Crops
- Landscaping
- Stones or rocks ($\geq$ 6")
- Railroad Ties
- Buildings
- Non-conforming mailboxes
- Bridges or walkways over ditches
- Wells
- Signs on non-break-away supports
- Stairs

Obstructions are generally not allowed within the road right-of-way. All obstructions within the clear zone (typically 10' from edge of road) are to be removed. A road agreement gives the property owner the option to take responsibility for obstructions outside the clear zone or allows the County to remove the obstructions. If the owner takes responsibility, the obstructions may remain at their current locations until the obstruction is in need of extensive repair or replacement. At such time, the obstruction shall be removed from the County right-of-way at the property owner's expense.

A work within the right-of-way permit is required for the property owner to perform work within the County road right-of-way. The permit is required prior to the work commencing.

Section 5. Road Design

Road design information is included in the County Standard Specifications.

For new developments (minor subdivision) a private lane may serve as access for up to three lots. If four or more lots (major subdivision) are to be accessed the subdivision road must be built per County Standard Specifications.

Whether private or public, the subdivision road must be built to County Standard Specifications or a minor variance may be requested, justified and granted in writing prior to construction. When the development street varies significantly from the County standards, is justified by the developer and is allowed by the County Engineer, the street will remain private and will not be accepted into the Secondary Road system. Private street signs (white letter on red) and caution signs will be placed at the owner's expense to clearly indicate the private street. All design variances must be submitted to the Linn County Engineer and approved prior to construction.

The maximum length for a public road that ends in a cul-de-sac is 600' measured from the center of the cul-de-sac to the centerline of the nearest intersection. Any road segment beyond 600' shall not be accepted by the County until the subdivision street system is completed and the dead end condition eliminated.

APPENDIX G. WTG CONFIGURATION SPECIFICATIONS FOR FIELD/SITE INBOUND/OUTBOUND TRANSPORTATION, CLIPPER TURBINE WORKS, INC.

Clipper

WTG Component Transportation Configuration Specifications

Subject Matter Expert(s)	Change Summary
Kathy Hyman **Steve Chaffee** **Ruy Lima** **Josh Kissinger**	Updated converter platform shipping dimensions.

IMPORTANT SAFETY INFORMATION

Personnel working in or on a Clipper turbine, project or facility must follow all applicable Clipper and Project Owner Environmental Health and Safety policies without fail. All personnel must also hold a Clipper Environmental Health and Safety certification or have a Permission to Work Verification on file with the project owner and /or Clipper Windpower prior to accessing any equipment on site.

CAUTION

Adhere to all Clipper Environmental Health and Safety policies without fail, including the use of personal protective equipment during the performance of procedures outlined in this document and whenever applicable.

RECOGNIZE SAFETY SYMBOLS, WORDS, AND LABELS

DANGER

DANGER—Immediate hazards which **WILL** result in severe personal injury or death if policies and procedures are not strictly adhered to.

WARNING

WARNING—Hazards or unsafe practices which **COULD** result in severe personal injury or death.

CAUTION

CAUTION—Hazards or unsafe practices which **COULD** result in minor personal injury or product or property damage.

Clipper 2.5 Series Wind Turbine

DC-018748-01 Rev F
Date of Submission: 6/9/2008

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GENERAL PROVISIONS

Purpose and Scope

The purpose of this document is to provide recommended configuration specifications for field/site inbound/outbound transportation. The weights and dimensions in this document are representative of the maximums encountered to date. Weights and dimensions are subject to variations due to the manufacturing process. Information specific to individual part numbers can be requested by contacting Clipper.

Note: All drawings and pictures are for reference use only.

Component List

- Power Distribution Panel (PDP)
- ICDLP with (2 ea.) Inverter/Converter Cabinets
- 80M Hub Height 4 section tower with Service Lift and stairs
- Machine Base Assembly with Jib Crane / Rollup Door
- Gearbox Assembly with/without Generators
- Nacelle/Spinner Fiberglass Kits
- C-93/C-96 Hub
- C-93/C-96 Blades
- Hardware Container

Safety

Personnel working on a Clipper turbine or project must follow all applicable Clipper and Project Owner Environmental Health and Safety policies. All personnel must also hold a Clipper Environmental Health and Safety certification or have Permission to Work Verification on file with the project owner and /or Clipper Windpower prior to accessing any equipment on site.

Power Distribution Panel (PDP)

Load ID **Load-01 (PDP)**

Shipping Requirements As necessary

Requirement	Size (ft)	Type	Length	Amount
Straps and Tarps	Min 50X50	Lumber (Tarp)	TBD	TBD

Transportation Configuration Options Standard Flatbed Trailer

Basic Configuration – multiple units with staging area
14 units (maximum) per 53 ft. trailer
10 units (maximum) per 48 ft. trailer

Width (in)	Length (in)	Height (in)	Weight per Unit (lbs)
48	86	77	2200

Reference Illustration

Hardware Container

Load ID	**Load-02 (HWC)**
Transportation Configuration	40 ft.- Standard Container Standard Flatbed
Turbine Assembly Hardware Kits	

In Tower Converter Door Level Platform (CDP) with Cable Trays

Clipper

Load ID **Load-03 (CDP)**

Transportation Configuration Options

Standard Flatbed Trailer

Basic Configuration

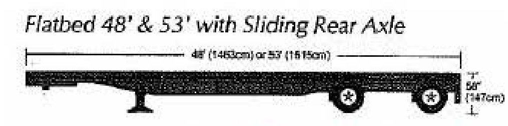
4 units per truck

Width (ft)	Length (ft)	Height (in)	Weight per Unit (lbs)
12.5	12.5	26	7000

Shipping Requirements

Requirement	Size	Type	Length (ft)	Amount
Straps	As necessary	Nylon	5.5	As necessary

Reference Illustration



Converters

Load ID **Load-04 (CON)**

Transportation Configuration Options: Step Deck Trailer

Basic Configuration: 2 set per truck (1 set = 2 converter cabinets, 1 fan assembly)

	Width (in)	Length (in)	Height (in)	Weight per Unit (lbs)
Xantrex Converter without Fans	33	80	91.5	5960

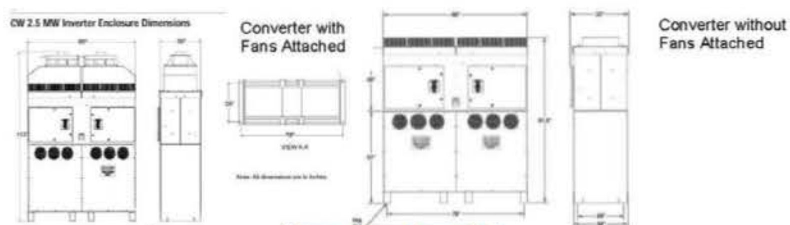
	Width (in)	Length (in)	Height (in)	Weight per Unit (lbs)
Xantrex Converter with Fans Attached	33	80	113	6210

Shipping Requirements

- Ships inside High Top 40 ft. Container
- Requires a crane to unload from truck
- Pallet jack required for removal from container

Reference Illustration

Xantrex Converters



Drop Deck 2 Axle Spread

Load ID **Load-04 (CON)**

Transportation Configuration Options Step Deck Trailer

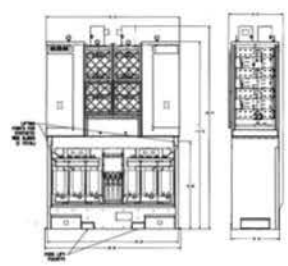
Basic Configuration 2 set per truck (1 set = 2 converter cabinets)

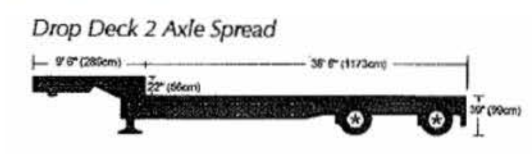
Magnetek Converter	Width (in)	Length (in)	Height (in)	Weight per Unit (lbs)
	84.35	32.25	128.97	7550

Shipping Requirements

- Requires a crane to unload from truck
- Pallet jack required for removal from container

Reference Illustration **Magnatek Converter**





Tower Base Assembly

Load ID **Load-05 (TBA)**

Transportation Configuration Options

- Double Schnabel with Steer able Dolly (Air Ride only)
- Single Front Schnabel with Load Bundle Dolly (Air Ride only)
- Multiple Axle High Tonnage Double Drop (Air Ride only)
- High Tonnage Double Drop Expandable (Floor Deck) (Air Ride only)

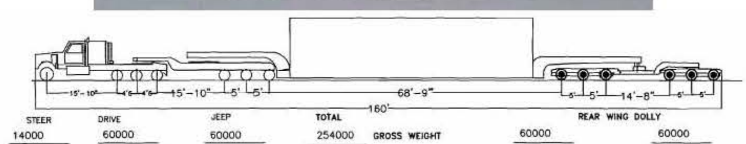
Basic Configuration

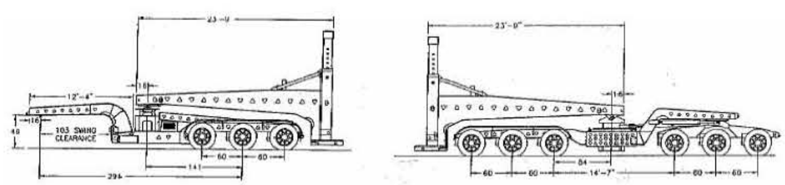
Tower Type	Overall Length (mm)	Overall Length (in)	Outer diameter top flange (mm)	Outer diameter top flange (in)	Outer diameter bottom flange (mm)	Outer diameter bottom flange (in)	Tower Weight (kg)	Tower Weight (lbs)
80m Standard	10000	394	4150	163	4420	174	48920	107625
80m Seismic	10000	394	4150	163	4420	174	53419	117522

Shipping Requirements

- All transport configurations must be padded to protect tower against damage to Tower Shell and Tower external paint.
- All non-Schnabel tower configurations require a crane to unload, while Schnabel's do not.
- All tower section ends must be ship covered and braced (see DC-018540-xx and DC-016496-xx).
- All Schnabel configurations require at least 8 connection points to the tower flange, encompassing a minimum of 120 degrees of the 360 degree flange

Reference Illustration





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Tower Lower Mid

Load ID **Load-06 (TLM)**

Transportation Configuration Options

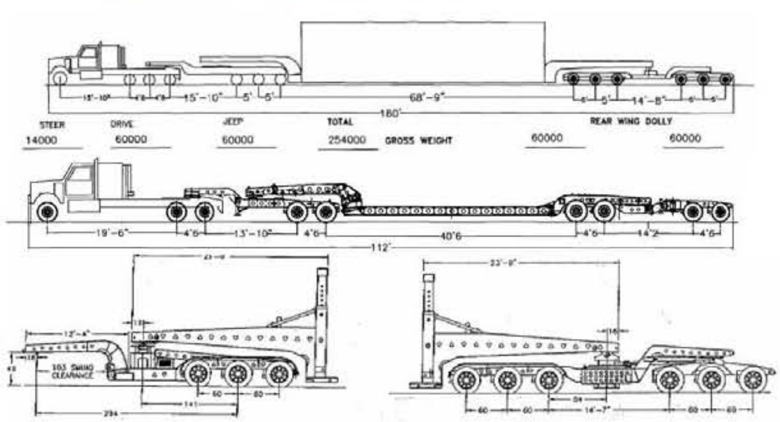
- Double Schnabel with steer able Dolly (Air Ride only)
- Single Front Schnabel with Load Bundle Dolly (Air Ride only)
- Multiple Axle High Tonnage Double Drop (Air Ride only)
- High Tonnage Double Drop Expandable (Floor Deck) (Air Ride only)

Basic Configuration

Tower Type	Overall Length (mm)	Overall Length (in)	Outer diameter top flange (mm)	Outer diameter top flange (in)	Outer diameter bottom flange (mm)	Outer diameter bottom flange (in)	Tower Weight (kg)	Tower Weight (lbs)
80m Standard	15545	612	4142	163	4150	163	51211	112665
80m Seismic	15545	612	4145	163	4150	163	55920	123025

Shipping Requirements All transport configurations must be padded to protect tower against damage to Tower Shell and Tower external paint.

Reference Illustration



Tower Upper Mid

Load ID **Load-07 (TUM)**

Transportation Configuration Options

- Double Schnabel with Steer able Dolly (Air Ride only)
- Single Front Schnabel with Load Bundle Dolly (Air Ride only)
- Multiple Axle High Tonnage Double Drop (Air Ride only)
- High Tonnage Double Drop Expandable (Floor Deck) (Air Ride only)

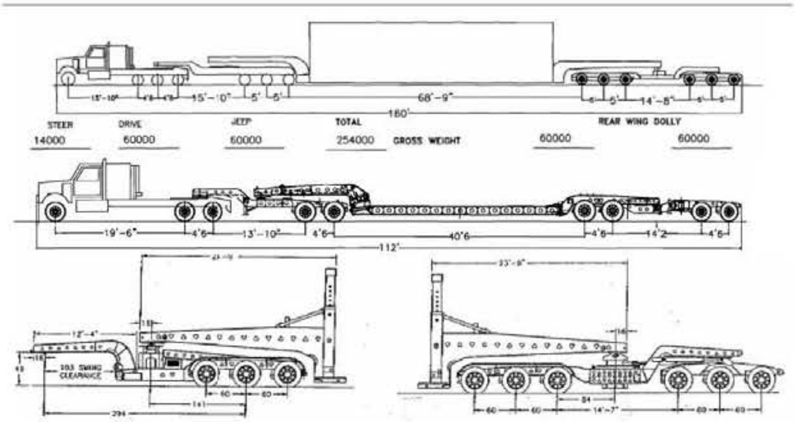
Basic Configuration

Tower Type	Overall Length (mm)	Overall Length (in)	Outer diameter top flange (mm)	Outer diameter top flange (in)	Outer diameter bottom flange (mm)	Outer diameter bottom flange (in)	Tower Weight (kg)	Tower Weight (lbs)
80m Standard	23455	923	3637	143	4142	163	52309	115080
80m Seismic	23455	923	3640	143	4145	163	57443	126375

Shipping Requirements

All transport configurations must be padded to protect tower against damage to tower shell and tower external paint.

Reference Illustration



Tower Top Assembly

Load ID **Load-08 (TTA)**

Transportation Configuration Options

- Expandable Drop Deck Multiple Axle
- Truck Mounted Load Bunk with Steer able Load Bunk Dolly

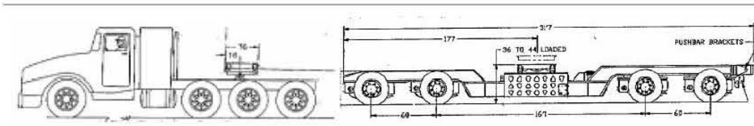
Basic Configuration

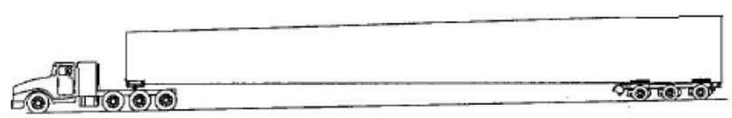
Tower Type	Overall Length (mm)	Overall Length (in)	Outer diameter top flange (mm)	Outer diameter top flange (in)	Outer diameter bottom flange (mm)	Outer diameter bottom flange (in)	Tower Weight (kg)	Tower Weight (lbs)
80m Standard	28400	1118	3036	120	3637	143	44959	98910
80m Seismic	28400	1118	3036	120	3640	143	49093	108005

Shipping Requirements

All transport configurations must be padded to protect tower against damage to Tower Shell and Tower external paint.

Reference Illustration





Machine Base Assembly

Load ID **Load-09 (MBA)**

Transportation Configuration

- Multiple Axle High Tonnage Double Drop (Air Ride only)
- Multiple Axle High Tonnage Double Drop Steer able Axle

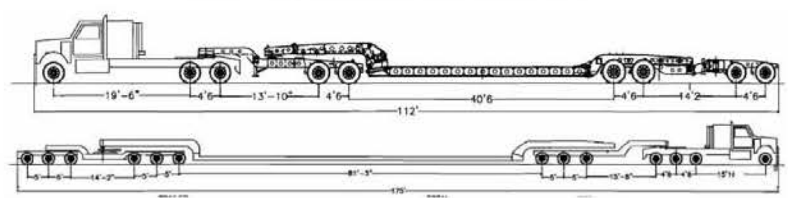
Basic Configuration

Component	Width (ft)	Length (ft)	Height	Weight per Unit (lbs)
Shipping Fixture	9.9	11.9	13 (in)	4400
Machine Base Assembly	14.1	18.6	12.08 (ft)	71400

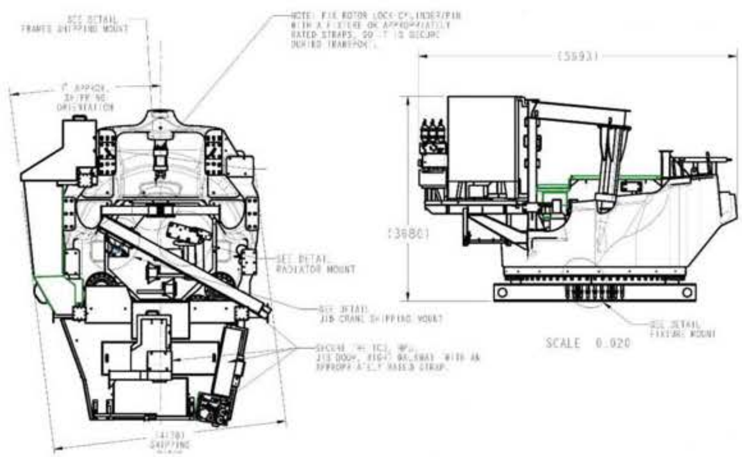
Shipping Requirements

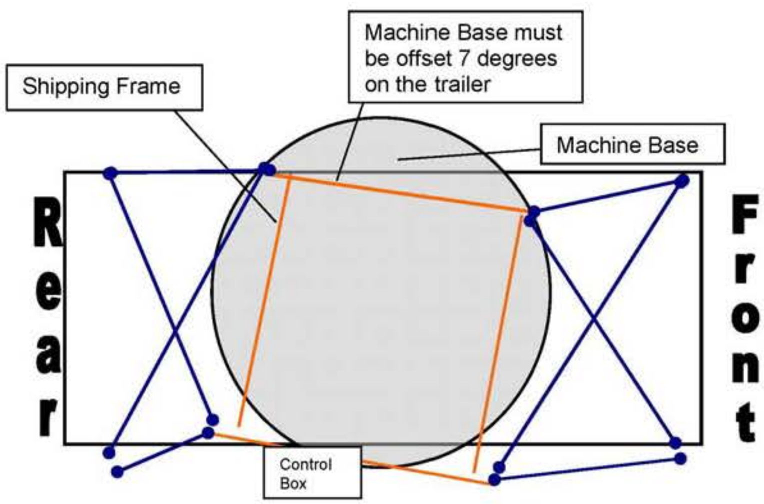
Requirement	Size (ft)	Type	Length	Amount
Shrink wrapped	N/A	N/A	N/A	N/A

Reference Illustration



Recommended Load Securing





Gearbox Assembly

Load ID **Load-10 (GBA)**

Transportation Configuration Options

- Multiple Axle High Tonnage Double Drop (Air Ride only)
- Multiple Axle High Tonnage Double Drop Steer able Axle

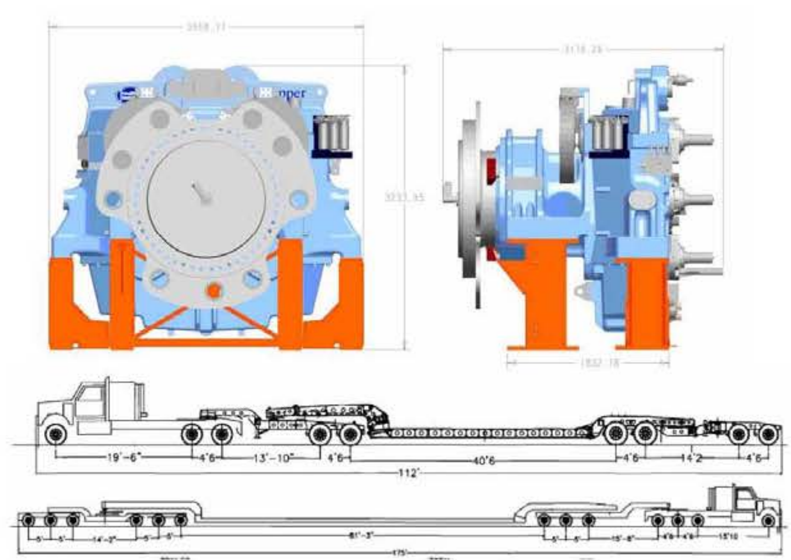
Basic Configuration

Component	Width (ft)	Length (ft)	Height (ft)	Weight per Unit (lbs)
Shipping Fixture (Front Supports)	7.16	3.45	4.16	2400
Shipping Fixture (Rear Supports)	11.6	2.29	3.43	
Gearbox Assembly with Shipping Fixtures	10.5	11.8	10.6	103425

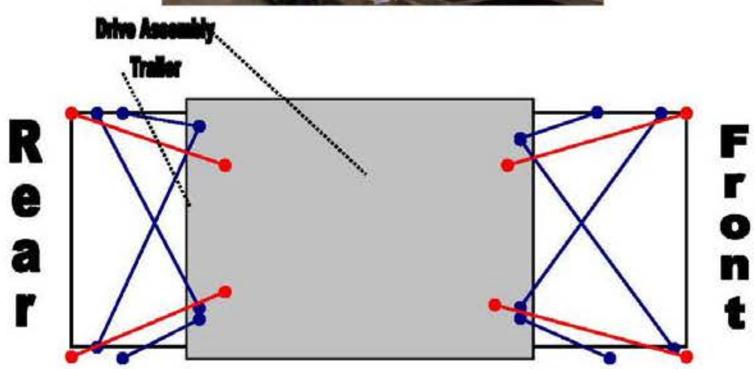
Shipping Requirements

Requirement	Size	Type	Length	Amount
Shrink wrapped	N/A	N/A	N/A	N/A

Reference Illustration



Recommended Load Securing This picture shows the side of the Gearbox assembly that if loaded towards the front of the truck.



The blue lines indicate at least ½ chains connecting to the shipping legs with at least a 12 ton clevis. The red lines indicate chains coming off of the Gearbox Assembly with at least 3/8" chains and using at least 12 ton clevis to connect with.

Nacelle/Spinner Fiberglass Kits

Load ID **Load-11, 12, 13 (NAC)**

Transportation Configuration Options

- Drop Deck Trailer
- Curtain Vans
- Container 40 (ft)

Basic Configuration

2 High Cube 40 ft Containers (When shipped directly from Vendor)
3 Drop Deck 53 ft , 5 skids
Drop Deck Trailer/Curtain Vans requires fork truck with fork length over 94 in, width between forks not less than 5 ft.

Shipping Requirements

Requirement	Size	Type	Length	Amount
Shrink wrapped	N/A	N/A	N/A	N/A

Reference Illustration

Hub Assembly

Load ID **Load-14 (HUB)**

Transportation Configuration Double Drop Lowboy 3 Axle Trailer

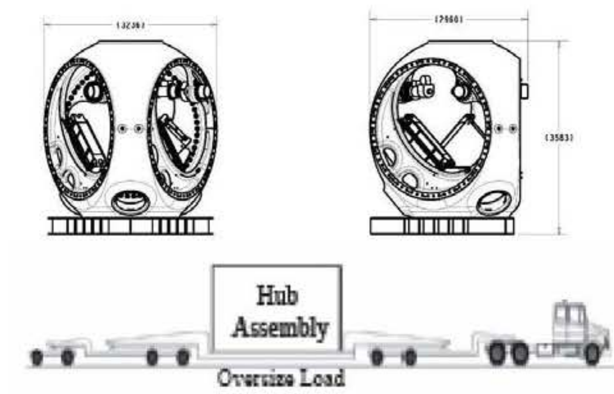
Basic Configuration

Component	Width (ft)	Length (ft)	Height with fixture	Weight per Unit (lbs)
Shipping Fixture only	10.34	10.34	13 (in)	3200
Hub Assembly with Pitch bearings and shipping fixture	11.6	9.0	11.75 (ft)	59850

Shipping Requirements

Requirement	Size (ft)	Type	Length	Amount
Shrink wrapped	N/A	N/A	N/A	N/A

Reference Illustration



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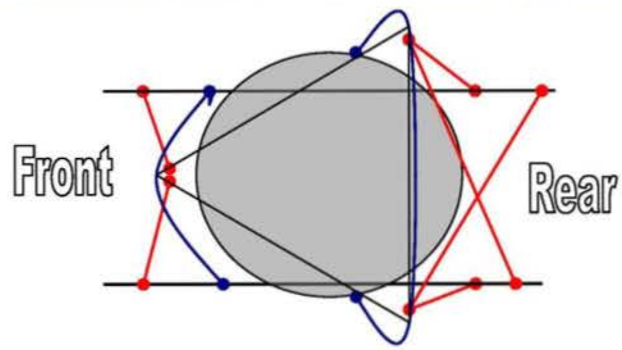
Recommended Load Securing

The shipping leg has 2 attachment points on each of the 3 corners. Each carrier will need 6 clevis' 8 chains and 8 binders.



This is a top view of the Hub on a trailer. The red colored line refers to chains coming off the attachment points. The blue lines refer to chains wrapping in front or behind the shipping frame to prevent forward or backward movement.

Note: The lifting point on the top of the hub must be removed prior to transportation

Continued on next page

Blade Assembly Set of 3

Load ID **Load-15, 16, 17 (BLD)**

Transportation Configuration Expandable Flatbed to 115 ft. with steer able rear axles

Basic Configuration

Component	Width (ft)	Length (ft)	Height (ft)	Weight per Unit (lbs)
C-96 Blade with Shipping Fixtures	11.15	155	9.5	28875 ea
C-93 Blade with Shipping Fixtures	11.15	150	9.5	27130 ea

Reference Illustration

Expandable Flatbed to 115'

C93

Figure 04 – C93 shipping fixture average COG position (14,347mm from root face)

C96

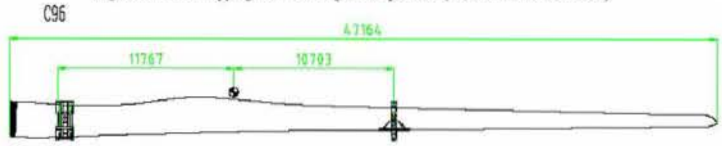
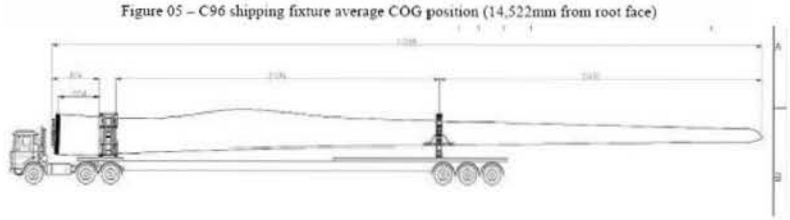


Figure 05 – C96 shipping fixture average COG position (14,522mm from root face)



Generators

Load ID **Load-18 (GEN)**

Basic Configuration

Components	Width (ft)	Length (ft)	Height (ft)	Weight (lbs)
Generator with Shipping fixture	4	4	4.1	3922

Transportation Configuration

Standard 40' Container
Standard Flatbed
(4) per set (2) sets per container

NOTE: DO NOT STRAP OR CHAIN THE RECTIFIER DURING SHIPPING.

Reference Illustration

Fixture Return Instructions

Requirements

1. Project Site notifies CFS Logistics in writing via email and a phone call no less than (5) days prior to having shipping fixtures that are stacked and ready for removal;
2. List in writing type of component and estimated size of load per Shipping Fixture Return criteria;
3. CFS Logistic will notify the Transportation Company via email and phone with type of component and designation point.
4. Transportation Company will notify Project Site and CFS Logistic 3-days prior of their time of arrival.
    - Transport Company should plan on a full day to load, due to layout of site staging areas; these could be some distance apart in order to fill the truck.

Fixture Return Process

Items returned to Clipper

The following item(s) should be shipped to Clipper:

- Generators fixtures should be stacked on pallets, banded
- Blades fixtures (depending on contract agreements)
- Drive train fixtures
- Machine Base Fixtures
- Hub Fixtures
- Loose parts should be returned in wooden boxes

Vendor Fixture Return Process

Items returned to Vendor

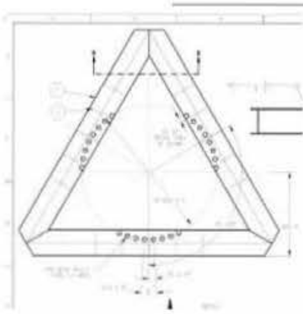
- Tower shipping fixtures
- Blade fixtures (depending on contract agreements)

Hub Shipping Fixture

Load ID **Load-50 (HUB-SF)**

Transport Requirements

Height each (in)	Width each (in)	Number in Stack (ea)	Stacks per Trailer (ea)	Weight each (lbs)	Total Weight (lbs)	Total Height (per stack)
13	118	4	3	3200	38400	54



Fixture Return Process

- Standard Flatbed
- Hub lifting fixtures are to be returned to Clipper at the end of the project

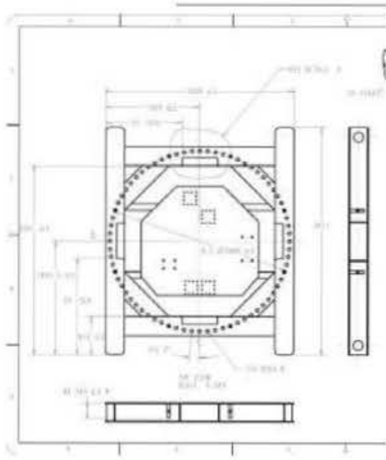
Machine Base Shipping Fixture

Load ID **Load-51 (MBA-SF)**

Transport Requirements Standard Flatbed

Fixture Return Process See Table Below

Height each (in)	Width each (ft)	Number in Stack (ea)	Stacks per Trailer (ea)	Weight each (lbs)	Total Weight (lbs)	Total Height ((in) per stack)
13	9.9	4	2	4400	35200	54



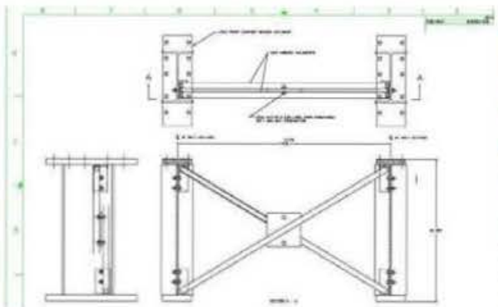
Gearbox Assembly Fixtures

Load ID **Load-52 (GBA-SF)**

Transport Requirements Standard Flatbed

Height each (in)	Width each (in)	Number of Sets per Trailer	Weight each (lbs)	Total Weight (lbs)	Total Height (in)
50	32	12	2400	28800	52

Fixture Return Process Pallet and band



Blade Fixtures

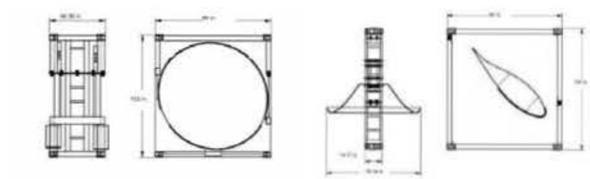
Load ID **Load-53 (BLD-SF)**

Transport Requirements 5 sets per standard flatbed

Fixture Return Process

- Return to Clipper
- Clipper returns fixture to Tecsis - Reference DC-036480-xx Rev A Handling Manual Packing Clipper C96 Shipping Fixture Into ISO 40' Dry And ISO 40' High Cube Container

Height each (meter)	Width each (meter)	Number of Sets per Trailer	Weight per set (lbs)	Total Weight (lbs)
2.60	2.44	5	4410	22050



Nacelle Fixtures

Load ID **Load-54 (NAC-SF)**

Transport Requirements

Number of Sets
12 per container

Fixture Return Process

- Cut off or unbolt all uprights
- Return to Clipper
- Clipper returns fixture to Tecsis

Tower Fixtures and Tarps

Load ID	**Load-55 (TOW-SF)**
Transport Requirements	Typically 10 towers fixtures per 40 ft. container
Fixture Return Process	• Number and type varies by vendor • Place tower manufacturer/vendor on frame • Return frame to vendor • Return tower bracing and covers to vendor • All nuts bolts and washers should be boxed (wooden) and returned with fixture • Return tower tarps with fixtures

Generator Fixture

Load ID **Load-57 (GEN-SF)**

Transport Requirements
- Standard 40 ft. Container
- Standard Flatbed

Fixture Return Process
- 6ea fixtures per pallet
- Band
- Place in container (maximum 60 fixtures per 40 ft. container)
- Return to Clipper

Height each (in)	Width each (in)	Length each (in)	Number in Stack (ea)	Stacks per Trailer (ea)	Weight each (lbs)	Total Weight (lbs)
8.5	39.75	32	6	10	122	12200

Appendix A

Supplier/Clipper Inspection

References

DC-016496-xx Tower Inspection Supplier/Clipper Checklist
DC-007997-xx Blade Inspection Supplier/Clipper Checklist
DC-019465-xx Converter Container Packaged Checklist
DC-019466–xx Electrical Container Packaged Checklist
DC-019468-xx BOP Hardware Kits Container Packaged Checklist
DC-019469-xx FFAW Hardware Kits Container packaged Checklist

Transporter Checklist

References

DC-015419-xx Hub Assembly Final Quality Inspection Checklist
DC-015931-xx Machine Base Final Quality Inspection Checklist
DC-016389-xx Gearbox Assembly Transportation Checklist
DC-015699-xx PDP Transportation Checklist
DC-019471-xx Pitch Bearing Transportation Checklist
DC-019472-xx ICDLP Converter Platform Checklist
DC-015693-xx Rev "A" - Blades transportation Checklist
DC-019474-xx Tower Transportation Checklist
DC-008690-xx PDP Receiving Inspection Checklist
DC-017429-xx ICDLP Receiving Inspection Checklist
DC-008677-xx Inverter Converter Cabinet Inspection Checklist
DC-008674-xx Tower Receiving Inspection Checklist total 4 per Turbine
DC-008654-xx Nacelle/Spinner Receiving Inspection Checklist
DC-009626-xx Machine Base Receiving Inspection Checklist
DC-008653-xx Gearbox Assembly Receiving Inspection Checklist
DC-007439-xx Hub Receiving Inspection Checklist includes Pitch Bearing Inspection
DC-008655-xx Blade Receiving Inspection Checklist
DC-006582-xx Liberty Wind Turbine Series Onsite Storage Requirements for Turbine Components
DC-013579-xx Special Tools

BOL Form (sample)

Clipper WINDPOWER

UH 832 (7-69) (Uniform Domestic Straight Bill Of Lading adopted by Carriers in Official, Southern and Western Classification Territories, Mar. 15, 1922 as Amended June 15, 1940)

UNIFORM STRAIGHT BILL OF LADING
ORIGINAL - NOT NEGOTIABLE

Shipper's No: ____________
Agent's No: ____________

RECEIVED, subject to the classification and tariffs in effect on the date of the issue of this Bill of Lading

At Cedar Rapids, IA　　Date:

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown) marked consigned and destined as indicated below which said company (the word company being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its own road or its own water line, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at anytime interested in all or any of said property, that every service to be performed hereunder shall be subject to all the conditions not prohibited by law, whether printed or written, herein contained, including the conditions on back hereof, which are hereby agreed to by the shipper and accepted for himself and his assigns.

(Mail or Street address of consignee - For purposes of notification only)

CONSIGNED TO ____________

Destination ____________ State of ____________ County of ____________

Route ____________ **DRIVER MUST CALL 1 HOUR BEFORE DELIVERY**

Delivery Carrier ____________ Phone: ____________ Appt Time:

No. Packages	Description of Articles, Special Marks and Exceptions	Weight Subject to Correction	Class or Rate	Check Column

Subject to Section 7 of conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:

The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

____
(Signature of consignor)

If charges are to be pre-paid, write or stamp here, "To be prepaid."

PRE-PAID

Received $____________ to apply in prepayment of the charges on the property described herein.

____
(Agent or Cashier)

Per ____________
(The signature here acknowledges only the amount prepaid).

Charges advanced
$

If the shipment moves between two ports by a carrier by water, the law requires that the bill of lading shall state whether it is "carrier's or shipper's weight."

NOTE - Where the rate is dependant on value, shippers are required to state specifically in writing the agreed or declared value of the property.

The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding

per

FREIGHT BILL MUST REFERENCE SHIPPERS NO. FROM BILL OF LADING

____________, Shipper　　Trailer No: ____________

Per ____________ Loaded by CLIPPER　　Company ____________

Permanent post office address of shipper CEDAR RAPIDS, IA　　Agent Driver ____________

Our Shipping Order No.

DISTRIBUTION: Top two copies for Logistics Department; Bottom two copies for driver

Appendix C

Liberty Turbine Major Subassembly Weights

Gearbox / Generator Assembly	**KG**	**LBS**
Gearbox without Shipping Fixtures (No Generators)	45866	100905
Gearbox with Shipping Fixtures (No Generators)	47011	103425
Generator with Shipping Fixture	1783	3922
Gearbox without Shipping Fixtures (Generators Installed)	53502	117705
Gearbox with Shipping Fixtures and (Generators Installed)	54593	120105

Machine Base Assembly	**KG**	**LBS**
Machine Base as delivered from Cedar Rapids (with shipping fixture)	32455	71400
Machine Base as delivered from Cedar Rapids (without shipping fixture)	30355	66780
Machine Base assembly, gearbox with generators, nacelle fiberglass (not including the roof or shipping fixture)	86720	190785
Nacelle Roof	1235	2716

Rotor Assembly	**KG**	**LBS**
C-96 Blade	13125	28875
C-93 Blade	12332	27131
Hub assembly with pitch bearings and shipping fixture	27204	59850
Complete C-96 Rotor including spinner (no shipping fixtures)	65530	144165
Complete C-93 Rotor including spinner (no shipping fixtures)	63151	138933

Tower Assembly (10-007751-xx: 80m, C-96)	**KG**	**LBS**
Base Tower Assembly	48920	107625
Lower Mid Tower Assembly	51211	112665
Upper Mid Tower Assembly	52309	115080
Top Tower Assembly	44959	98910

Tower Assembly (10-026151-xx: 80m, C-93, Seismic)	**KG**	**LBS**
Base Tower Assembly	53419	117522
Lower Mid Tower Assembly	55920	123025
Upper Mid Tower Assembly	57606	126735
Top Tower Assembly	49093	108005

Miscellaneous	**KG**	**LBS**
ICDLP (Converter Platform)	3182	7000
Xantrex Converter (with fans installed)	2823	6210
Magnetek Converter	3409	7550
Power Distribution Panel (PDP)	1000	2200

All weights accurate to +/- 10%