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BIOMASS POWER FOR RURAL DEVELOPMENT

Quarterly Report for the Period
April 2 - July 2, 1997

James T. Cooper

CHARITON VALLEY
RESOURCE CONSERVATION & DEVELOPMENT, INC.

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DISCLAIMER

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INTRODUCTION

The following information summarizes the major areas of project activities accomplished during the last quarter. Activities concerning conversion technologies have continued to be focused on gaining information and comparing similar systems world wide with the needs of our project. One major effort was the trip to Denmark and Finland by Jerod Smeenk of Iowa State University and Gary Walling of Iowa Electric Services, Inc.. They followed up on the contacts provided from Ed Woolsey's trip last quarter and his presentation of findings to Walling (IES), Anderson (R.W. Beck) and Smeenk (ISU) on April 4th. The *first section* of the report details some of the trip highlights from Mr. Walling and the *second section* is a write up provided by Mr. Smeenk.

Additional conversion work has been simultaneously undertaken at Iowa State University on the development of material handling, gas sampling, and gas analysis equipment. This work is detailed in the *third section* of the report.

In addition, several members of the project have been preparing materials for presentation at the 3rd Biomass Conference of the Americas in Montreal Canada. Their work will be highlighted in future reports.

The field work is in progress and Mr. Teel's monthly progress reports have been included in a task format.

An additional field work update is provided by Dr. Charlie Brummer on the installation of some field trial plots.

A summary of the quarterly GIS work is included to show the level of informational accuracy currently being developed for the project.

MR. WALLING REPORTS FROM EUROPE

Summary Findings:

1. The Denmark engineers 'cautioned' that you must **forget** everything you know about handling wood-chip type biomass. Handling straw is completely different, the combustion is completely different and the ash/combustion products are completely different.

2. There was no use of **bins** to even-out the process. In fact, their experience indicated that use of bins were detrimental to handling since it added a element which was prone to plugging. They designed the straw processing itself to levelize the process flow.

3. Process Risk / Safety Analysis is very important to identify areas requiring fire protection personnel safety (e.g. in automated handling areas), high noise areas, and provisions for an explosion potential.

4. Slagging and fouling due to alkalis in the ash and high temperature corrosion due to chlorine needs to be evaluated. There may be no problem if switchgrass is consumed at low percentage to the total heat input or if the alkali and chlorine content is small. More extensive analysis of switchgrass ash is recommended along with some water wash testing of the switchgrass.

5. Transporting crushed straw long distances (450 meters) by pneumatic piping can be done reliably, but sizing of the straw particle, vis-a-visa the piping diameter, is extremely important.

Discussion:

1. Alkali and Chlorine

A. Denmark's experience burning high percentage of straw indicates problems with alkali constituents in the ash. Slagging and fouling may be a problem while burning biomass at a high percentage (greater than 10 percent) of total fuel input. At smaller percentages (5 to 10 percent) there is no consensus but some of the Danish experiences would suggest that this would not be a problem.

B. Equally important is the indication that at least some of the alkali is present in the form of chlorine salts. Normal fuel or ash analysis will not reveal the chlorine because of the high temperature employed in the ash analysis process. It would be advisable for us to have analyses performed on the switchgrass to determine the chlorine content since some of the Denmark plants have encountered accelerated superheater corrosion as they employed straw at units with higher steam temperature conditions (or higher percentage of straw fuel input, e.g. 20%). One plant indicated that with 100 percent straw, they saw accelerated corrosion at metal/steam temperatures above 470 °C.

C. Denmark experience indicates slagging/fouling increases as a function of difference between the flue gas temperature and the heat transfer metal surface temperature. Their second and third generation plants are being designed around this point and have much lower temperature difference than the US plants.

D. It may be possible to reduce both alkali and chlorine content by **washing** the switchgrass. The recommended wash process should involve at least two separate wash steps. The final step should involve a rolling process to dewater, as well as crush any nodules or joints in the plant stems.

We should definitely test wash switchgrass to determine how much of these elements are water soluble or present as "dirt" adhered to the material.

E. Part of the motivation for the Denmark gasification development is to **pre-gasify** the straw in order to separate the parts of the combustion process which liberate alkali and chlorine from the parts of the process involving energy recovery at high temperatures. In this way the slagging, fouling and corrosion constituents are confined to the gasifier which operates at lower temperatures (at which these constituents are not a problem). This also separates the straw-derived ash from the coal-derived ash, in multiple-fuel applications, to allow the coal ash to continue to be marketed for cement admixture applications.

2. Processes Driving Biomass

A. In Denmark a commitment has been made to achieve 1990 CO^2 levels by the year 2005. They have access to natural gas which is within 30 percent of the price of coal and the gas distribution system has significant underutilized capacity. They are targeting increased use of natural gas and straw for power generation and district heating, and are prohibited from building new coal plants.

B. Denmark is targeting 1,400,000 tons of biomass for energy recovery, with straw accounting for 1,000,000 tons up from 90,000 tons today. Since straw is a by-product of agriculture (grains), this dramatic increase is expected to impact the price. Because the program is government mandated and plants are built exclusively to burn straw, a seller's market has developed and prices have remained artificially high already.

Note that the situation is <u>not</u> comparable to the US where the programs are not mandated and cheaper alternative fuels are readily available. Straw is approximately equal to the price of natural gas and approximately double the price of coal in Eastern Denmark.

C. In Finland, the government policy is directed at provided new generation **without** the use of new nuclear plants nor new coal plants. They are also committed to CO^2 reduction but, with their existing natural gas supply coming exclusively from Russia, they are motivated to develop biomass plants consuming wood waste products and selected municipal waste. Therefore, many of their current initiatives are directed at utilization of multiple, or mixed, waste fuels.

Since they now generate less CO^2 than most countries, their objective is to hold CO^2 emission constant to the year 2005 and reduce by 10% thereafter.

D. In Denmark, the electric pricing is approximately twice the value of heat; therefore the electric industry can support more expensive electric generation processes. In Finland, heat and electric are approximately equal in price so that more expensive process cycles cannot compete with simple steam cycles.

Foster has merged/purchased Alstrom and is actively marketing fluid bed combustors as well as gasifiers. Although most of their experience has been with peat and wood waste, their primary selling point is that this technology can easily accommodate mixed fuels, particularly mixed wastes, in order to achieve the economies of larger scale.

3. Process suggestions

A. Burning pelletized straw has been very successful for testing in Denmark. The pellets could be handled by the conventional coal-handling equipment, processed, and pulverized with the coal. Although pelletizing is too expensive for full scale utilization, it would allow for boiler testing with very minimal impact to existing equipment.

B. Co-firing 10-20% straw with coal in Denmark revealed improved precipitator (cold side precip) performance with reduced performance of limestone desulfurization (alkali in straw reduces reactivity of limestone).

C. Used in conventional low NOx burners, the straw burned like gas, close to the burner tip and with lower NOx generated than with coal (note that with concentric burner design, the region closer to the burner tip is lower air region which may contribute to improved NOx performance).

At Studstrup, a revised burner design was developed. The straw is introduced in the center where the ignitor and pilot fuel equipment is located. The burner was modified to locate the ignitor/pilot essentially (*drawing is attached in Appendix*). They fire in middle burners to achieve extended residence time at higher flame temperature regions of the boiler.

D. Handling systems need to be designed with good dust collection and fire protection systems since the straw is more dusty and more flammable than coal.

E. Need to monitor pulverizer temperatures closely to detect mill fires.

F. Straw should be sized to minus 1" and you definitely need to crush any modules or stem joints to facilitate carbon burnout. The straw will combust within one to three seconds at 1100°C while uncrushed joints of stems require 20 to 40 seconds to completely combust.

Note: We may wish to consider grinding equipment, like disc mills, such as used in food industry to make flour or rolling equipment used to roll oats for the process.

G. Suggestion for a wash process could have the following characteristics:
Screw process with counter-current water flow. If the release of untreated wash water is not permitted then cleaning via filtration and then reverse osmosis is suggested. Grass heating value may decrease by a couple percent due to wash process. Up-moving belt/roller press at end to dewater & crush. Drying with 1.6 bar steam. (Or with flue gas, if available.) This could help reduce temperature and humidify in the flue gas for improved hot-side precipitator performance. Note: More information on recent Elsam testing may be available from Niels Kirkegaard. Unofficial initial testing suggested 90% reduction of alkali in straw may be achieved.

H. At Studstrup the storage barn is located at some distance from the boiler. The straw is aggressively "divided" from the bale, stones and other debris are rejected, the straw is leveled, crushed in a hammer mill, fed through a lock hopper to a pneumatic conveyor and transported 450 meters to the burner. The boiler controls adjust the rate of straw fed by the drag-chain into the bale divider (to match the boiler load demand).

There are four process lines, each feeding an individual burner (four burners of twelve for a 150 MW plant). The straw supplies 50 percent, at most, of the fuel input to the burner and is not introduced until the coal flame is established. The flame safety system is unchanged and continues to monitor the coal flame. Any disruption in straw supply is automatically compensated by increased coal flow by the unit's control system.

Studstrup did not feel that grinding the straw could be justified (too energy consuming). The size reduction at the hammer mill is to achieve particle size of less than 50mm (and to crush any nodules or stems) for efficient transport (in 8 inch pipes). Testing with larger particle size proved that the material would accumulate in clumps during transport and would enter the boiler in large "slugs" (looking and sounding like a giant tennis-ball throwing machine).

Material size reduction can consume two to three times as much energy as coal, per unit of fuel heat value. When considering alternative designs, energy requirements should be one of the primary design criteria.

I. Storage: Designs varied depending on local conditions. At small plants there was more storage with automated retrieval allowing unattended operation (plants were not manned at night at all). At Studstrup, the local fire codes limited an individual storage pile to no more than 400 m^2 in a 2000 m^2 building (at 6-bales high this equals 576 bales) and they have two such buildings (side-by-side). This provided 30 hours of straw at full feed rate and operation continued on coal when straw supply was exhausted. The handling system was automated and attended only during the day shift on weekdays.

J. Straw price given to producer is adjusted for moisture, from base range of 15 to 17 percent. Moisture at Studstrup was determined from microwave cells mounted on the crane hoists. Note the computer controlled crane stored the location of all bales, by producer, date received, and moisture content and could use this information in inventory management.

Bales were also weighed with load cells on the crane. The receiving data was automatically computer linked to accounting so that the producers were all paid via electronic funds transfers. The trucking company performed all logistic services with the producers to schedule and manage deliveries. Deliveries occurred on day-shift, weekdays only. At time of delivery a weigh-ticket was issued to the driver by the computer with all pertinent quality data. The driver vacuumed the truck prior to exit.

LIST OF ATTACHMENTS
(Available upon request)

1. Power Plant data - Masnedo CHP Plant Four sheets showing screen-prints from control system at unit startup.
2. Straw Conveying System Design - Slagelse CHP plant
3. Studstrup Design Drawings
   a. Burner Drawing - modifications for straw input to burner
   b. Straw storage Building design
   c. Straw handling crane control logic
   d. Straw conveying system to hammer-mill crushers
   e. Straw conveying from crushers to pneumatic piping

RESOURCES OBTAINED

The following reference material was obtained during this trip. Because of the volume of the material, copies are not attached but are available to the combustion sub-project team.

1. SK Energi (Elkraft) plant descriptive bulletins including basic design data.
   b. Combined Heat & Power (CHP) concept document
   c. Masnedo CHP plant
   d. Haslev CHP
   e. Slagelse CHP
   f. Naestved CHP
   g. Haslev Pyrolyseanlaeg
   h. Avedore2 CHP

2. Elkraft Annual Report

3. Elkraft Technical Reports
   a. Action Plan for Bioenergy, June 1996.
   b. Use of Biomass in Denmark, 94-JPGC-PWR-49 (ASME paper)
   c. Biomass use in large power plants. Point of view of a utility. (Elkraft Planning Department, undated).
   d. Straw-firing tests at Amager and Kyndby Power Stations
   e. Processes for Large, Central Power Stations.

4. Midtkraft Electricity Company (Elsam) plant descriptive bulletin: Studstrupvaerket

5. Reports from Thomas Koch Energy
   a. Logistics and feed preparation of straw for gasification and combustion
   b. Afvanding af helm og koks ved hoje tryk
   c. Halmindsamling og opbevaring i modificerede containere
   d. Forprojekt vedrorende etablering af halmbaseret kraftvarmeanlaeg I Glamsbjerg

6. Reports from VTT, Technical Research Centre of Finland
   a. VTT's 1996 Annual Report
   b. Pyrolysis Network for Europe, issue 3, March, 1997.
   c. Biomass Gasification and hot gas cleaning R&D at VTT Energy (Oct. 1996)
   d. Recent results and plans concerning co-gasification of biomass and coal - An overview.
   e. VTT Energy, 1996 Highlights.

7. Reports from Foster Wheeler
   a. Ahlstrom Pyroflow, CFB gasification technology
   b. Atmospheric and pressurized CFB gasification of biomass. (Includes process data from Varnamo plant)

Mr. Smeenk Reports From Europe

Jerod Smeenk traveled to Denmark and Finland in May to tour biomass power plant facilities, make professional contacts in theses countries, and identify equipment that will be beneficial to biomass gasification research. Companies visited include: Elkraft Power Company Ltd., located in Ballerup, Denmark; Thomas Koch Energi AS located in Gadstrup, Denmark; the Danish Technical University located in Lyngby, Denmark; dkTEKNIK located in Soberg, Denmark; Foster Wheeler Energia Oy, located in Varkaus, Finland; and VTT Energy located in Espoo, Finland.

Some observations from the trip to Europe include:

1) The Danish government has mandated the use of biomass for power and heat production. The primary motivation for use of biomass is mitigation of CO^2 emissions. A commitment to reduce CO^2 emissions by 20%, SO^2 emissions by 50%, and NOX emissions by 60% of the 1988 levels by the year 2005 has been made. An additional mandate requires CO^2 reduction of 50% by the year 2030. As a means of meeting this goal, the Danish Parliament reached a political agreement in 1993 which stipulates that 1.0 million tons of straw (primarily wheat straw which is very similar in composition to Iowa switchgrass) and 0.4 million tons of wood shall be used for power production before the year 2000, up from the present day usage of 90,000 tons. The Finnish energy policy also has CO^2 reduction in mind, but has mandated that new generation may not be coal-fired or nuclear.

2) Denmark currently does very little with gasification. Most of the emphasis is on straw or wood combustion systems. They currently have one operational gasifier located at Harbooere,

developed by Volund. The gasifier operates in the updraft mode and is rated at 15 MW thermal input.

3) Denmark currently has several combined heat and power plants, i.e., operate only on biomass and produce both electricity and steam for process and district heat. They have numerous plants that co-fire coal and biomass. Three biomass plants have been constructed within the last five years and are rated at between 6 - 8 MWe and 15 - 20 MJ/s heat.

4) To date, Denmark has preferred to combust biomass to generate steam. Existing coal fired boilers have been retrofit to consume straw and new biomass only power plants have been constructed. However, slagging, fouling, and corrosion problems caused by high temperature combustion of straw have been limiting factors. The slagging and fouling problems have been attributed to alkali and chlorine in the straw. Slagging due to straw combustion is typically only a problem if the biomass constitutes greater than 10% energy input to the boiler. Equally important is the indication that at least some of the alkali is present in the form of chlorine salts. Danish power plants operating at higher steam temperatures have experienced accelerated superheater tube corrosion due to the chlorine. It has been suggested that steam temperatures below 880 °F would reduce this problem. Further Danish experience indicates slagging and fouling increase as a function of difference between the flue gas temperature and the heat transfer metal surface

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5) Much effort is being focused to reduction of alkali and chlorine in the straw to allow higher operating temperatures in plants that utilize straw as a fuel. There are many approaches being pursued to achieve this goal. Harvesting practices may reduce the amount of alkalis and chlorine if the straw is allowed to sit in the field until it is washed by rain. Because the straw is a byproduct of wheat harvesting, timeliness of straw collection is hard to adjust. On a similar note, washing of the straw at the power plant to remove the soluble components is being considered. The volatilization of alkali and chlorine is a function of temperature. Therefore the straw may be gasified or pyrolyzed at lower temperatures. The alkali and chlorine remains with the ash while the producer gas may be used in a higher temperature boiler for superheating steam. The residual char and ash may be utilized in a low temperature boiler to raise steam (low temperature steam). The Danes constructed a straw pyrolysis unit at the Haslev biomass plant for this purpose. Foster Wheeler Energia Oy in Finland has initiated construction of a gasifier to receive numerous types of fuel. The producer gas will be scrubbed prior to combustion in a high temperature coal boiler. This type of system also allows separation of ash streams from the biomass and coal reactors, thereby reducing the possibility the ash will not meet standards set by the concrete industry.

6) Gas clean-up methodologies are being developed to remove particulates, alkalis, and ammonia from the producer gas before it is combusted in a boiler, gas turbine, or other high temperature conversion technology. VTT Energy in Espoo, Finland, has been instrumental in this

development. High temperature filters, which operate between 750 and 1100 °F, have been developed that are able to remove the contaminants somewhat reliably. Most of this development is proprietary and good information on design and operation is hard to obtain. It is desirable to remove the particulates and alkali from the 8a's to prevent erosion and corrosion in combustion turbines. It is desirable to remove the ammonia to reduce NOx emissions.

7) Both Denmark and Finland have imposed CO^2 taxes on fossil fuels. Without this tax, biomass fuels would not be able to compete. Large quantities of centralized biomass waste (usually as a byproduct of another process) would be the only scenario under which the use of biomass in power production would be economical.

Overall the trip was highly successful and informative. Many professional contacts were made for future references and possible collaborations.

Future work includes continued development of the material feeding and injection system. Testing will resume when an operational system is in place. Materials to be tested include switchgrass, corn stover, and wood chips. Gas analysis will be performed to determine undesirable producer gas constituents..

IOWA STATE GASIFIER PROGRESS

The third quarter has been occupied with continued development of a material handling system for switchgrass as well as additional gas sampling and analysis equipment. Additionally, project engineer, Jerod Smeenk, traveled to Denmark and Finland to tour biomass power plant facilities, make professional contacts in these countries, and identify equipment that will be beneficial to biomass gasification research. A summary of each of these activities is described below.

It is desirable to have a material handling system to feed switchgrass, corn stover, wood chips, corn cobs to the gasifier. The immediate fuel of choice is switchgrass. This material has been difficult to handle because of its low bulk density, tendency to bridge, and inability to flow smoothly. Feeding bulky materials at a given rate and injecting the material into the reactor have been two unique problems.

The original feed hopper was constructed with a V-bottom configuration. This led to bridging, packing, and ultimately no flow of switchgrass. A new feeder was designed with the help of Thomas R. Miles Consulting Services. An Auto CAD drawing of the hopper may be found in Figure 1. The feeder measures six feet in length with two foot side walls. Three of the walls are vertical while the fourth wall is slightly angled to ease loading of the feeder. Two, nine-inch counter rotating screws feed material at a variable rate into a rotary air-lock. The hopper was fabricated by Pioneer Hi-Bred. Additionally, Pioneer supplied a ten inch rotary airlock for use with bulky materials such as corn stover or switchgrass.

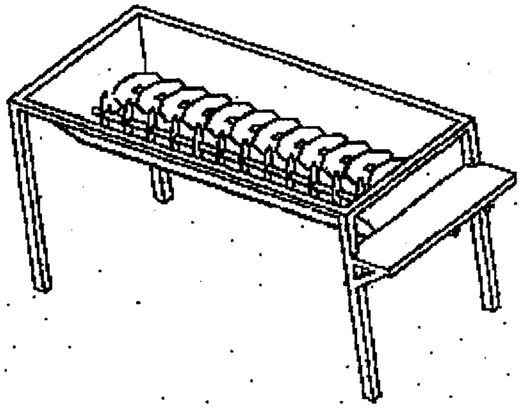


Figure 1. Auto Cad Drawing Of The Feed Hopper.

The previous airlock had a tendency to plug due to biomass caught between the vanes and the airlock wall. Knives on the vanes would help alleviate this problem. The airlock supplied by Pioneer utilizes rubber flaps to make the air seal. This design is not as effective as steel vanes for preventing back-flow of gases but is more tolerant of stringy biomass materials.

Injection of bulky materials has also been challenging. The original design of the injection auger placed a hanger bearing near the discharge end of the injection auger (near the reactor). Bulky materials have a tendency to get hung up on the hanger bearing jamming the auger. However, removal of the hanger bearing would cause excessive wear of the auger housing. The current alternative being pursued is to utilize a stainless steel liner that the auger will ride on. This liner will protect the mild steel housing as well as cover the hanger bearing mounting plate, thereby eliminating another snag for the biomass to catch on., Additionally, the gear box on the injection auger will be changed to increase the speed of the auger. Presently, the auger turns at 30 rpm. This is too slow to prevent material from reacting while still in the auger. Therefore, a new gearbox will be installed to increase the auger speed to 120 rpm.

A gas sampling system has been installed to quantify tar and moisture content of the producer gas. An iso-kinetic sampling system, capable of quantifying particulate matter, has been considered but has not been installed due to the complexity of such a system. Additional gas analysis will be provided by an on-line alkali monitor and a Fourier transform infrared (FT-IR) spectrometer. The FT-IR currently has a short path length cell. This cell works well for common, optically active components and also for transient analysis, but is inadequate for quantifying hydrocarbon and other minor constituents. Therefore, we are currently looking into a new gas cell to meet these needs.

IOWA STATE UNIVERSITY -AGRONOMIC ACTIVITY

Monthly report from Alan Teel, Field Coordinator

Baled and moved into storage 143 large square bales and 63 large round bales of Switchgrass (SWG) biomass for use in the project through the summer and fall.

Assisted in the organization of a farmer non-profit cooperative that will pick up and continue to promote some of the elements that I have been studying over the last two years. A description of these items was prepared and distributed to the board of directors of the new cooperative. I will continue to work with them to bring them up to the level of understanding that we have accomplished to this time. Specific items that are being studied: Pelletizing, Fiber Board Products, Bedding and Landscaping, Paper Fiber and gasification using the PRM system.

Consulted with John Rodebush regarding the details of how to set up an experimental plot area that would look at methods of establishing corn in SWG areas using no-till.

Attended a Rathbun Lake water quality testing program meeting to represent Iowa State University. This program will begin in April, ISU will not be involved in the testing program but may be involved in any follow up programming to address problems that are identified if any.

Conducted a one hour seminar at Oklahoma State University (OSU)dealing with the Switchgrass to biomass project. Twenty two staff and students were in attendance. While on the OSU campus I had the opportunity to visit with several OSU agronomy staff regarding both our efforts in the area of SWG to Biomass production. Also, I visited an extensive germplasm nursery that is being sponsored by the Oak Ridge National Laboratory Biomass group, to look for superior genetic material that will possibly lead to increased yields. I was invited back this summer or fall to observe their progress. I also shared our new publication, Pm-1710, as well as one from the Oak Ridge group that deals with SWG as a biomass product.

Set up a tour to Northwest Missouri State University for the farmer non-profit group to visit with the staff responsible for the pellet operation. The first trip was canceled because of snow so a second tour has been arranged.

Attended the annual meeting and conference for the American Forage and Grassland Council held in Ft. Worth, Texas. As a board member I participated in several events that dealt with leadership activities. I participated in an educational tour that encompassed two large (over 1500 acres) native range ranches. The contrast was in the way they were managed. One used "modern techniques" such as fertilization and interseeding the other used only grazing to manage the grass growth and specie selection. I also had the opportunity to suggest some biomass topics to be used as part of the program at the 1998 annual meeting and conference. This suggestion was well received and I believe that a biomass section will be included. I have also identified the procedure to establish a symposium on biomass production at the 1999 annual meeting and conference and will be following up to try and accomplish this exposure for our program.

Met with other ISU staff and McNay research farm staff to evaluate some of the research needs at the McNay farm.

Coordinated a trip to Madison Wisconsin to participate in an extended co-firing session using coal and SWG. This was a joint program with the University of Wisconsin, Wisconsin Department of Natural Resources(DNR) and the Wisconsin Gas and Electric Co. We sent them two semi-trailer loads of SWG biomass last year. They used that material to make some trial runs and then, using our methodology with the CRP, they were able to establish 250 acres of SWG to be used in their program. Jerod Smeenk, ISU engineering, and I made the trip. We spent over two hours consulting with the agronomy and DNR staff regarding issues of harvesting, handling, production and wildlife. We spent three hours at the burn site observing the handling and burning operations. We were able to observe first hand the types of problems that we are likely to face as we proceed to co-fire SWG at the IES plant. We then spent about two hours at the research farm located on the north side of Madison where they were storing and tub grinding the SWG. They were using large round bales and were having some problems with handling and storage. Again, we saw first hand the kinds of problems that they have encountered and will now be able to anticipate how to deal with them before we get involved. I took one roll of slides and about 30 minutes of video that will be used with the farmer group at their next board meeting. Anyone else desiring to view these items should feel free to contact me.

Selected the fields to be used for the management and variety trials and contacted the farmers who would be seeding SWG this spring and provided those names and address to Mike Duffy for use in gathering data on establishment cost.

We now have 2367 acres that farmers have indicated they will allow us to use in the SWG to biomass program.

MAY

Completed all the paper work regarding the two CRP plots being renovated from cool season grass to switchgrass.

Consulted with Jim Rodebush on several occasions to coordinate the application of herbicides in a large test plot he is conducting on the DNR land as well as planting the food plots on the DNR land.

Coordinated the application of herbicides on the CRP conversion plots as well as that applied on the DNR land.

Served as a consultant at two meetings of the Prairie Lands Bio-Products, Inc. This group is making progress toward a business plan that is designed to purchase a pellet making system and put into operation a fuel pellet business.

Consulted with Joe Neat, Lucas Co. District Conservationist and John Frieden, Monroe Co. District Conservationist regarding the biomass project and the farmers that had indicated an interest in the project from their counties.

Presented a program to the Iowa Association for Energy Efficiency at the Des Moines Area Community College regarding the biomass project.

Secured and distributed switchgrass seed for the two CRP conversion projects as well as for the new seeding to be done at the DNR area.

Determined the area to be used for the nitrogen test plot area, consulted with Lee Burras to approve the site. Then harvested 52 large square bales for the site and moved them to the Millerton site for storage. This was done so the site could receive the N treatments. Four treatments with six replications were laid out on the site. Plots were laid out to cross as many soil map units on the landscape as possible.

Coordinated the selection of a site and the planting of the switchgrass variety in Appanoose county on a cooperator's farm.

Problems Encountered
The wet cool conditions in May slowed the growth of weeds as well as our switchgrass and delayed much of our herbicide application and seeding.

JUNE

The weather finally gave us a break in early June. Worked with the 130 acres of CRP cool season grasses to get them converted to switchgrass (SWG). This has turned into a two year project due to weather abnormalities. It is now complete and all 130 acres have been re-seeded to switchgrass.

We have successfully re-seeded 24 acres of old Blackwell SWG to cave-in-rock. This was accomplished by burning the areas in March and applying Round-up and Atrazine just prior to seeding with an interseeder.

Application of the nitrogen to the fertility plots located east of Derby was completed and the plants are showing a good response.

Attended the annual "Goose Feed" sponsored by the Chariton Valley RC&D. This was a good opportunity to consult with a number of people regarding the status of the Switchgrass to Biomass Project.

Consulted with the Prairie Lands Bio-Products Inc. group regarding the number of acres under agreement and other projected production numbers. Traveled with the group of producers to visit a plant in Minnesota that was making a 3.5 inch wide round log from sander dust, and then visited with the manufacturer of the machine that makes the log regarding the possibility of making a log from switchgrass. His response was positive. He is currently building a mobile model of his press and we are first on his list to have it demonstrated in our project area. This should take place in August or September. A log made from switchgrass appears to be very saleable at this time. The group also visited the corn stover densification plant located at Harlan, Iowa. These pellets are shipped to Omaha for processing into furfural, a chemical used in the process of making hard plastics. We left a sample of switchgrass to be tested for furfural content. We have received results that indicate that switchgrass has a furfural content equal to corn stover. The group will continue to explore possibilities of marketing opportunities.

Consulted with Mike White and Saqib Mukhtar regarding the possibility of setting up a trial to investigate the use of liquid swine manure in the production of switchgrass for biomass use. We will meet again in July to report on our individual findings regarding this issue.

Organized a Technical Field day designed to inform USDA and Extension staff regarding the current status of the project as well as to update them on various production techniques being used to increase switchgrass production. This program was requested by these groups. Attendance was not good. A follow-up program will be planned in each county later this summer--the switchgrass is now too tall to allow for good observation of establishment and production activities.

Coordinated a meeting with Marty Braster, Steve Barnhart, Monlin Kuo and Lee Burras regarding the status of 1) fiber and the switchgrass project 2) the status of the graduate student being brought on to conduct the fertility study and 3) the possibility of establishing a trial that would determine the feasibility of using various short term crops that could be harvested ahead of the active growing time of switchgrass and afford producers an income stream on the front end of the growing season.

QUARTERLY ACTIVITIES BY CHARLIE BRUMMER

Established two switchgrass studies to evaluate biomass yield and quality. Twenty cultivars and experimental populations were included. Two management treatments will be used on the plots in upcoming years: a fall harvest after a killing freeze and a spring harvest (e.g. March) after overwintering standing material.

The test sites:

McNay Research Farm, Lucas County: established 29 April 1997
- applied Atrazine for weed control in mid-May
- stands adequate to very good.

Don Clark Farm, Appanoose County: established 13 May 1997,
- applied Dual + Atrazine for weed control on 3 June 1997 killed stands entirely.
- radicles had emerged on some seedlings, but all killed
- test will be re-established in 1998

SWITCHGRASS PRODUCERS GROUP

The Producers Group met several times and took two field trips during this quarter. In May group members toured a plant in Harlan Iowa which densifies corn stover for a furfural plant in Omaha Nebraska. The densification plant is some 60 miles from the processing facility. The group was interested in the densification process as well as in the potential usage of switchgrass for furfural.

In June the Producer Group members went to a Minnesota sawdust densifying facility. The unit was manufactured and sold by Andy Lee from Prior Lake Minnesota. Mr. Lee has had experience densifying switchgrass into what he calls "briquettes". The facility which was visited, makes a "briquette about 4 inches in diameter and of varying lengths from waste sawdust. The briquettes are then sold to a local school for heating fuel. The group thinks that this may be an alternative option for switchgrass to fuel marketing. Mr. Lee has offered to allow us to use his first "mobile" unit after it is constructed.

GEOGRAPHICAL INFORMATION SYSTEMS

Continued creation and maintenance of map layers and database for cooperating land owners. Maps include boundaries of fields that will be used to produce switchgrass for the project and a series of interpretations including soil mapping units, land capability classes, and yield potential. The accompanying database includes land owner name, field acres, field location, and soil mapping units and interpretations. These maps and database have been used to help plan and conduct specific research activities related to soil quality and water quality impacts of large scale biomass production and genetic improvement of switchgrass as a biomass crop. Maps and database have also been used to help plan the management and harvest of switchgrass plantings for use during the project.

Continued evaluation of soil mapping unit characteristics in the four county project area for the purpose of identifying and grouping similar soils into "switchgrass management units." Soil characteristics being evaluated for the purpose of creating switchgrass management units include slope, landscape position, and capability class. Presently, like soil mapping units have been grouped into close to 70 potential switchgrass management units. Application of management units will facilitate assessment and recommendations related to productivity and environmental impact of large scale switchgrass plantings for biomass.

Wildlands for the Future Biomass Fields

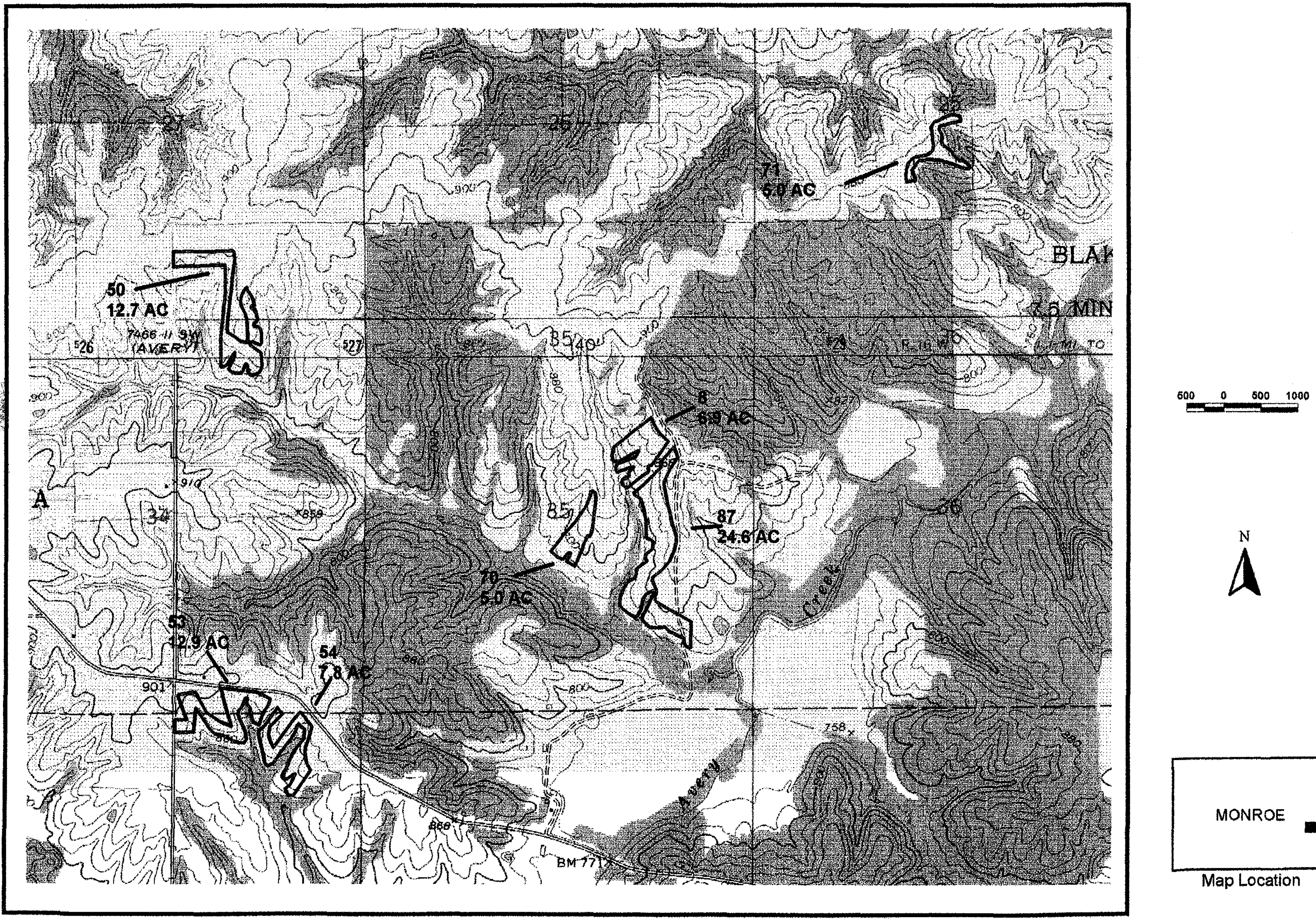
Field#	Producer's Name	Acres	County	Location	Crp Exp	Switchgrass	Yr Seeded
54	Wildlands for the Future	7.8	Monroe	T71 R16 Sec 3	1998	Yes	1997
87	Wildlands for the Future	24.6	Monroe	T72 R16 Sec 35	1998	Yes	1997
50	Wildlands for the Future	12.7	Monroe	T72 R16 Sec 27	1998	Yes	1997
71	Wildlands for the Future	5.0	Monroe	T72 R16 Sec 25	1998	Yes	1997
8	Wildlands for the Future	6.9	Monroe	T72 R16 Sec 35	1998	Yes	1997
70	Wildlands for the Future	5.0	Monroe	T72 R16 Sec 35	1998	Yes	1997
53	Wildlands for the Future	12.9	Monroe	T72 R16 Sec 34	1998	Yes	1997

Wildlands for the Future Soil Mapping Unit Characteristics

Soil Mapping Unit	Field #	Land Capability Class	Tall Introduced Grasses Yield	Approx Acres
132C	54	3E	4.1	1.5
65D	54	4E	4.1	3.4
65E	54	6E	3.4	1.5
13B	54	2W	5.4	0.1
65G	54	7E	2.8	1.6
132C	53	3E	4.1	0.7
131B	53	3E	4.9	0.3
423D2	53	4E	2.6	0.9
65E	53	6E	3.4	1.4
65D	53	4E	4.1	1.5
65D	53	4E	4.1	0.6
65D	53	4E	4.1	0.9
65E	53	6E	3.4	2.0
131B	53	3E	4.9	0.6
423D2	53	4E	2.6	0.3
65D	53	4E	4.1	1.7
65G	53	7E	2.8	0.6
13B	53	2W	5.4	0.1
131C	87	3E	4.7	2.0
423D2	87	4E	2.6	0.3
13B	87	2W	5.4	0.2
65E2	87	6E	3.3	0.1
424E2	87	6E	2.5	6.6
452C	87	3E	3.8	4.8
594D2	87	4E	2.1	5.2

Soil Mapping Unit	Field #	Land Capability Class	Tall Introduced Grasses Yield	Approx Acres			
58E2	87	6E	2.3	1.6			
594C2	87	3E	2.5	0.2			
731C2	50	3E	4.4	1.4			
131B	50	3E	4.9	0.2			
223D2	50	4E	2.5	1.8			
223D2	50	4E	2.5	0.4			
131C	50	3E	4.7	1.6			
993D2	50	4E	3.6	1.0			
179E2	50	6E	3.6	2.9			
792D2	50	4E	2.6	1.6			
179F2	50	7E	3.2	0.0			
792D2	50	4E	2.6	2.5			
65G	71	7E	2.8	0.1			
132C	71	3E	4.1	0.7			
65G	71	7E	2.8	0.4			
132B	71	3E	4.3	0.6			
732C2	71	3E	3.8	2.6			
131C	8	3E	4.7	1.8			
423D2	8	4E	2.6	2.5			
13B	8	2W	5.4	1.5			
65E2	8	6E	3.3	2.5			
131C	70	3E	4.7	0.7			
425D	70	4E	2.7	1.7			
65E	70	6E	3.4	3.1			

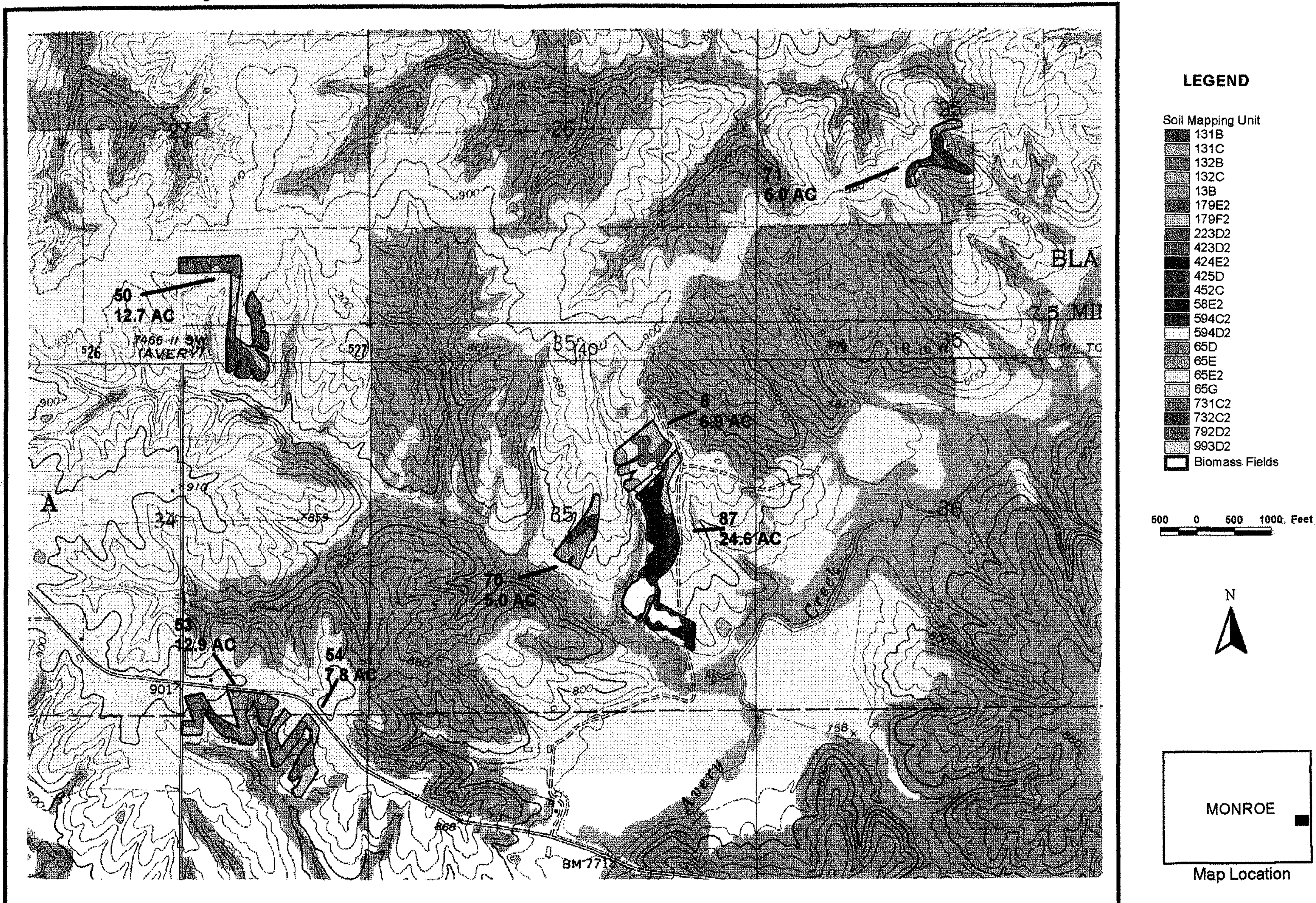
Field Numbers -- Biomass Project (Wildlands for the Future -- Participant)
Monroe County, Iowa (T72N R16W Sec. 25,27,34,35) (T71N R16W Sec. 3)



Wildlands for the Future Biomass Fields

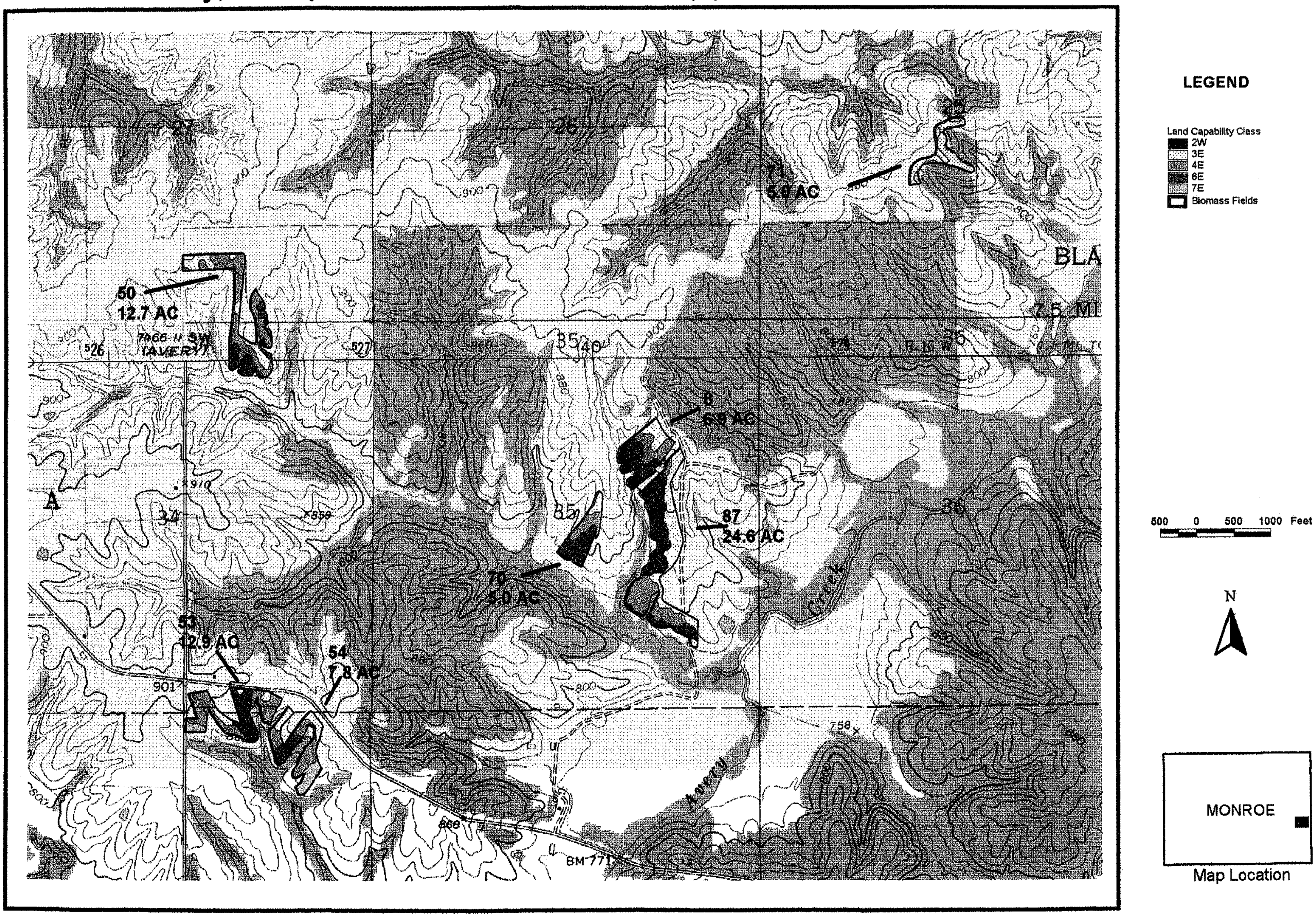
Source: USDA Natural Resources Conservation Service
USGS Digital Raster Graphics, Olmitz, Iowa 7.5 Minute Quadrangle

Soil Mapping Units -- Biomass Project (Wildlands for the Future -- Participant)
Monroe County, Iowa (T72N R16W Sec. 25,27,34,35) (T71N R16W Sec. 3)



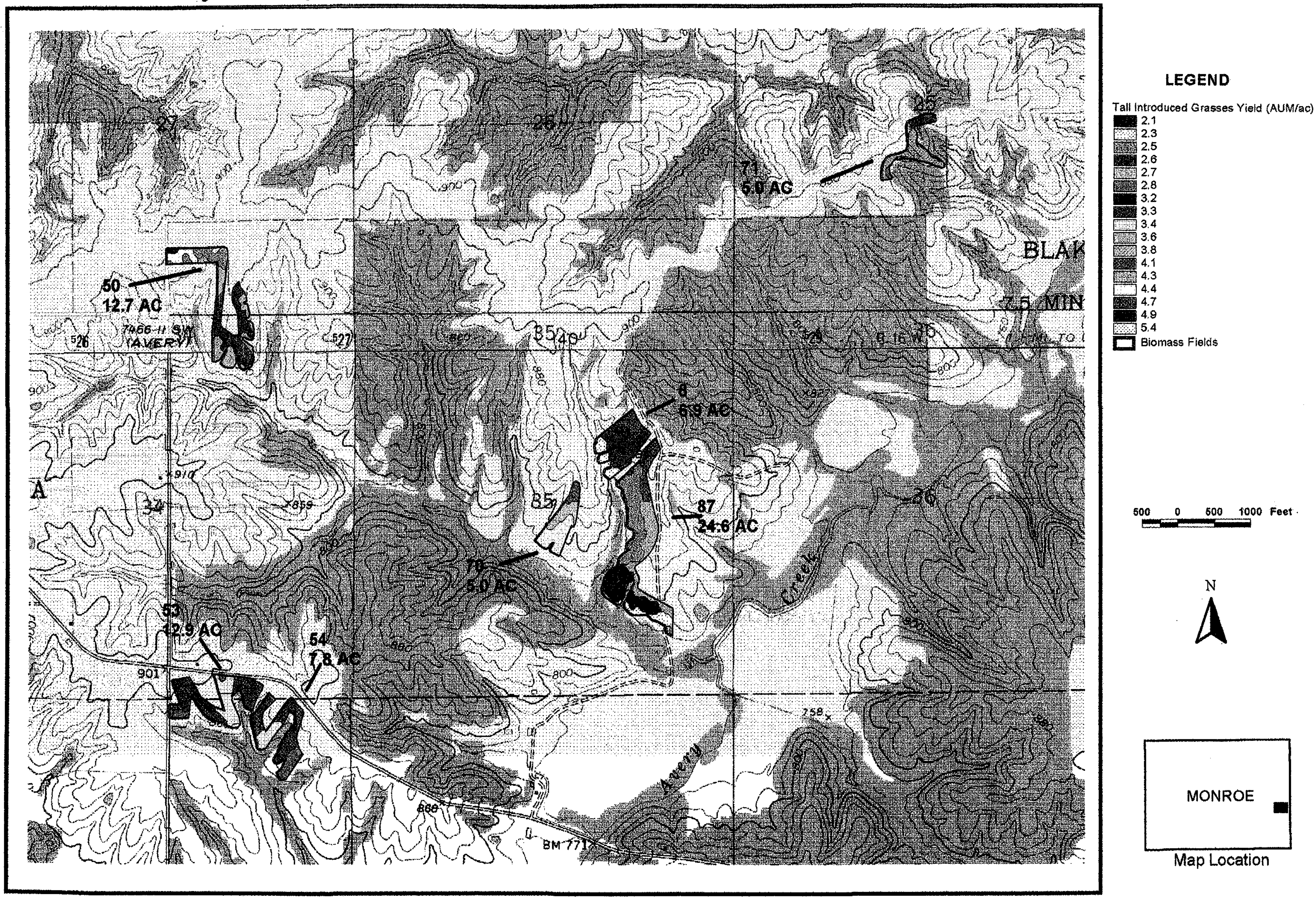
Source: USDA Natural Resources Conservation Service
USGS Digital Raster Graphics, Olmitz, Iowa 7.5 Minute Quadrangle
Iowa Cooperative Soil Survey Data

Land Capability Class -- Biomass Project (Wildlands for the Future -- Participant)
Monroe County, Iowa (T72N R16W Sec. 25,27,34,35) (T71N R16W Sec. 3)



Source: USDA Natural Resources Conservation Service
USGS Digital Raster Graphics, Olmitz, Iowa 7.5 Minute Quadrangle
Iowa Cooperative Soil Survey Data

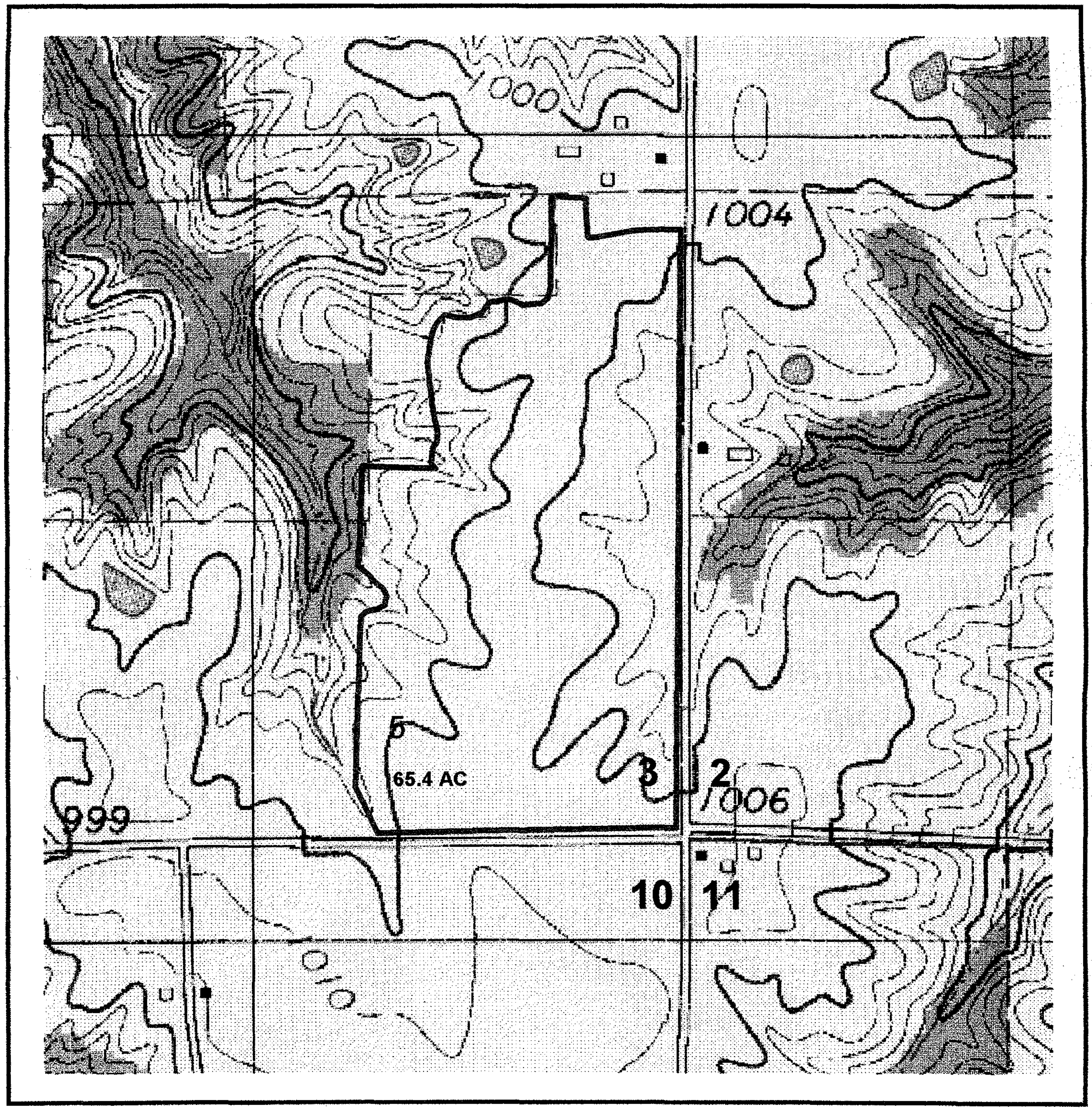
Tall Introduced Grasses Yield -- Biomass Project (Wildlands for the Future -- Participant)
Monroe County, Iowa (T72N R16W Sec. 25,27,34,35) (T71N R16W Sec. 3)



Source: USDA Natural Resources Conservation Service
USGS Digital Raster Graphics, Olmitz, Iowa 7.5 Minute Quadrangle
Iowa Cooperative Soil Survey Data

James Wright Biomass Field							
Field #	**Producer's Name**	**Acres**	**County**	**Location**	**Crp Exp**	**Switchgrass**	**Yr Seeded**
5	James Wright	65.4	Lucas	T72 R20 Sec 3	2006	Yes	1997
James Wright Soil Mapping Unit Characteristics							
Soil Mapping Unit	**Land Capability Class**	**Tall Introduced Grasses Yield**	**Approx Acres**				
131C2	3E	4.4	3.1				
65G2	7E	2.7	0.1				
131B	3E	4.9	5.5				
131C2	3E	4.4	17.2				
364B	2E	5.5	15.1				
423D2	4E	2.6	0.2				
423D2	4E	2.6	2.8				
23C2	3E	5	4.1				
792D2	4E	2.6	3.1				
222C2	4W	3	2.8				
23C	3E	5.2	8.2				
423D2	4E	2.6	0.9				
131B	3E	4.9	0.4				
223C2	4W	2.6	1				

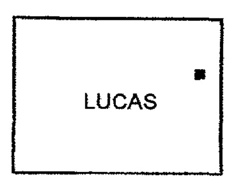
Field Number -- Biomass Project (James Wright -- Participant)
Lucas County, Iowa (T72N R20W Sec. 3)



James Wright Biomass Field

N

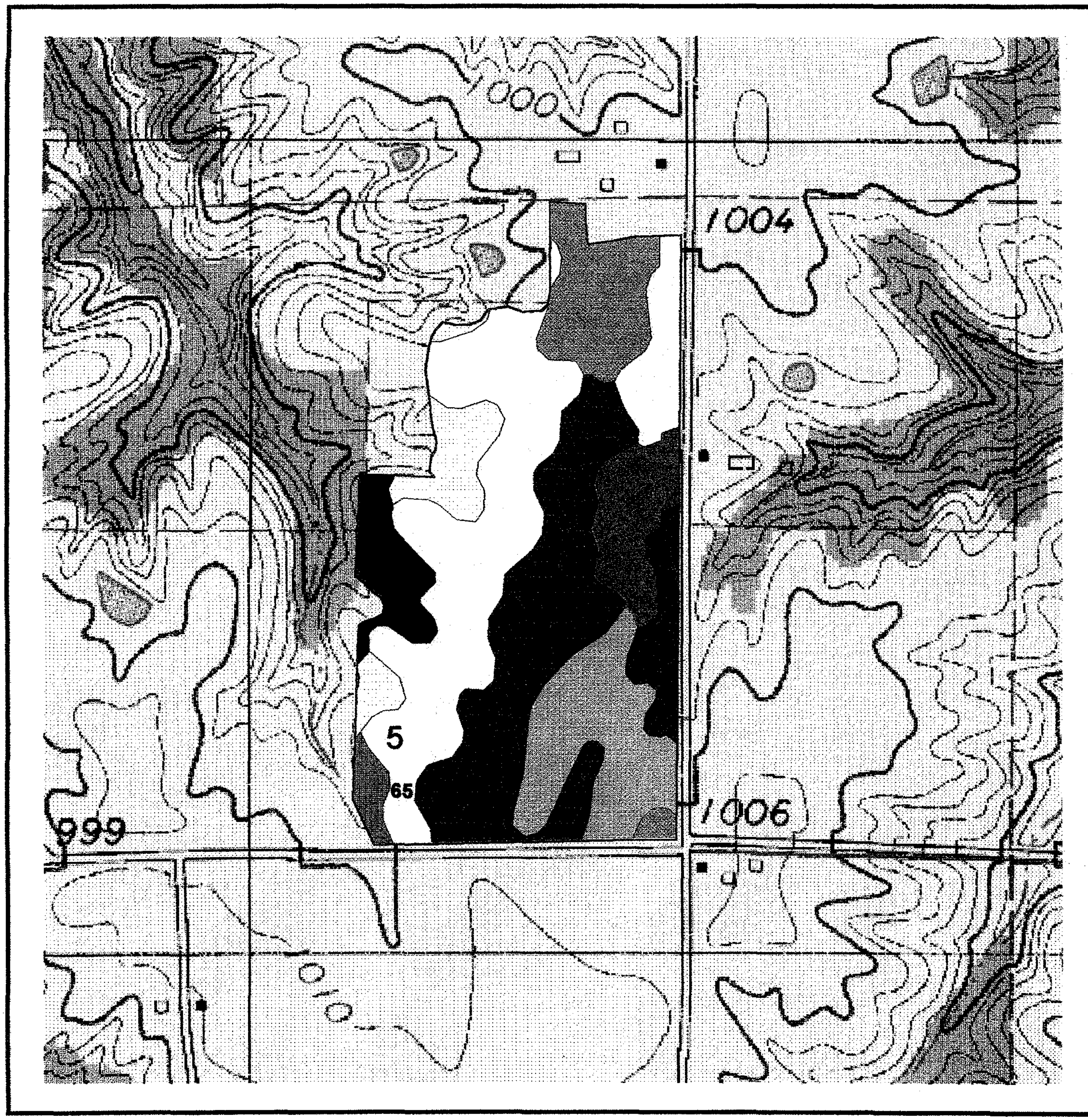
500 0 500 Feet



Map Location

Source: USDA Natural Resources Conservation Service
USGS Digital Raster Graphics, Olmitz, Iowa 7.5 Minute Quadrangle

Soil Mapping Units -- Biomass Project (James Wright -- Participant)
Lucas County, Iowa (T72N R20W Sec. 3)



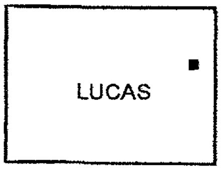
LEGEND

James Wright Biomass Field Boundary

Soil Mapping Units
- 131B
- 131C2
- 222C2
- 223C2
- 23C
- 23C2
- 364B
- 423D2
- 65G2
- 792D2

N

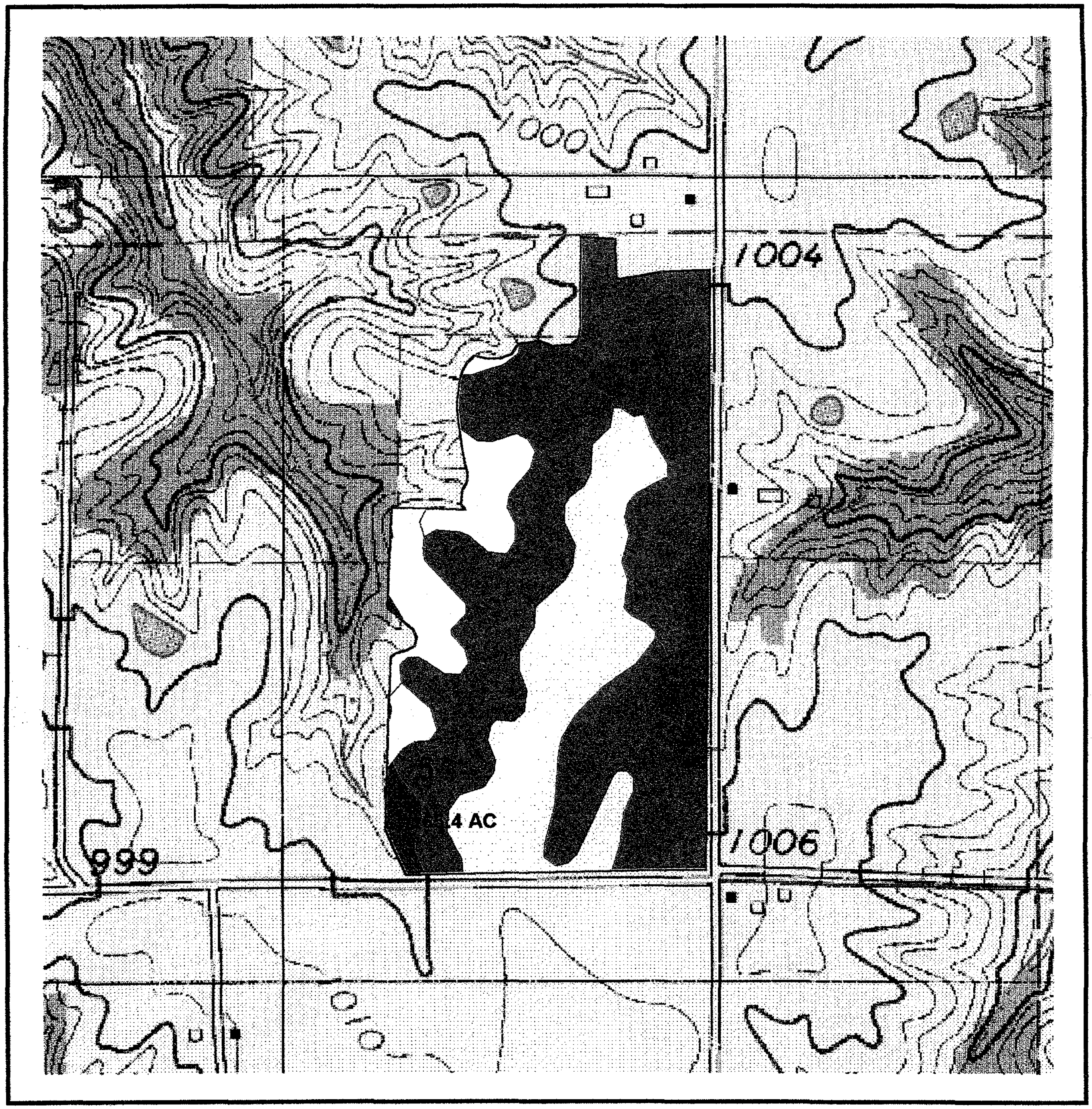
500 0 500 Feet



Map Location

Source: USDA Natural Resources Conservation Service
USGS Digital Raster Graphics, Olmitz, Iowa 7.5 Minute Quadrangle
Iowa Cooperative Soil Survey

Land Capability Class -- Biomass Project (James Wright -- Participant)
Lucas County, Iowa (T72N R20W Sec. 3)



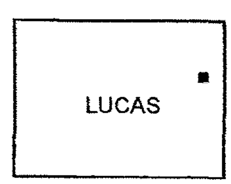
LEGEND

- James Wright Biomass Field Boundary

Land Capability Class
- 2E
- 3E
- 4E
- 4W
- 7E

N

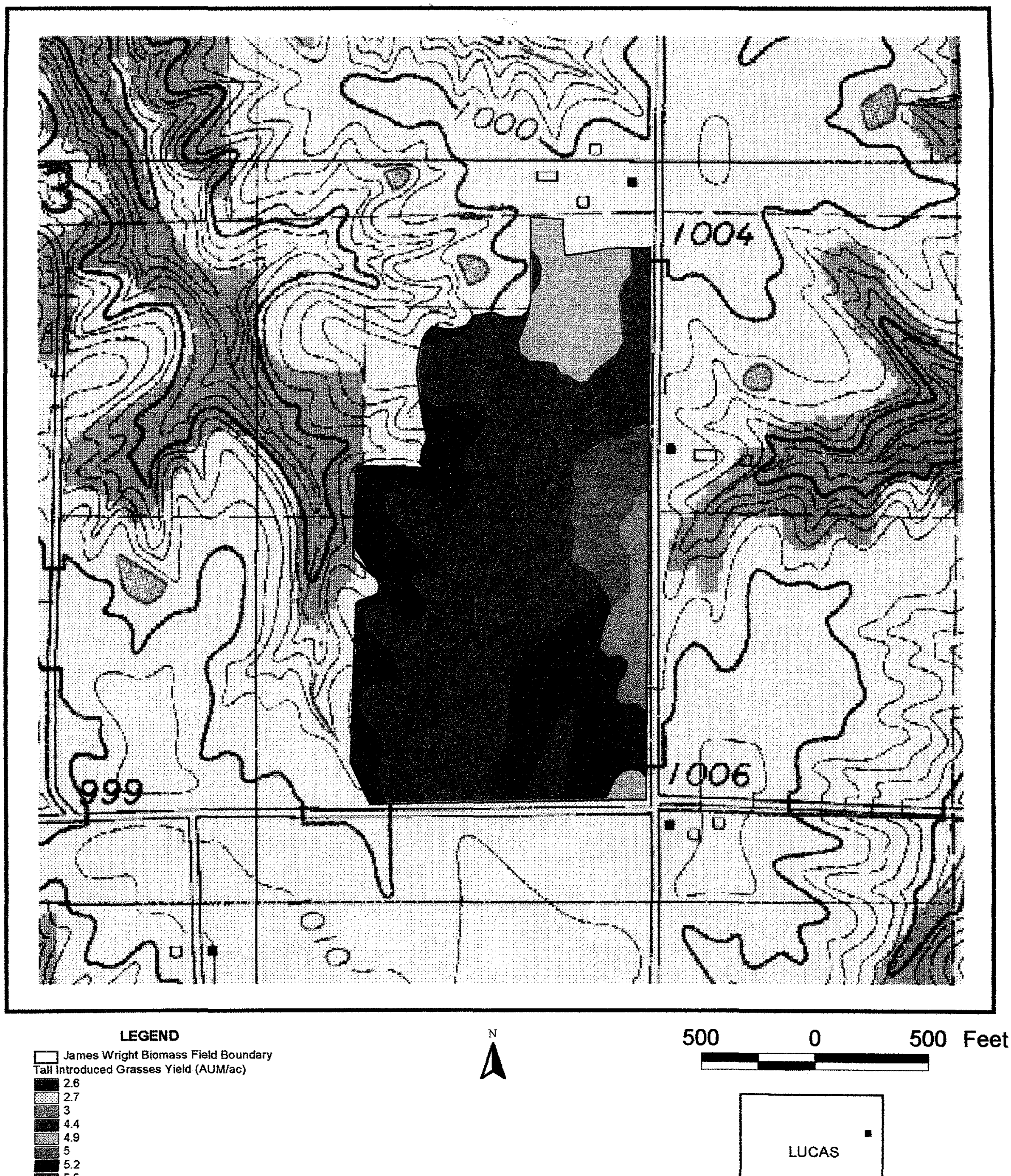
500 0 500 Feet



Map Location

Source: USDA Natural Resources Conservation Service
USGS Digital Raster Graphics, Olmitz, Iowa 7.5 Minute Quadrangle
Iowa Cooperative Soil Survey

Tall Introduced Grasses -- Biomass Project (James Wright -- Participant)
Lucas County, Iowa (T72N R20W Sec. 3)



Source: USDA Natural Resources Conservation Service
USGS Digital Raster Graphics, Olmitz, Iowa 7.5 Minute Quadrangle
Iowa Cooperative Soil Survey