

BIOMASS POWER FOR RURAL DEVELOPMENT

TECHNICAL PROGRESS REPORT

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Burlington Electric Department (BED)
General Public Utilities (GPU)
Ontario Hydro Technologies (OHT)

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Cornell University College of Agriculture & Life Sciences
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New York Gas Group (NYGAS)
South Central New York RC&D
New York State Energy Research and Development Authority (NYSERDA)
Gas Research Institute (GRI)

August 1997

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1.0 INTRODUCTION

Developing commercial energy crops for power generation by the year 2000 is the focus of the DOE/USDA sponsored Biomass Power for Rural Development project. The New York based Salix Consortium project is a multi-partner endeavor, implemented in three stages. Phase-I, Final Design and Project Development, will conclude with the preparation of construction and/or operating permits, feedstock production plans, and contracts ready for signature. Field trials of willow (Salix) have been initiated at several locations in New York (Tully, Lockport, King Ferry, La Fayette, Massena, and Himrod) and co-firing tests are underway at Greenidge Station (NYSEG) and Dunkirk Station (NMPC). Phase-II of the project will focus on scale-up of willow crop acreage, construction of co-firing facilities at Dunkirk Station (NMPC), and final modifications for Greenidge Station. Cofiring willow is also under consideration for GPU's Seward Station where testing is under way. There will be an evaluation of the energy crop as part of the gasification trials occurring at BED's McNeill power station. Phase-III will represent full-scale commercialization of the energy crop and power generation on a sustainable basis.

Willow has been selected as the energy crop of choice for many reasons. Willow is well suited to the climate of the Northeastern United States, and initial field trials have demonstrated that the yields required for the success of the project are obtainable. Like other energy crops, willow has rural development benefits and could serve to diversify local crop production, provide new sources of income for participating growers, and create new jobs. Willow could be used to put a large base of idle acreage back into crop production. Additionally, the willow coppicing system integrates well with current farm operations and utilizes agricultural practices that are already familiar to farmers.

There are potential environmental benefits associated with willow production. Willow crops can provide soil and water resource conservation benefits and are being evaluated as riparian buffer strips to protect watersheds. Willow may also be useful for bioremediation of contaminated sites and for beneficial uses of various organic waste streams. The Consortium is investigating the possibility of demonstrating these benefits.

For this project, willow will be grown on local acreage - within approximately 50 miles of the power stations. The willow will be harvested and delivered to either the power plant or a storage site. At the power plant, the willow will be further processed ensuring proper moisture content and sizing for firing in the power plant's boilers. Years of feedstock field testing and research by SUNY ESF and more recently co-firing tests and analysis at Greenidge Station are expected to reduce the learning required to optimize these processes in scale-up efforts. In addition, efforts are underway to increase the yields of U.S. clones through the native clone research and development project. The investigation of these advancements are part of the goals of this project and other allied projects with SUNY ESF.

For power generation, the project will utilize commercially available equipment for co-firing dedicated feedstocks in pulverized coal boilers. An experimental project to test biomass reburn

systems for NO_x control is in the planning stages. Power generated by co-firing coal and willow offers a variety of incentives to the utilities, growers, and local economies. Co-firing biomass at existing coal-powered facilities is being considered as a technically feasible and economical strategy for SO₂ and NO_x emission reductions mandated by the Clean Air Act Amendments. Because of its low sulfur content, co-firing biomass feedstocks can improve the emission characteristics of coal-fired plants and allow generators to earn emission allowances. When used on a sustainable basis, biomass is also a near zero generator of CO₂. Therefore, substituting biomass for coal can also reduce CO₂ emissions. Although reducing greenhouse gases is being pursued by utilities on a voluntary basis, these reductions can be "banked," allowing power generators to hedge against future mandates regarding emission levels.

While co-firing is the Salix project's initial technology choice to build a biomass power infrastructure, the participation of Burlington Electric in the Consortium is providing an avenue to test the energy crop in a prototype of future high-efficiency conversion technology. Burlington's biomass gasification repowering demonstration is the first step toward an integrated gasification combined cycle power generation system. Initial plans in Burlington are to test the use of product gas in the power plant's existing boiler. Later, the product gas is expected to be used to power a combustion turbine.

1.1 Project Tasks

The specific tasks for Phase-I are as follows:

- Development of cost estimates, construction documents and site plans necessary to convert Greenidge and Dunkirk power stations to co-fire biomass fuels. Application for required environmental permits will also be completed during this phase.
- Development of detailed fuel supply plans for Greenidge and Dunkirk outlining the quantity and source of fuels to be used as feedstock. For the willow portion of the fuel supply, this would include drafting contracts, binding letters of intent, or purchase orders necessary to obtain feedstock.
- Further investigation into willow production issues such as the organization of future enterprises, cuttings sales, fuel delivery to the power plants, and ways to reduce planting, harvesting, processing, storage, and delivery costs.
- This phase will also see the expansion of willow field trials, initiation of comparative site preparation and comparative soil amendment and fertilizer studies, characterization of willow resistance to insects, and a riparian benefits analysis. The Consortium is integrating our USDA and DOE program efforts in these areas to assure the success of the demonstration.
- The members of the development team will also be seeking product, and process

guarantees from equipment manufacturers. Additional effort will be directed to evaluating possible project risk sharing strategies and their impact on the team members as willow energy crops approach commercialization.

- Outreach is a vital element of the program. The Consortium continues to seek new partners in both the agricultural and power sectors.

1.2 Revised Schedule of Deliverables

Deliverable	Original Due Date	Revised Delivery Date
<u>Design Reports</u>		
Greenidge -	February 1997	August 1997
Dunkirk -	July 1997	October 1997
<u>Fuel Supply & Site Development Plans</u>		
Greenidge -	January 1997	August 1997
Dunkirk -	July 1997	October 1997
<u>Risk Management Report</u> -	July 1997	August 1997
<u>Optimization and Experimental Plan</u> -	July 1997	August 1997

2.0 PROGRESS SUMMARY

During the second quarter of 1997, effort has focused on continued feedstock development, fuel supply planning, and fuel contract development. A few of the more important milestones are outlined below. Activity in the third quarter is expected to increase in preparation for the 1998 spring plantings and the Phase-II effort. Additionally, a number of contract deliverables should be finalized.

Fuel Supply Development

- Draft Fuel Supply Plan for Greenidge Power Station is prepared and undergoing review. Acreage is a combination of utility and private acreage supplemented with residue sources that NYSEG has been developing for several years.
- Two willow research plantings and a demonstration area were planted near Lafayette, New York.
- A willow demonstration planting occurred in cooperation with Wegman's Egg Farm near Wolcott, NY.

- The Frobbesta planter, modified by Cornell University, was tested at several locations including Wolcott, NY.
- SUNY ESF and SoCNY RC&D Staff continued to review soil maps of the areas around Dunkirk and Greenidge. Nine different farms have been identified as good targets for the demonstration. A list of landowners and acreage currently being considered can be found in the exhibit.

Power Conversion Technology Development

- NYSEG performed a test of biomass handling equipment at Greenidge using several tons of willow. The tests highlighted some deficiency in the existing equipment's ability to process the material effectively. In response to dust control and processing concerns, additional equipment was added to the system.
- GPU performed several co-firing tests in June. Co-firing rates of up to 10% by heat input were obtained. Additional tests may occur early in the fourth quarter.

3.0 DETAILED TASK PROGRESS REPORTS

3.1 Task 1. Design Packages

NYSEG continues to evaluate potential improvements in the retrofit design for Greenidge Station. Testing and tuning of the system is providing the experience needed by NYSEG production staff to make further refinements. Cost estimates for additional storage and handling capacity have been prepared and are being evaluated.

NMPC's engineering staff have made significant headway in preparing Dunkirk for co-fire tests in the third quarter. An injection nozzle for biomass has been procured and will be installed in upcoming months. The staff is in the process of designing the layout for the test system and the first co-firing using ready to burn feedstock will take place early in the fourth quarter. Preliminary designs for scaled-up storage, handling and transport systems have also been completed.

Design Packages Statement of Work

An engineering design package, environmental permits, cost estimate and construction documents, sufficiently detailed to proceed in Phase 2 with construction/operation, will be prepared. The elements of the package will be used to meet the following requirements for the Greenidge and Dunkirk projects:

- ▶ utility financial approvals for investment in facilities modifications
- ▶ permits for construction/operation
- ▶ construction bid packages and internal work orders

Conceptual designs will also be prepared for 2 to 3 additional projects (U.S. Generating,* GPU, and Burlington Electric). These projects are in the wider region represented by the Consortium partners. They will be in the development evaluation phases as Greenidge and Dunkirk Stations take the lead in commercial scale-up.

*Since the preparation of the original proposal U.S. Generating has discontinued its membership in the Consortium

Under a separate contract BED is nearing completion of its gasification facilities and tests of the gasifier are expected to occur in October.

In June, General Public Utilities (GPU) completed five co-firing tests. Separate injection ports were used to combust one hundred and fifty tons of sawdust in unit 12 at Seward Station. Co-firing rates of 10% by heat input were obtained. Emission and boiler performance tests were successful. As a result of the testing, GPU engineering staff will recommend a 5% co-firing rate when using composted sawdust.

3.2 Task 2. Fuel Supply and Site Development Plans

All of the landowners present at the initial willow biomass information meetings held during March of 1995 and who signed a letter of intent to grow willow biomass crops, were re-contacted by SUNY ESF in April of 1997. Eight individuals from this group, representing almost 600 acres, have been targeted for follow-up and are providing additional information about their land. Additional landowners are responding to the survey sent out in the biomass newsletter. Each parcel of land will be assessed for its suitability for willow biomass crops.

During this period, the Consortium held discussions with the Stoud Water Research Center in Avondale, PA on the use of willows in riparian zones. The meetings resulted in the planting of about 100 cuttings in mid April as part of the Research Center's ongoing trials of species in riparian zones. About 1,000 cuttings were shared with another researcher at SUNY ESF to examine the potential for using willow to re-vegetate mine spoils.

The effort to identify landowners who will cooperate with the consortium during phase two of the Biomass Power for Rural Development Program continued. SoCNY RC&D and SUNY ESF staff continued to use county soil maps to identify potential acreage. Nine different farms near the Greenidge and Dunkirk power plants have been targeted in this manner. One site visit was

Fuel Supply and Site Development Plans Statement of Work

A fuel supply plan will be prepared, including contracts or binding letters of intent, which provide the terms and conditions for firm costs and supply quantities of fuel for the project. The plan will also detail the responsibilities and associated costs including land preparation, planting, harvesting, processing, storing and delivery to the generating station. Contingency plans will be prepared for fuel shortages and for conversion of energy crop acreage if the business fails to materialize as planned at the end of the demonstration period. As part of this planning task two acre field trials providing region specific data to select hybrids and guide plantings will be initiated. This is necessary to ensure that the information required for crop scale up scheduled for Phase 2 is available at the earliest possible date.

Activities at the field trial sites will include site selection, preparation, planting, intermediate treatments, monitoring and harvesting. Sites will be selected to include soil types representative of those available for commercial biomass crops. Tasks will include soil sampling, fall site preparation and layout, spring planting of multiple clones in randomized-block design (double-row system of 6200-7200 trees per acre), 1st-year winter cutback (to promote multiple stem coppice), 3 years of growth (monitored for productivity & pests), and winter biomass harvest (end of year 4). Planting and harvesting of measurement plots will generally be done by hand, but, mechanized operations will be used to plant and harvest border rows whenever possible. This work will be conducted by SUNY-ESF with matching support from Consortium power companies.

made to a farm in Stueben county, but this site was determined too brushy and wet for use in the initial scale up. However, several important lessons were learned from this visit and the screening procedure for identifying landowners was revised. Arranging site visits with farmers has become difficult because many producers are busy with field work. As winter approaches the number of meetings with potential cooperators is expected to increase.

A draft fuel supply plan was prepared by SUNY ESF for NYSEG. The report is undergoing internal review and should be available late in the third quarter.

3.3 Task 3. Major Equipment Guarantees and Project Risk Sharing

On going discussions are being held among the partners to establish the base line for the agreements for Phase II.

3.4 Task 4. Power Production Commitment

NYSEG has already begun producing power at the 5% to 10% cofiring level using residue supplies. In effect, its commitment to power generation from biomass has already been demonstrated. However, as part of the Phase II proposal to DOE, NYSEG will prepare a letter of commitment to continue co-firing of biomass including feedstock produced at the willow farms for the duration of the program. NMPC will not co-fire on a continuous basis until Phase II, but a letter of commitment similar to the letter from NYSEG will be included in the Phase II proposal.

Power Production Commitment Statement of Work

NYSEG will provide a letter stating its intention to co-fire biomass at Greenidge throughout the Phase 2 Demonstration Period. NMPC will provide a similar letter of intent for co-firing at Dunkirk.

3.5 Task 5. Power Plant Site Plan, Construction & Environmental Permits Report

Site plans for the co-firing retrofit of Greenidge were prepared by NYSEG and will be revised pending location of the day bin and expanded yard area for receiving biomass fuel supplies. Environmental permits for co-firing biomass at Greenidge are already in place. Emissions monitoring has already begun with the test program and preliminary air emissions results are available. SO₂ reduction have been quantified and NO_x reductions have been measured under certain feedstock and firing conditions. A report is being prepared with the Electric Power Research Institute (EPRI) that

Power Plant Site Plan, Construction and Environmental Permits Report Statement of Work

Site plans for the Greenidge and Dunkirk Stations showing the location of existing and proposed facilities will be provided. An area map will indicate the routes to be used for fuel supply deliveries. A general arrangement of the facility including the footprint and elevations will be provided. The plans will also include a discussion of permit modifications obtained as well as traffic impact studies performed for the increase in road use by fuel supply trucks. A plan for environmental baseline monitoring and project monitoring following construction will be provided. Copies of permit modifications obtained or correspondence from the permitting agencies indicating the likelihood of success of obtaining outstanding construction permits for the project will be included.

will characterize the performance of the biomass fuel ramp-up tests.

A decision about permanent facilities for GPU is not likely to be in Phase I. GPU will need more time to evaluate the long term fuel supply situation and the perform tests with the system at Seward.

The Greenidge test system is fully operational on a single shift basis and there are no outstanding permit issues. NMPC has begun to evaluate potential issues for permitting a cofiring project at the Dunkirk site including potential impacts on its ash sales.

3.6 Task 6. Experimental Strategies for System Evaluation

Two willow research plantings and a demonstration area were planted on a private landowner's property near Lafayette, NY in May. A clone-site trial containing 14 willow and two hybrid poplar clones was planted by hand using the Swedish double-row spacing. The experimental design was a randomized complete block with four replications. Each experimental plot contains 156 trees of one clone three double-rows. The final treatment steps for a site preparation study located at the same site were also completed. One willow clone (SV1) and one poplar clone (NM6) were planted in the study. Seventy-five percent of the plots were hand planted, while the remaining 25% were machine planted. A demonstration area, approximately 1 hectare in size, containing four willow clones and one hybrid poplar clone was machine planted using Swedish double-row spacing. Trees were planted in a randomized complete block design with three replications. Each experimental plot contains approximately 1,100 trees of one clone in four double-rows. All appropriate areas were disked prior to planting and pre-emergent herbicide was applied at the 1.12 kg ha⁻¹ rate within one week of planting.

A willow demonstration planting was begun in cooperation with Wegman's Egg Farm near Wolcott, NY in May. Four willow and two hybrid poplar clones were machine planted using Swedish double-row spacing. Plot sizes varied from approximately 200 by 10.5 m (5 double-rows, 3,250 trees) to 200 by 15m (7 double-rows, 4550 trees). A clone-site trial was also established adjacent to the demonstration planting. Eleven willow clones and two hybrid poplar clones were planted in a randomized complete block design, and each experimental unit was approximately 18 by 6 m (3 double-rows), 180 trees. Site preparation included: plowing and disk during the fall of 1996, glyphosate application to kill weeds that grew in spring 1997, followed by disk shortly before planting. Pre-emergent herbicide (simazine) was applied to the site at a rate of 2.24 kg ai ha⁻¹ after planting. The site was extremely rocky. This situation

Experimental Strategies for System Evaluation Statement of Work

A plan will be prepared for experimental strategies and designs to optimize and evaluate crop production and power production. The power production studies will be carried out at Greenidge and Dunkirk. A central site for core energy crop studies will be employed to monitor and evaluate crop nutrient cycling, crop and pest management techniques, and biodiversity impacts.

must be resolved in preparation for machine harvesting in year 2000.

The King Ferry willow planting established at King Ferry, NY in cooperation with NYSEG, was treated with pre-emergent herbicide at a rate of 2.24 kg ha⁻¹ in early May. This treatment was necessary because the initial growth for some clones was poor and weed competition was expected to become a problem without tree canopy closure. Ammonium nitrate fertilizer was applied in the irrigation and spacing/cutting cycle studies at Tully at the 37 kg ha⁻¹ rate (33 lbs ac⁻¹). Five more nitrogen applications will be made during the growing season for a season total of 224 kg ha⁻¹ (200 lbs ac⁻¹).

Survival of clones was measured on June 20th in the Tully genetic selection trail. The average survival was 83.5% and the median was 95.8%. In plots with less than 65% survival, cuttings were replaced with fresh ones. Physiological variables were studied intensively in 10 of the 40 clones. The numbers of stems and leaves per tree on a subset of trees in every plot were measured on June 30th. Leaf area measurements will be completed the first week of July.

Progress continued on the biosolids application research in the willow bioenergy demonstration planting at Tully, NY, and in a greenhouse study. In the greenhouse study, root biomass production of pot-grown willows was estimated. Ion exchange resin columns were removed from pots receiving various biosolids applications and nitrate and ammonium concentrations in the columns will be determined. Ion exchange resin columns were installed in the Tully demonstration planting for monitoring nitrate leaching. Temperature loggers were reinstalled at Tully for monitoring conditions for organic matter decomposition. Nutrient analyses of root, stem, and leaf biomass samples from the greenhouse and the field experiments are being completed.

The Burlington willow field trial was planted in May following extensive site preparation. Mechanical weed control efforts are ongoing and have been successful. Pest monitoring shows several expected insects and selective browsing by deer.

A number of feedstock development studies reached completion in the first and second quarter. These include:

- Completed study on the impacts on soil properties nutrient return via litter fall (this is one of the benefits of fall/winter harvesting) and harvesting over seven years. There was no detectable impact on soil properties over this seven year period suggesting that the system is sustainable.
- A study is being completed on wood ash as a soil amendment in willow biomass crops. The goal was to determine the feasibility of reducing a possible waste product of wood burning by recycling it as a soil amendment to help ameliorate negative soil impacts of intensive harvests. No leaching of any nutrient from the ash was detected. There were no

significant differences in biomass production between applications of various ash rates or the control.

- Baseline data were collected in the fall of 1996 as part of a study to determine the impact of willow biomass crops on soil biodiversity. Because of high levels of density, diversity, and ecological significance, soil micro arthropods are perfectly suited as indicator organisms for monitoring sustainability of willow biomass crops. Changes in their densities and community structure will be studied over a five year period.

Several new studies being initiated and planned include:

- A study has been initiated to determine the impact of various pests on willow biomass crops. Different deployment patterns for clones of different resistance is also a part of this effort. The results will be an integral part of designing an integrated pest management strategy for willow biomass crops. This approach will reduce pesticide use.
- A cooperative study with the Department of Soils, Crops, and Atmospheric Sciences at Cornell University has been established to examine the effectiveness of willow biomass crops in filter strips to control nutrient runoff from farm fields.
- A study is being designed, and will be initiated in the summer of 1997, to examine, over the next 10 years, the extent of carbon sequestration in the soil in which willow biomass crops are planted.
- A study to look at alternatives to the current fall, full tillage site preparation method for willow biomass crops was designed and initiated. Alternatives include no-till, strip-till, use of cover crops, and spring full tillage preparation. This study addresses concerns raised by project cooperators about soil erosion during the establishment period for willow biomass crops and harvest loses from other crops due to site preparation starting the previous summer.

In April, the irrigation system at Tully was renovated to provide greater irrigation capacity. Larger pipes were installed and re-routed. Cutting orchards, the irrigation study, and the spacing/cutting cycle study will be initiated during 1997.

The Frobbesta planter that was modified by Cornell University engineers over the winter worked quite well in a variety of soils, including the extremely stony Wolcott site. However, after planting about 3 ha the wheels in the feed mechanism began to heat up and deteriorate. The heating was a result of the feed roll rubbing on the edge of the case mounting and the flexing and expanding of the roll disks, due to the centrifugal force, against the roll frame. The vibration was a result of the uneven drive roll disk rotating against the idler roll feed mechanism. Additional modifications will need to be made to the machine in order to successfully plant larger areas.

Three additional test areas using the modified planter were: Lafayette, NY (8 acres); Wegman's egg farm, Wolcott, NY (7 acres); NYS Department of Environmental Conservation Saratoga Tree Nursery, Saratoga, NY (1 Acre).

Data has been collected by SUNY ESF for the comparison of machine versus hand planted trees establishment and growth of willows and poplars. Results will be reported at a later date after analysis.

Weekly assessments of avian biodiversity were started in the spring of 1997 at two sites where willow plantings are already established. Field surveys were done by staff at the Laboratory of Ornithology at Cornell University.

3.7 Outreach, Extension, & Technology Transfer

Numerous outreach, extension, and technology transfer events have also occurred during the second quarter. A highlight of these events has been provided below. Presentation materials, and newspaper articles have been included in the appendices.

The first issue of Willow Biomass News was completed and sent out in April, by SUNY ESF, to almost 400 individuals and organizations. The newsletter included a brief questionnaire for landowners and producers to fill out if they are interested in participating in the scale up program under Phase II of the Biomass Power for Rural Development program. Two different groups of landowners are sought. One is producers who are interested in actively growing willow biomass crops. The second group is landowners who are interested in leasing land to the Salix Consortium for production of willow biomass. This questionnaire is being used as a screening tool for identifying additional suitable land and potential producers for the program.

A display was set up as part of Earth Day celebrations in April for the Syracuse community on the SUNY ESF campus. Packages of information were sent out to the New York State Department of Environmental Conservation in St. Lawrence County for display and distribution at the alternative energy fair in Canton, NY.

On April 16th, at Clinton High School in central New York, two presentations were given to seventh and eighth grade students as part of their earth month celebrations. The students were very interested in learning about how to grow willow biomass crops and the associated environmental benefits. Also on April 16th, A group of about 35 high school students came to visit the field plots in Tully, NY.

During April, staff from SUNY ESF met with other project cooperators and staff from the USDOE in Burlington, VT for the semi-annual update meeting. Some very beneficial ideas came out of the meetings as well as a substantial list of items that need to be brought to a close in the next few months.

In May, discussions were held with organizers of the Empire Farm Days and the farmers who own the land where the event is held. The purpose of the meeting was to locate an appropriate site for a demonstration planting. Several sites were identified but it was decided that planting should wait until the spring of 1998 to ensure that site preparation is complete.

Also in May, Stacie Edick (SoCNY RC&D), accompanied by Mark Downing (ORNL), visited hybrid poplar farms in Minnesota. The meeting provided valuable information about production systems, contracting with landowners, using CRP land, the role of RC&D's in these projects, and the potential for grower cooperative participation.

Early in June, Joe Battista (GPU) met with staff from ANTARES, Mike Palko (PA-DNR), and Dwayne Berger of Lafayette College. The meeting focused on determining strategies for expanding the role of Pennsylvania's Partners in the project. LaFayette College has expressed interest in contributing acreage for planting and local GPU power plants are being sought as a potential end-market for the willow.

A meeting of Consortium members was held in Syracuse, NY on June 16th to discuss plans for Phase II of the project. The following individuals were present: Larry Abrahamson, Ed White and Time Volk (SUNY ESF), Ed Neuhauser (NMPC), Ed Gray and Chris Lindsey (ANTARES), Stacie Edick and Madison Wright (SoCNY RC&D), Dan Aneshansley, Roger Pellerin and Wesley Gunkel (Cornell University), Curtis Bauer and Andrew Metz (FORECON Inc.).

As a result of this meeting, Consortium members determined that an additional three to five months were needed to complete the requirements of Phase-I. They also recognized the importance of keeping the key team members in place and allowing them the time to complete their evaluation and implementation plans. In subsequent discussions, it was agreed that a transition period from August 1997 to December 1997 would be sought. In order to maintain the momentum of the program, up to 100 acres in the vicinity of each power plant (NYSEG's Greenidge plant in central NY and NMPC's Dunkirk plant in western NY) will be located and agreements signed with landowners in anticipation of initiating site preparation by the end of July 1997 so that sites can be planted in the spring of 1998.

One and one half days were spent with a representative from CAMECO Industries Incorporated. CAMECO specializes in producing equipment for the sugar industry including harvesting machines. Discussions focused on the possibility of modifying one of their sugar cane harvesters for willow biomass crops. About 40% of CAMECO's equipment is one-of-a-kind so they have considerable experience with building and modifying equipment for special uses. Preliminary plans were made for a follow-up meeting between key Consortium members and CAMECO's engineering staff. The visit is planned to include equipment demonstrations and CAMECO's role in Phase-II of the project.

The Biomass-Bioenergy advisory board has been established to provide input to the willow biomass project from a wide array of groups and organizations including National Audubon

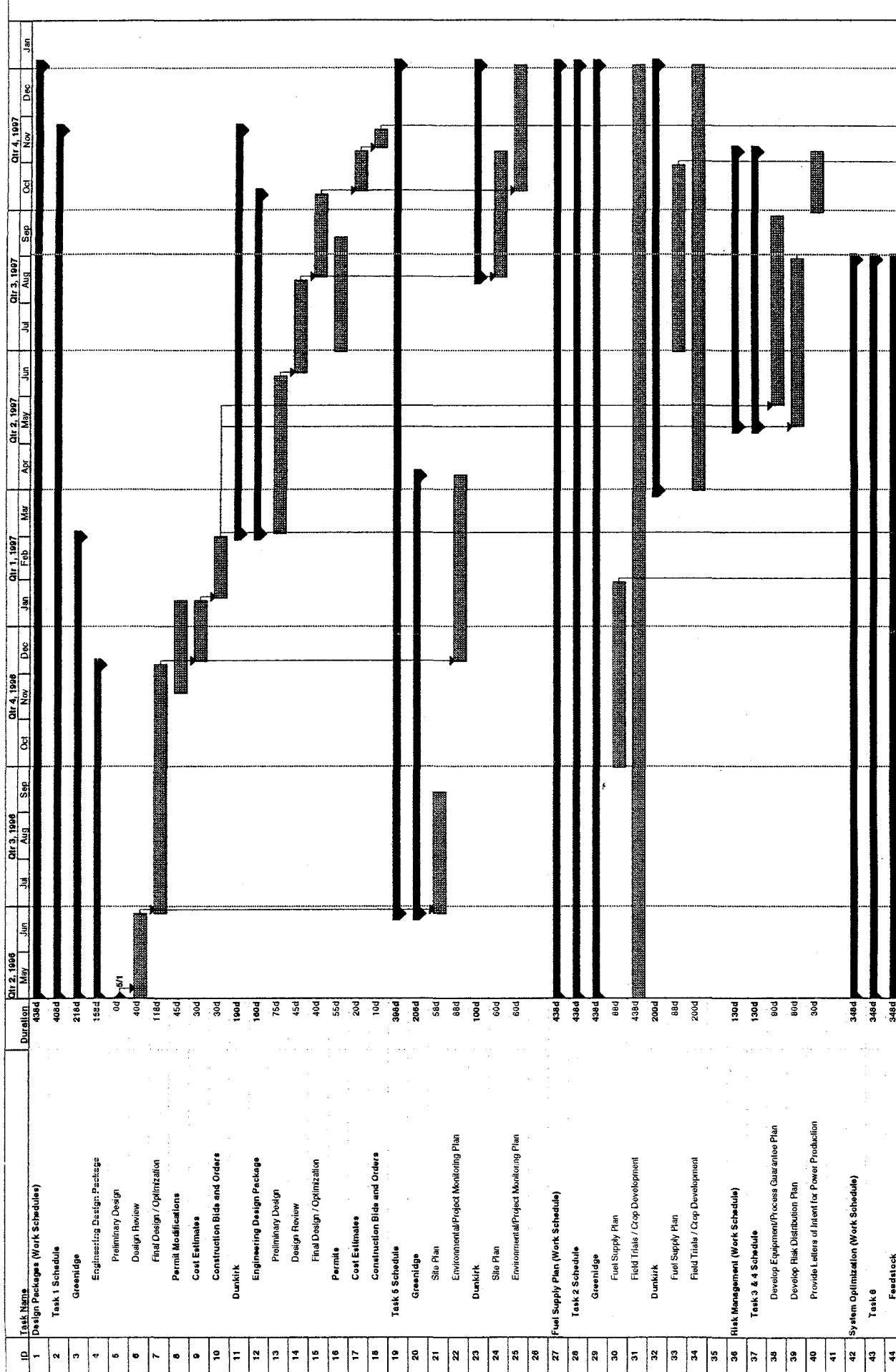
Society, Natural Resources Conservation service, Union of Concerned Scientists, New York State Soil and Water Conservation Committee, New York State Department of Environmental Conservation, New York State Association of Environmental Management. One meeting with the advisory board was held in the spring of 1996, another meeting is scheduled for August 1997 in conjunction with the Willow Biomass Crops field day.

Media coverage about the program continued. Articles appeared in the May 1997 issue of *New York Farmer*, "Farmers, scientists like willows potential"; *The Morning Call*, "Willow to warm dorms?"; and *Biologue*, "Planting for Power in Central New York". A program summary was also written and submitted for inclusion in the UBECA newsletter.

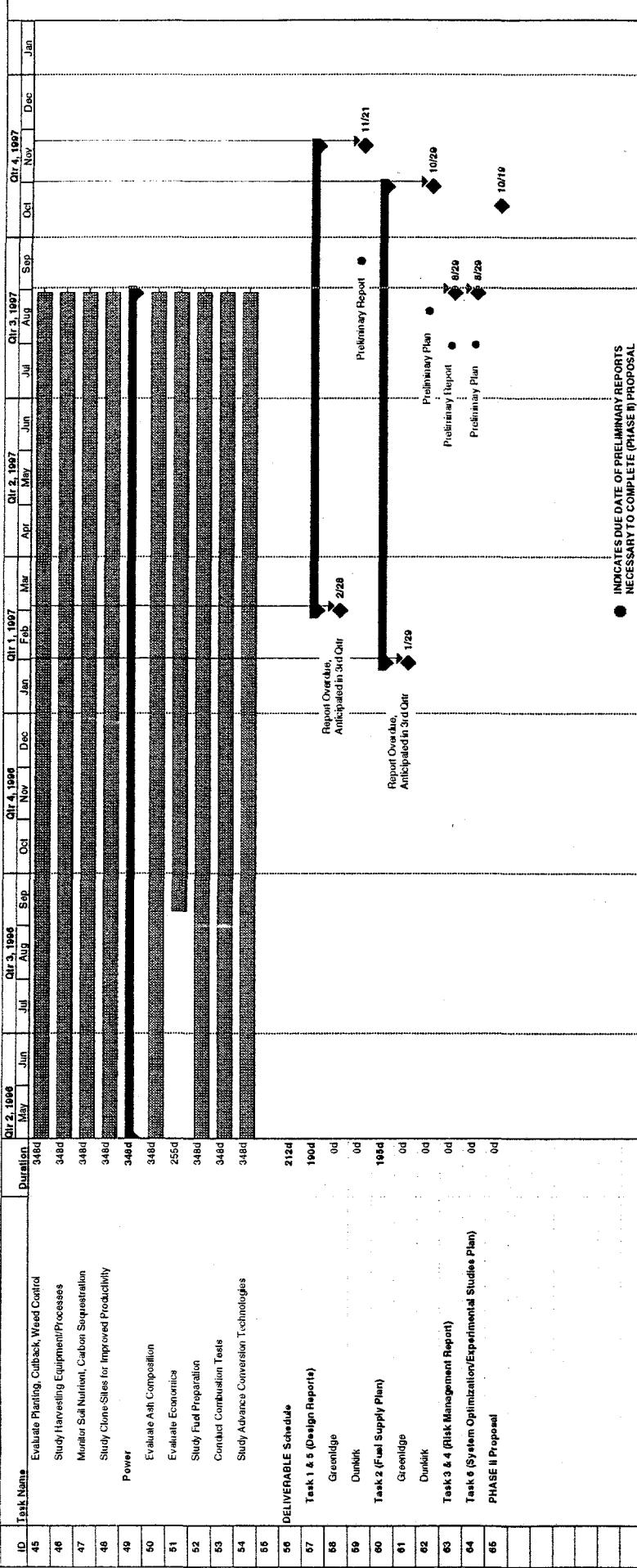
APPENDIX A

PROJECT SCHEDULE

BIOPOWER FOR RURAL DEVELOPMENT
SALIX CONSORTIUM
SCHEDULE OF WORK & DELIVERABLES



BIOPOWER FOR RURAL DEVELOPMENT
SALIX CONSORTIUM
SCHEDULE OF WORK & DELIVERABLES



APPENDIX B

ARTICLES

APPENDIX C

ACREAGE PROSPECTS

Name	Area	Map #	Miles to Plant	Acres	Lease/Grow	Status	Source
M. Cotton	Greenridge	12?	?	62	No Response	95 Migs	
R. Gleason	Greenridge	45?		20	No Response	95 Migs	
R. Secor	Greenridge	20?		30	No Response	95 Migs	
Simmons	Greenridge	12?		10	Not interested at this time	95 Migs	
K. Cotton	Greenridge	12?		40	No Response	95 Migs	
D. Wright	Greenridge	20?		550	No Response	95 Migs	
Eskildsen	Greenridge	18?		15	No Forwarding Address	95 Migs	
N. Hunt	Greenridge	12?		20	Off mailist, rent to dairy	95 Migs	
R. Klein		15?		25	No Response	95 Migs	
W. Chisom		12?		20	No Response	95 Migs	
Moon	PA	10?		0	Did not buy land, wait on NYS	95 Migs	
Campbell	PA	X		100	No Response	95 Migs	
Palko	PA	50++		100	No Response	95 Migs	
Furber	Wayne	50++	15-20		No Response	95 Migs	
Marnillion	Greenridge		55	20	Not suitable, RC&D Board	95 Migs	
Ellsworth	Wayne	50+		100	soil maps looks good, need fo	95 Migs	
Raposo	Greenridge		30	30	Visit, not suitable, need to wait	95 Migs	
Agliata	Greenridge		13	40	Waiting for Map	95 Migs	
Nemec	Greenridge	1*		50	Waiting for map	Comell Referral	
Norman	Greenridge		40	50	No Response	Comell Referral	
Riemer	Greenridge	2*		66	Visit, looks great	95 Migs	
T. Stanton	Greenridge	35?		20	looks too wet, not accessible	other	
C. Green	Greenridge	?		50	coop Ext Agent, need to visit	SW/CD Referral	
A. Breese	Greenridge	3*		9	Need to chk soil maps	Nwsltr Survey	
LaBar	Greenridge	?		20	No Response	95 Migs	
A. Burke	Greenridge	4*		12	Waiting Maps	95 Migs	
M. Lane	Greenridge		16	40?	No Response	95 Migs	
J. Ritter	Greenridge		25	40	No Response	95 Migs	
Chedzoy	Greenridge		15	200	No Response	95 Migs	
Dalympie	Greenridge		25	130	No Response	95 Migs	
A. Joeger	Greenridge		40	50	Not interested. Big \$ grapes	Nwsltr Survey	
R. Chambers	Greenridge	50+	560?	Lease	In process of purchase	Nwsltr Survey	
Graham	Greenridge		?		"please remove from mail list	Tim visit 96, marginal soil, high altitude	
G. Hill	Rushville, Y		50	100?			
B. Esposito	Rockstream,		20	100	lease/grow		
D. New	Canastota		60	60	lease	maps, soil not suitable, need to	SW/CD news
			20-50	?		Have survey, wait maps	

V.Lemke	either, both	Cassadaga	Willing To ?	Purchase ?	Grow ?	Soils map, not suitable	Nwsltr Survey
C.Vink	Dunkirk	5*	25	30 Lease	Sent land survey 6/17, waiting		
Klosinski	Dunkirk	6*	3	0.67 Lease	Signed lease \$20 per acre	Other	
Hopkins	Dunkirk	7*	12	200 Lease/grow	Signed lease, \$40 per acre	Buff News Article	
Pannella	Dunkirk	?	?		Visit, A Soils, wait till 5 yr lease	95 Migs	
P.Fruhoff	Dunkirk				No Response	Other	
C.Sam	Dunkirk		5	80 ?	Need to chk soil maps, conta	Nwsltr Survey	
R.Hite	Dunkirk		35	60 lease	need More specific map info	Other	
R.Brown	Dunkirk		9	15-20, either	Eager golfcourse need to look	Other	
B.Newcomb	Dunkirk		15	10 either	allergic to herbicides, not inte	Other	
D.Hanby	Dunkirk		15	10 curious	also land in PA	Buff News Article	
J.Romanowski	Dunkirk		6.5	10 ?	need more info	Other	