
Photo by Jason Magoon

TRANSMISSION RIGHT-OF-WAY MANAGEMENT PROGRAM

OCTOBER 1989

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Transmission Forestry Strategy

Revised:
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nationalgrid

* Added text for Case 10-E-0155

Table of Contents

APPENDICES

Appendix 1: Article VII Specials for Electric Transmission Facilities

Appendix 2: Environmental Energy Alliance of New York Position Paper

Appendix 3: Summary of National Grid's Research

Appendix 4: Environmental Protection Agency's Pesticide Environmental Stewardship Program

Appendix 5: Inventory

Appendix 6: Vegetation Management Notification Materials

Appendix 7: Niagara Mohawk's Annual Reports to the Public Service Commission

Appendix 8: Environmental Guidance "EG-502, Unauthorized Dumping", "EG-504, Pesticide and Herbicide Application" and "EG-202 Herbicide Spill Reporting"

Appendix 9: Special Plan Conditions Which Apply Within the Adirondack Park

Appendix 10: Procedure for Ground Patrols of 230kV and 345kV transmission rights-of-ways

Foreword:

On December 20, 1977, Niagara Mohawk was ordered by the New York State Public Service Commission (PSC) to present specific plans for an ecologically sound, long-range, system wide, right-of-way vegetation management plan (Case 27277). In May 1978, Niagara Mohawk submitted its program to the PSC and approval was granted in an Order issued October 25, 1978.

On December 15, 1980, Section 84.2 of 16 NYCRR Part 84 was adopted in PSC Opinion 80-40, Case 27605, requiring all investor-owned utilities to develop and submit for PSC approval, a long-range Transmission ROW Management Program by April 1981.

A revision of the approved May 1978 Transmission Right-of-Way (ROW) Management Program was submitted to the PSC in May 1981, in response to the new Part 84 Regulations. Niagara Mohawk was granted an extension from the original April 1981 filing deadline to May 1981. Subsequent revisions were made in February 1982, October 1984, March 1986, and October 1989. The revised and PSC approved March 1986 Plan included revisions to establish special considerations for the Adirondack Park.

On May 5, 1995, the PSC issued proposed revisions to Part 84 Regulations, assigning Case No. 94-M-0101. Subsequent discussions with stakeholders, and exchange of comments resulted in agreement by the investor-owned utilities to update all existing plans under the current rules. A November 2003 revision was the result of those discussions.

On June 22, 2005 the NY DPS issued Order# 04-E-0822, an "Order Requiring Enhanced Transmission Right-of-Way Management Practices by Electric Utilities". This order required further revisions to the program. This 2010 revision is in response to that order.

As has been consistently demonstrated during those discussions, and is reaffirmed by this document, the original Niagara Mohawk order (Case 27277) together with the Part 84 rulemaking (Case 27605), have been very successful in accomplishing their goals and objectives. The New York utilities have become nationally recognized industry leaders in the adoption and application of ecologically sound vegetation management practices, combined with the use of research to guide vegetation management philosophies and practices. The results have been significant reductions in herbicide use, improved reliability and safety, and effective cost management.

I. Description of Organizational Structure

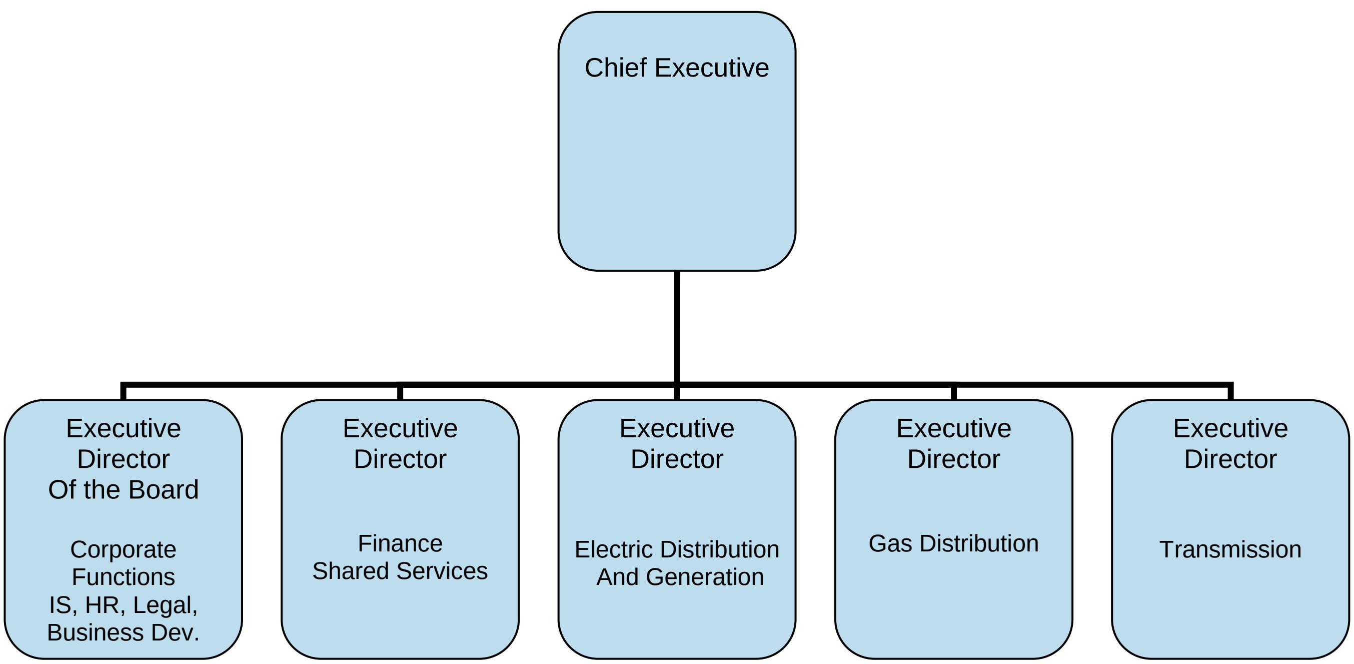
A. **Territorial Description**

A merger between the former Niagara Mohawk Power Corporation and National Grid USA was completed in January 2002, forming one of the largest, investor-owned utilities in the United States. The former Niagara Mohawk portion will continue to serve more than 1.5 million electric customers across 24,000 square miles of upstate New York, including residential, commercial, and industrial service to 31 cities and 639 towns. Gas service is provided to 550,000 customers in 197 cities, towns, and villages across 15 counties in central, northern, and eastern New York.

B. **Management Description**

The Board of Directors of National Grid is elected by the stockholders. National Grid is organized into five business groups. The leaders and function of each group are shown in the following organization chart. Transmission is managed as one of the major five groups.

National Grid Global Organization



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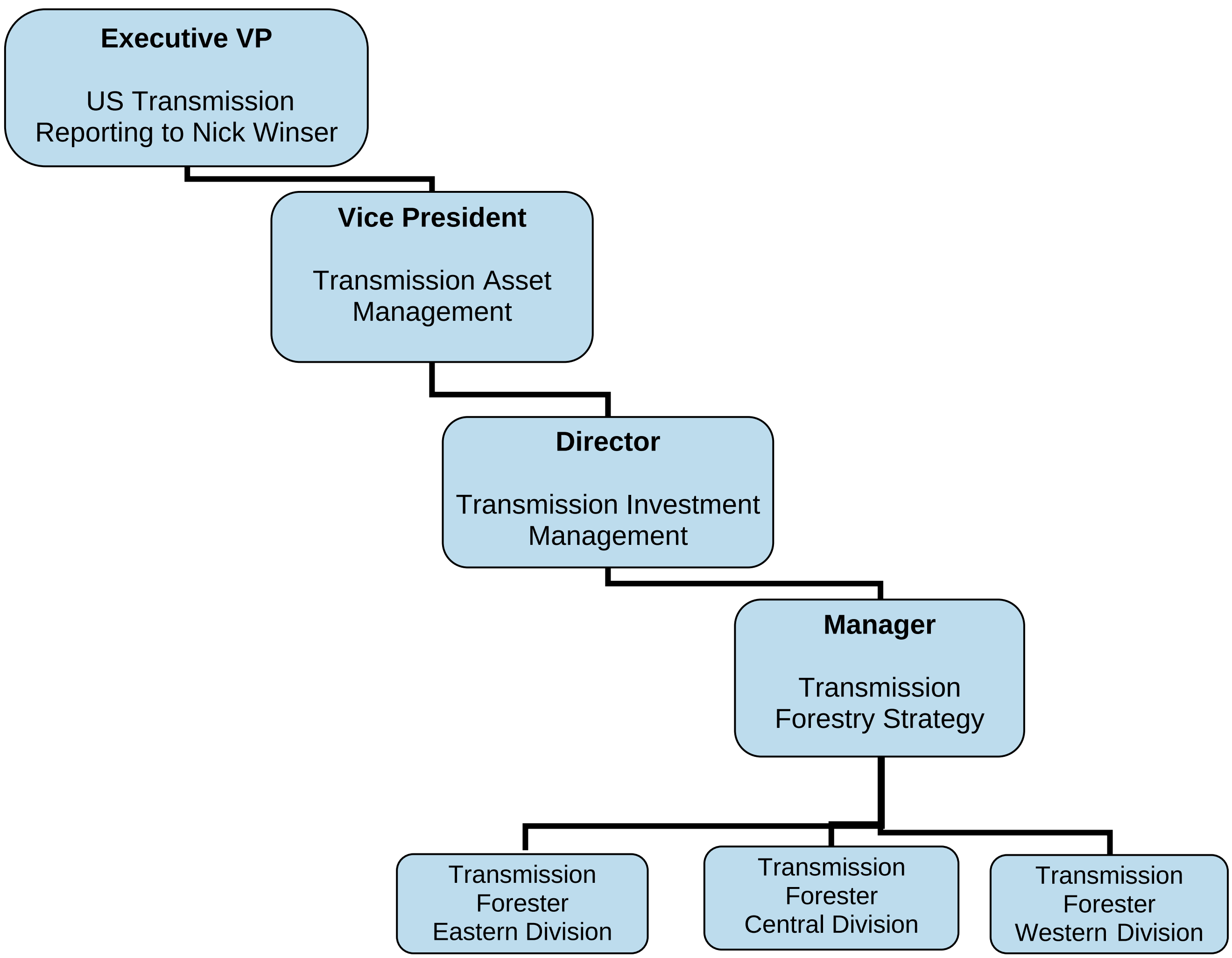
The chart below illustrates the organizational structure for the Transmission Group. Within this group, Vegetation Management reports under the Vice President of Transmission Asset Management.

US Transmission Group



The Manager of Transmission Forestry Strategy is functionally responsible for administering and implementing right-of-way vegetation management policies, goals, and procedures throughout the company in accordance with this Program. The Manager of Transmission Forestry Strategy coordinates and monitors the implementation of the Transmission Right-of-way Management Program across New York.

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Three Foresters, one each for the East, West, and Central Divisions, report to the Manager of Transmission Forestry Strategy. They oversee the day-to-day implementation of this Program.

C. **Territorial Regions**

The map on page 4 identifies National Grid's service territory. The Eastern Division includes the Capital and Northeast Regions and provides service to electric and gas customers. The Central Division includes the Mohawk, Central, and Northern Regions and also includes electric and gas service. The Western Division includes the Frontier and Western Regions (the Western Region was formerly two separate regions known as the Genesee and Southwest Regions) and provides electric service only.

D. **Names/Terminology**

The name National Grid is used throughout this document to reference the owner and operator of the New York electric and gas transmission systems that are included within this Program. When the term National Grid is used in a historic perspective, it is intended to describe the operations of Niagara Mohawk Power Corporation and its predecessor companies. When the name National Grid is used in the present or future perspective, it is intended to describe the policies and procedures of the National Grid Transmission group and those personnel working to implement the Program.

II. Description of the Transmission System

Transmission-US Electrical System/ Upstate New York

The electric and gas transmission systems are organized within operating Regions and Divisions, with record keeping and reporting at the Regional level, and vegetation management coordination and supervision at the Divisional level. In 1984, the former Genesee and Southwest Regions were combined into one region now known as the Western Region. However, for record keeping and reporting purposes the Transmission Right-of-way (TROW) computer program continues to organize and track them as separate reporting areas using their original names of the Genesee and Southwest Regions.

The Electric Transmission System

The electric transmission system includes all bulk transmission (230 and 345 kV), transmission (69 and 115 kV), and sub-transmission (23, 34.5, and 46 kV). The sub-transmission right-of-way and voltage classes are incorporated into this Program to provide uniform implementation of vegetation management policies, procedures, and practices. The Program incorporates all electric transmission that has been constructed since the mid-1970's under the environmental siting and construction requirements of Article VII or Part 102 (Phase III) of the Public Service Commission law, regulation, or order. The Program acknowledges the incorporation of proven vegetation management practices in order to facilitate uniform and consistent management of the entire transmission system. A listing of specific Article VII electric transmission facilities that are incorporated into this Program is provided in Appendix 1. Appendix 1 also identifies and incorporates the special environmental and vegetation management concerns for each line addressed in the Article VII process, and provides a brief comment discussing how these concerns are addressed or incorporated into the current Program.

The following table identifies the total miles of overhead electric transmission right-of-way segments by voltage class and by division as of 2008.

Miles of Overhead Electric Transmission Right-of-Way Segments by Voltage (kV)

	345 kV	230 kV	115 kV	69 kV	46 kV	34.5 kV	23 kV	Total
East	174	95	692	151		413	76	1601
Central	257	83	1115		320	598	183	2556
West	37	115	743	41		987	35	1958
Total	468	293	2550	192	320	1998	294	6115

The transmission system includes 64,718 total acres of right-of-way. Of this there are 10,914 acres in open field, grasslands, lawns; 8,418 acres with trees or shrubs that did not require maintenance in the past seven years; and 45,386 brush acres requiring some form of vegetation management.

The following chart is based on December 2009 data and identifies the right-of-way acres by Region and Division that are managed under this long range Transmission Right-of-way Program for electric transmission lines. "Open Field" includes any site that contains only grass or herbaceous species, including active cropland, pastures with no woody brush, lawns, commercial sites, and similar areas. "Brush – No Work" describes sites that contain woody shrubs or trees, but due to growth and clearance conditions, they do not require maintenance during this cycle. Finally, "Brush – Requires Work" describes those acres that require management intervention to control undesirable, tall growing woody vegetation.

Right-of-way Acres for Electric Transmission

	Open Field	Brush No Work	Brush Requires Work	Total
Capital	1,377	867	8,147	10,391
Northeast	2,075	601	6,027	8,703
East	3,452	1,468	14,174	19,094
Mohawk	1,193	1,092	4,749	7,034
Central	1,503	2,714	7,984	12,201
Northern	1,110	828	6,959	8,897
Central	3,806	4,634	19,692	28,132
Frontier	802	418	2,287	3,507
Genesee	1,135	1,306	3,443	5,884
Southwest	1,719	592	5,790	8,101
West	3,656	2,316	11,520	17,492
System	10,914	8,418	45,386	64,718

III. Development of the Transmission Right-of-way Management Program

Historic Perspective:

Vegetation management on electric transmission rights-of-way (ROWs) in New York State can be divided into three eras. It began with the Manual Era of the early 1900's, continued through the Broadcast Era of the 1950's to mid-1970's, and evolved into the Selective Management Era that has been adopted by most ROW management programs used today.

The Manual Era:

The 1882 construction of Thomas Edison's Pearl Street Station in New York City marked the beginning of the investor-owned electric utility industry. This plant was a direct current facility capable of transmitting electricity just two miles.

The first alternating current generating station in America began producing power in Buffalo in 1886. However, this plant did little more than supply electricity to light a few hundred incandescent lamps.

In "Niagara Mohawk, An Uncommon History," editor, R. F. Dischner writes "the 1890's saw one of the greatest standards controversies ever, The War of the Currents, as Nikola Tesla and Edison debated over the relative merits of alternating current (AC) and direct current (DC). Alternating current was more flexible and had the advantage of being able to be transmitted in large blocks over long distances. Direct current was supported by Edison, but required large amounts of copper and generating stations every two miles."

Mr. Dischner also writes that "when the Cataract Construction Company, under the leadership of Edward Dean Adams, was formed for the purpose of harnessing the power of (Niagara) Falls in 1886; there was no consensus on how that power would be transmitted. It took five years of study before electricity was selected over pneumatic and mechanical means."

Dischner continues to write, "The construction of the immense tunnel that would carry water for more than a mile under the town of Niagara Falls was the largest engineering project of its day, and a risk of enormous proportions. The reward was the revolutionizing of modern life. A decision had to be made: whether to use direct current (DC) or alternating current (AC). Direct current, championed by Thomas Edison, seemed to have important advantages. However, alternating current was easier and cheaper to transmit over long distances, an important consideration for remote generating plants."

And finally, “alternating current won the day, and George Westinghouse won the contract to build the generators, basing his design on several theories and patents of Nikola Tesla,” Dischner adds.
When the switches were thrown at the Adams plant on November 15, 1896, it was the first large-scale effort to generate and transmit bulk power from a remote generating site over 22 miles of transmission line to the factories, plants, and streetcars of Buffalo.

In his book “Niagara Power, History of the Niagara Falls Power Company, 1886-1918” Edward Dean Adams includes a statement from Paul M. Lincoln describing this early attempt at AC transmission. Mr. Lincoln was the Operating Superintendent and Resident Engineer for the Niagara Falls Power Company with responsibility for supervising the operation of the new transmission line from 1896 to 1902. In his report, Lincoln describes the line as an 11,000-volt, three-phase line. While there were other plants transmitting power at even higher voltages, this line was both unique and of historical importance because of the amount of power it transmitted, the importance of the service it provided, and the distances over which this occurred. This line transcended anything that had been previously attempted. It was the goal of these earliest developers to replace the hydraulic, steam, and mechanical sources of power for the industrial engines of the day with dependable electric power for their motors. Continuity of service and reliability were essential from the beginning.

As early electrical engineers tackled the problems of porcelain insulators, switches, and protective devices, they soon learned the importance of sound tree pruning programs as well.

In an 1897 paper presented to the National Electric Light Association in Niagara Falls, J.G. White of the White-Crosby Company, the company who engineered and constructed the line, describes its first year of operation. In particular, Mr. White describes ***“one short interruption last winter was due to the dead limb of a tree blowing across the wires, illustrating the fact that all trees should be cut down for some considerable distance on both sides of any high voltage line.”***

In 1900, a new wood pole line was constructed to upgrade the system to 22,000 volts, and in 1906, a right-of-way was being purchased to construct a transmission line from Niagara Falls to Syracuse. The line used Sears, Roebuck and Co. Aeromotor windmill towers. The transmission grid continued to grow as this line was connected to others from hydroelectric plants on rivers in the Tug Hill plateau, the Adirondack Mountains, and across upstate New York. The importance of electricity and the electric transmission system in connecting our daily lives at work and at home is taken for granted today. However, the importance of sound vegetation management can never be taken for granted

Just as today, these first transmission corridors required tree clearing at the time of construction and periodic maintenance to keep vegetation from growing back into the lines. As illustrated by this early photo, the lack of mechanization made the initial clearing and subsequent maintenance very laborious. The first vegetation management tools included crosscut saws, small handsaws, and brush hooks. Horses, early tractors, and bulldozers were used to move logs and larger wood, while laborers piled the smaller limbs.

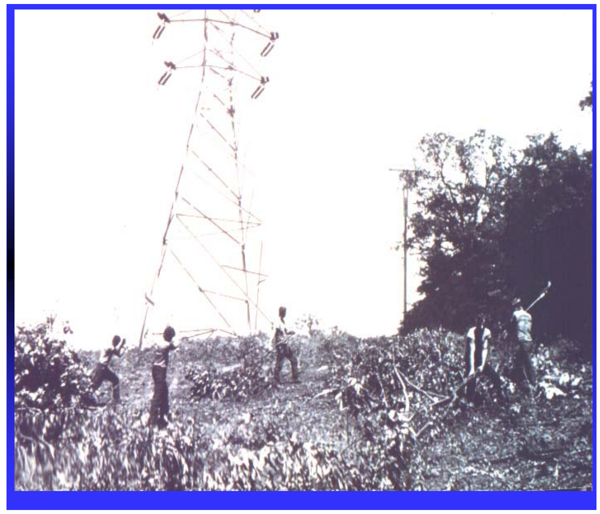


Photo compliments of Jim Orr, Asplundh Tree Co., Inc.
Shown here is a worker using a brush hook.

Chain saws began to be developed for logging applications in the 1930's and 1940's, but these were large two-man machines. While they may have been useful for clearing new lines, they were far too cumbersome for maintenance work.

Periodic reclearing was usually done by line crews during the off-season (winter) when line construction itself was difficult. This reclearing involved considerable time and money, and the results were unsatisfactory in terms of long-term vegetation control. Essentially, the Manual Era could be described as managing clearances rather than managing vegetation for several reasons.

The root system of a plant is one of its primary food storage sites. After cutting, trees and woody shrubs rejuvenate themselves from dormant or adventitious buds, producing fast-growing stump sprouts and/or root suckers. Growth rates for these sprouts and suckers can be many times faster and taller than seen in normal seedling development. This happens because the tree's severed root system continues to supply food and nutrients to the new growth more abundantly than it would in a seedling, enabling the existing root system to quickly reestablish a root-to-crown balance.

When mechanical clearing occurs during the growing season, new growth often resumes within a few days. However, when clearing is done in the dormant season, root reserves are at their highest, and the tree simply waits until the next spring before sending out new growth. In trying to survive and restore balance, it will send out a multitude of new stump sprouts and root suckers. Growth rates of 12-15 feet in a single year have been reported, and tree densities can easily range from 10,000 to 20,000 stems per acre with repeated manual clearings.

Photos compliments of Jim Orr, Asplundh Tree Co., Inc.

The photos above illustrate the development of both stump sprouts and root suckers from a single Aspen stem in a field setting. Numerous stems are developing from both
The stump and the root system, and the extensive spread of the root system is becoming evident in the photo on the right.

The Broadcast Era:

The commercial application of herbicides was introduced in the United States in the late 1940's, using the chemical Ammate. It was the first alternative to costly hand clearing methods, and it also improved worker safety. National Grid's first herbicide treatments made with Ammate were in 1951. However, Ammate was a contact herbicide that only provided "top kill" of woody brush, with limited translocation, or movement into the roots. As a result, stump sprouts and root suckers continued to create quick regrowth. Another problem with Ammate was its highly corrosive effect on spray equipment.

Eventually, smaller one-man chain saws found their way into the market and began to be introduced into right-of-way maintenance activities, replacing axes and brush hooks to reclear lines. This combined with the fact that Ammate was showing some effectiveness as a stump treatment when mixed with a small quantity of water and applied as a paste, began to expand the "tool box" for the early right-of-way manager.

But, with woody brush densities averaging 10,000 to 20,000 stems per acre, early managers even considered shrub communities problematic. As a result, all woody tree and shrub species were treated in an effort to establish clear, easily accessible rights-of-way.

The introduction of the phenoxy herbicides (2,4-D and 2,4,5-T) in the 1950's provided the first products to effectively translocate from the treatment area to the growth sites of the plant's stem and roots, and provide effective root "kill." The first formulations were amine salts that were soluble in water.

The subsequent development of low volatility esters expanded 2,4,5-T treatment options, providing the first basal applications. Basal treatments used fuel oil as the carrier for the herbicide instead of water. They targeted the lower stem and all exposed roots of the plant. The oil base enabled the product to penetrate the waxy bark substances, but once inside the bark, the herbicide solution did not mix well with the water-based transport system of the tree. Movement up or down the stem was poor, and these treatments could not control root sprouting.

National Grid set its first test plots with 2,4,5-T as a foliar application in the summer of 1953. By 1956, high-volume ground broadcast treatments had become so effective that 2,4-D and 2,4,5-T were fully incorporated into brush treatment efforts. In the next few years, these products would become important tools for field supervisors facing thousands of miles of tall, dense brush. High-volume broadcast applications promised to be an economic way to reduce this problem.

The use of herbicides soon began to reveal its own set of control problems. Each product exhibited varying degrees of effectiveness among species, controlling some, but not others, especially ash. Applicators learned that tank mixes of two or more products were necessary for effective, broad-spectrum control. Tank mixes continue today, enabling right-of-way managers to tailor products, mixes, and treatments to meet a variety of environmental and public issues, as well as plant conditions found along the right-of-way.

Picloram was introduced in the 1960's and proved very effective when tank mixed at higher rates with 2,4,5-T in controlling a broad range of hardwood and coniferous species.

The 1960's saw the introduction of helicopters for aerial spraying of rights-of-way for brush control and also development of the micro-foil boom that greatly improved drift control from aerial spraying. As a result, it became the treatment of choice on many lines. Helicopter treatments applied six gallons of herbicide concentrate per acre, while high-volume ground broadcast required three-to-nine gallons per acre, depending on brush densities. Helicopter applications and high-volume ground broadcast with tank mixes or 2,4,5-T and Tordon were the mainstays of National Grid's program until 1979 when the Environmental Protection Agency (EPA) banned the use of 2,4,5-T in the United States.

The Birth of Selective Management:

Research into herbicide use on rights-of-way began almost as early as the first treatments. The work of Drs. Egler and Neiring in New England began to explore both old field succession and the stability of shrub communities in the 1940's and 1950's. By the 1970's, Egler's theories about the stability of shrub communities became popular with New York regulators.

In 1951, the Penn Electric Co. teamed with manufactures, contractors, the Pennsylvania Game Commission, and Drs. Brambles and Byrnes of Purdue University to conduct one of the first studies on the impacts of right-of-way spraying on wildlife habitat. Their first work was published in 1953. Today, this study spans nearly 50 years and is commonly known as the "Bramble and Byrnes" or "Gamelands 33" research. It has become a cornerstone of vegetation management theory and practice.

The work of these early pioneers began to set the stage for the inclusion of science into the art of right-of-way management. In the 1960's utilities also began to hire Forestry Strategy professionals for vegetation management. When combined with the environmental movement of the 1970's, the public and the regulators, the utilities themselves prepared for adoption of selective management principles and a more ecologically-centered vegetation management approach.

Selective vegetation management began in 1970 when New York State enacted Article VII of the Public Service Commission (PSC) law, strengthening environmental requirements and public participation in the siting and construction of "new" transmission lines. Herbicide use was highly scrutinized, and selective clearing and treatment methods were adopted for these lines. Specifications were designed "to preserve low growing shrub communities and small tree species to the extent practicable." The PSC's role and involvement in routine maintenance on "existing" lines was still limited.

In the early 1970's right-of-way maintenance remained mostly reactive and treatment deferral was a common practice. The budget and scheduling process was still decentralized, with local T&D supervisors determining priorities. The concepts of cyclic scheduling and budgeting were not fully supported at either the district or system levels, and annual budget support was inconsistent.

The energy crisis of 1973, combined with Con-Ed's failure to declare a common stock dividend in 1974, sent shockwaves through the utility industry. Vegetation management programs were severely cut throughout New York, and at National Grid all contractors were laid-off. They would not return to transmission for two years. By the spring of 1976, the loss of contract pruning dollars had created tremendous deferrals, resulting in two separate tree-caused outages on transmission lines from the Nine Mile nuclear facilities on the very same day. The nuclear plants were down for three days before they were brought back on line. Contracts were immediately executed to allow helicopter treatment of these lines and a number of other lines across the state. In total, 2,000 acres were helicopter treated that summer; however, the operation produced numerous complaints, claims, and lawsuits. The public outcry eventually drew the attention of the PSC and resulted in PSC Show Cause Order #27277 dated December 20, 1977. A condition of that Order was the development of a long-range right-of-way management perspective for all electric transmission. This order resulted in National Grid submitting its Transmission Right-of-Way Management Program to the PSC in May 1978. This Program was approved by the PSC on October 25, 1978.

Throughout the 1970's National Grid's right-of-way management philosophies had been evolving toward a more selective approach. Specifications had been revised, supervision augmented by hiring professional foresters, training programs instituted, and more sophisticated planning procedures developed in an effort to maintain reliability in an environmentally compatible manner. The Nine Mile outages simply accelerated the completion of that process.

Creating the System Forestry Strategy Department in the early 1970's, hiring additional foresters from 1974 to 1976, and centralizing the scheduling and budgeting functions within System Forestry Strategy staff in 1977, provided the opportunity for a full reassessment of vegetation management policies, procedures, and practices in 1978. It was recognized that while acceptable reliability goals were being achieved, the rights-of-way were not necessarily being managed on a cost-effective basis. While serious efforts had been made over the years to "get the rights-of-way in shape," no real preventative maintenance program existed. Budgetary considerations and limited spectrum herbicides resulted in lines that were partially maintained, many of which contained high populations of herbicide resistant species. Then, in 1979, System Forestry Strategy presented senior management with a proposal to put the entire transmission right-of-way system onto a cyclical preventative maintenance program. The program was calculated to maintain reliability and provide long-term economies while reinforcing the current environmental ethic.

An eight-year cycle was adopted after considering the overall condition of the rights-of-way and reasonable budget levels. The proposals were incorporated into the electric rate filing for the first time in 1979, becoming the cornerstone to consistent program funding.

By 1980, the PSC had enacted its Title 16, NYCRR, Part 84 rules and regulations formally requiring all investor-owned utilities in New York to submit long-range right-of-way management plans for PSC approval.

The Selective Management Era:

The adoption of selective treatment practices and birth of integrated vegetation management philosophies beginning in 1978, define this period on rights-of-ways. It includes the use of research and information technology systems to expand the knowledge and understanding of natural systems, together with the long-term effects and effectiveness of various management practices. Today, it incorporates the ecosystem itself as an integral component in controlling undesirable vegetation and reducing pesticide use, while preserving and enhancing environmental quality. The three treatment cycles used over the last 23 years are described below.

First Cycle: In response to the PSC's order for a long-range right-of-way management plan, selective maintenance policies were implemented for all new and existing transmission ROWs in 1978. An eight-year, cyclical approach was adopted, and by 1985, all rights-of-way had been treated at least once. In fact, some ROWs were actually treated more than once. While it may seem inconsistent that lines could be retreated in less than eight years, this was not the case. The maintenance schedules were developed around line design, right-of-way widths and easement conditions, conductor-to-vegetation clearances, and land-use patterns on a right-of-way. For example, an older line, on single wood poles in a residential area may require more frequent maintenance than another line on taller structures, through rural areas on wider rights-of-way. Specific maintenance schedules were based on a combination of chronological timing, annual right-of-way assessments, and inventoried site conditions.

As a result, the "eight-year cycle" became the skeleton upon which the maintenance plans were constructed, rather than becoming a rigid, inviolate time frame. The year 1978 was selected as the beginning of the era, because it was the first year under the new "selective transmission right-of-way management program," which included complete site inventories and centralized record keeping.

The goal of the first cycle was to "eliminate a major percentage of the undesirable vegetation, while retaining and fostering the growth of desirable low growing vegetation." The low growing species would provide natural competition for growing space, retarding the reinvasion of tall growing species going forward. The anticipated benefits were decreased herbicide use; increased crew productivity; improved wildlife habitat; aesthetics; and public and regulatory acceptance. First cycle accomplishments were reported in 1989, when the approved "Transmission Right-of-Way Management Plan" was last revised and submitted for PSC approval. The success of these philosophies and practices are further reflected in the "Cycles and Trends" section of this document, which reviews the entire integrated management period from 1978 to today.

Significant mileposts of the first cycle included:

- EPA suspension of 2,4,5-T in 1979 and its replacement with Garlon herbicides later that year.
- Introduction of water borne, cut surface treatments in 1979 replaced oil based stump treatments. The effectiveness of these cut surface products resulted in reduced use of basal applications as well.
- Computerization of the ROW management program in 1980 provided the ability to monitor trends in management practices, vegetation conditions, and herbicide use.
- Phase one of the National Grid's Volney–Marcy 345 kV research project began in 1982 to look at environmental impacts and effectiveness of herbicide use following initial clearing.
- Cooperative efforts by National Grid to share important research and program results with the regulatory community enabled the company to negotiate the first statewide permit for utility application of approved herbicides in NYS DEC regulated wetlands.

Second Cycle: This cycle was reduced to seven-years, from 1986 to 1992. Once again, the time frame is considered a skeleton around which the overall program was developed. The cycle was reduced in order to address continuing problems of off cycle, spot maintenance and to reduce the height of treated undesirable tree growth. This would help to further reduce herbicide use and improve selectivity with high-volume ground foliar applications.

Through the first two cycles, undesirable tree densities were described as light, medium, or heavy. Light densities consisted of trees across the right-of-way ranging from 1 to 30% canopy closure. Medium represented stocking conditions from 30 to 65% and heavy included all tree growth conditions over 65% canopy closure. Integrated across the ROW were also light, medium, and heavy densities of lower growing shrubs that were being retained, along with herbaceous communities. Strong biases toward shrub preservation continued to structure program goals into the late 1990's.

Important mileposts of the second cycle were:

- Phase two of the Volney–Marcy 345 kV research project was designed and implemented to study effectiveness and environmental impacts of the various treatment methods available for maintenance, including such non-herbicide techniques as mowing, and grub and seed. This research, together with analysis of first and second cycle treatment statistics, began to clearly point toward selective foliar methods as the least impact, most effective choice.
- While Round-up herbicide was introduced in 1985, its mode of action was different from the phenoxy herbicides and did not have an effective partner for tank mixing until 1987 when Arsenal herbicide was introduced. Accord herbicide replaced Round-up as the utility ROW formulation,

providing utilities with the first product approved for use in seasonally dry wetlands.

Third Cycle: By 1992, the program was accomplishing its stated goals and exceeding expectations. Undesirable densities had continued to diminish so much that a new "very-light" density code was created in 1993. It describes sites with tall growing, undesirable species of 100 stems per acre or less. In addition to reductions in undesirable species, the right-of-way conversion to stable herbaceous and shrub communities enabled National Grid to move back to an eight-year cycle once again, from 1993 to 2000. In fact, by the end of the third cycle, desirable densities were becoming so heavy in many areas that they were "hiding" undesirable stems and keeping crews from locating them for treatment.

During the third cycle, vegetation management theories about treatment methods began to shift. The Volney–Marcy research, other state and national research, and the efforts of utilities across the country continued to reinforce the effectiveness of selective foliar treatments. Borrowing concepts from aerial application that applied small quantities of a more concentrated mixture on the leaf surface, vegetation management professionals began to test these principles using low-volume, ground delivery systems. By reducing pressures and working closer to the target, applicators were able to "lightly wet" the foliage, rather than "wetting to run-off." This greatly reduced herbicide use, especially the over spray associated with high-volume, ground foliar applications. The development of new spray guns and nozzles enabled backpack treatments with even smaller quantities of herbicides and the refinement of tank mixes with newer products continued to push application rates and costs even lower.

By 1997, low-volume hydraulic treatments nearly replaced high-volume methods. The low-volume backpack approach proved more effective at controlling regrowth in areas that historically required stump treatments.

Important mileposts of the third cycle include:

- Phase three of the Volney-Marcy research was approved to investigate long-term cost and effectiveness questions surrounding the latest products, delivery systems, and treatment methods.
- A broad-based partnership, led by National Grid, was established to identify areas for continued research, and to share costs and benefits of this work.
- New, low-volume techniques were introduced, tested, refined, and incorporated into treatment programs helping to reduce herbicide use requirements.
- New herbicide tank mixes with Krenite and Escort herbicides were field tested, and effective mixes were incorporated into the program that reduce the "zone of effect" of treatment on desirable herbaceous and shrub under story species.

Results of three cycles and 23 years of Integrated Vegetation Management at National Grid will be discussed in the "Cycle and Trends" section of this document.

VI. Cycles and Trends

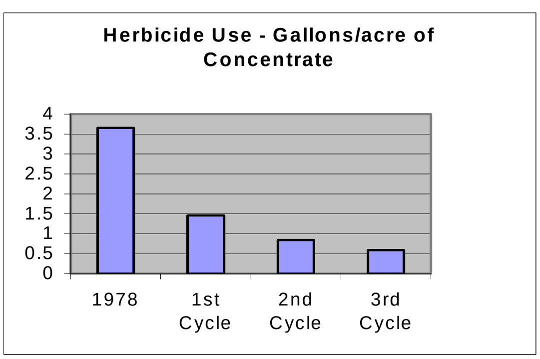
The first treatment cycle effectively began in 1978 with the introduction of selective treatment methods, site-by-site prescriptions, vegetation management by professional foresters, and annual crew training to broaden their understanding of program principles, goals, and objectives. The first cycle took eight years and included the years 1978-1985. The second cycle was reduced to seven years and included 1986-1992. The third cycle returned to an eight-year schedule and included the years 1993-2000. However, during this cycle, sub-transmissions located on narrow rights-of-way or in residential areas were scheduled on shorter five-to-seven year cycles.

Herbicide Usage:

During the 1960's and early 1970's, the tall growing vegetation on most rights-of-way was not effectively controlled. As a result, the treatment programs were heavily dependent upon helicopter and high-volume ground foliar applications. Brush densities were very high, often approaching 10,000 to 20,000 stems per acre, and tree heights averaged 15 feet or more under the conductors. Helicopter treatments applied 4-6 gallons per acre (gpa) of concentrate. High-volume ground foliar mixtures were more dilute than aerial applications, but required as much as 300-400 gpa of mix or 3-9 gpa of concentrate.

While the year 1978 represents the beginning of the selective, or integrated vegetation management approach, it also represents the transition year from the non-selective broadcast methods of the past. The last aerial treatments were conducted in 1982. The shift to prescriptive treatment required intense training and field inspection. Crews needed to recognize and avoid "small and green" shrub species while targeting full coverage of tall growing tree species that were interspersed among the compatible vegetation.

Graph 1 and Table 1 quantify herbicide use over the last 23 years. Herbicide quantities are taken from annual use reports, which were sent to the PSC as required by the 1977 show cause order for a long-range right-of-way management plan. They are expressed in gallons of herbicide concentrate per acre for all treated acres. 1978 is stated separately to serve as a baseline against which the program is measured, because it represents both the earlier, non-selective era with its high densities, tall growth and high-volume methods, while still using less herbicide because of the new selectivity.



Graph 1

Cycle-to-Cycle Herbicide Use Reductions				
	1978	**1st Cycle**	**2nd Cycle**	**3rd Cycle**
GPA	3.66	1.46	0.84	0.59
% Reduction		-60%	-42%	-30%

Table 1

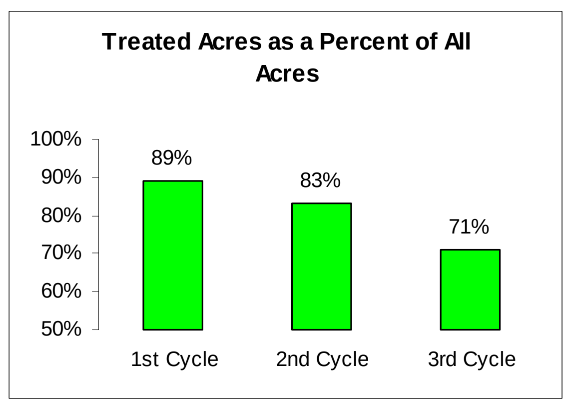
Graph 1 dramatically illustrates the reductions in herbicide use since 1978. The average use throughout the third cycle was 84% below the system use in 1978. Table 1 depicts cycle-to-cycle reductions, with first cycle reductions of 60% when compared to the baseline of 1978. The second cycle was 42% below first cycle requirements, while third cycle use dropped another 30% as low-volume foliar treatments were perfected.

Undesirable Densities:

Tall growing species that are capable of growing into the conductor area, commonly referred to as the "wire security zone," are considered undesirable species. The wire security zone is defined as a vegetation-free envelope around the conductor that should be achieved at the time maintenance is performed to the extent that easements, permits, and landowner constraints allow. The wire security zone requirements are discussed in detail in Chapter 7, section A. 3 of the Transmission Right-of-way Procedures.

Over the past two decades, the undesirable species list was primarily comprised of tall growing tree species. An effective management program aims to reduce the density of these undesirable species over time. As compatible ROW vegetation becomes more competitive and stable over time, an indicator of program effectiveness is a reduction in total ROW acres that require treatment from cycle-to-cycle. In Graph 2 below, treated acres are expressed as a percent of total ROW acres.

Graph 2 demonstrates how the Transmission Right-of-way Management Program has effectively reduced undesirable brush acres that require treatment. While 89% of all ROW acres needed treatment in the first cycle, only 71% had to be treated during the third cycle. This represents an 18% decrease in the treated acres and demonstrates the increasing stability and competitiveness of shrub and herbaceous communities in today's ROWs.



Graph 2

Table 2 illustrates the shift in tree densities since the concepts and strategies of Integrated Vegetation Management (IVM) were first adopted. During the first cycle, 56% of all treated acres were either medium or heavy undesirable tree growth. Today, sites with medium density have been reduced by 38%, and heavy densities have been reduced by 68%. Additionally, these densities are generally found on sites that have a history of either non-herbicide or stump treatment.

Undesirable Densities - Tall Growing Trees
(As a percent of all treated acres)

	Very Light	Light	Medium	Heavy
1 st Cycle	0%	44%	37%	19%
2nd Cycle	0%	52%	40%	8%
3 rd Cycle	32%	39%	23%	6%

Table 2

In response to this reduction in undesirable densities, the new category "very light" was added in 1993. This density represents sites with 100 stems/acre or less. These conditions were so rare during the first two cycles that they were simply included with light acres. Today's very light conditions are found on nearly one-third of all treated sites, and very light and light densities combine to represent 71% of all treated acres.

Desirable Densities:

Since its inception, the Transmission Right-of-way Management Program has primarily considered woody shrubs to be desirable species. Herbaceous growth such as the ferns, goldenrod, berries, and other perennial broadleaf weeds and grasses have been considered incidental vegetation components of the right-of-way in the past, however, research has shown that herbaceous plants make a significant contribution to right-of-way species richness and diversity. They also contribute greatly to the total competitiveness of low growing species found in the ROW, and are important factors in total habitat considerations.

Based on the work of Egler and the early PSC support for shrub communities, a bias toward shrub dominance of the ROW has persisted in New York since the earliest days of the Program. More recently, theories on optimal shrub densities have begun to change. For example, field observations of researchers have begun to indicate that as shrub densities increase beyond 70%, important songbird nesting habitat may be lost for both old field and shrub nesting species.

From the beginning, inventories have been designed to identify shrub density at the time of treatment and monitor trends toward increasing total shrub cover. Consistent with these goals and objectives, desirable species have been described as woody shrubs and small trees that would not grow into the wire security zone and lead to an outage. Densities have been reported in percent of canopy closure as follows:

- none present (including open field)
- light (1 - 30%)
- medium (30 – 65%)
- heavy (65 - 100%)

Table 3 illustrates the shift in shrub densities across the system since selective IVM principles were first adopted. We clearly see a reduction in light densities over the years, while medium and heavy shrub conditions have increased by 25% or more. It is important to note that these density classes are so broad that they may not fully represent the change in density that has occurred. For example, a change from 5% shrub cover to 25% shrub cover is a five-fold increase, but will continue to be reported as a light density at the time of inventory.

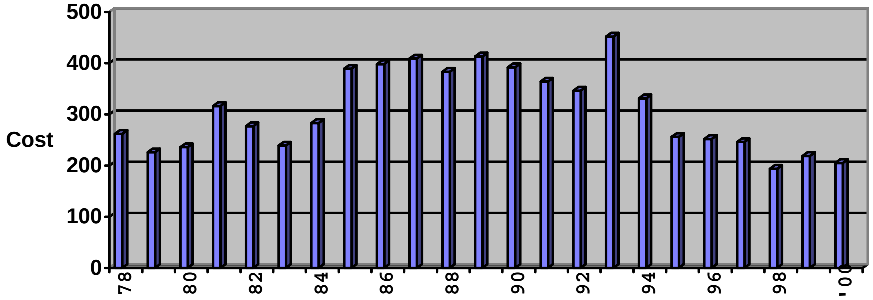
Desirable Densities - Shrub Species
(As a percent of all acres)

	1st Cycle	3rd Cycle	Change
None	28%	27%	-3%
Light	34%	24%	-26%
Medium	21%	27%	26%
Heavy	17%	21%	25%

Table 3

Cost Management:

Implementing a sound, integrated vegetation management program requires a higher up-front cost to effectively control taller, denser stands of undesirables and prevent or eliminate regrowth. However, once the undesirable stems have been brought under initial control, the right-of-way will stabilize into herbaceous plants and woody shrub communities that have been retained. This process is called the “Conversion Period” in the literature. The compatible communities then provide natural competition, slowing the invasion and redevelopment of taller growing undesirable species. Over time, a successful management plan will create fewer undesirable stems, require less herbicide, and cost less to maintain. The chart below illustrates changes in the average cost per treated acre, for all methods at National Grid from 1978 to 2000.



Graph 3

The cost savings of the program have exceeded initial expectations. Treatment costs from 1998 to 2000 were lower than actual costs from 1978 to 1980 when National Grid treated with helicopter and high-volume ground methods. Allowing for inflation over the past 23 years, it is clear that the Integrated Vegetation Management approach that was implemented in 1978 has been highly successful in managing costs, while also reducing herbicide use and inhibiting tall growing trees.

V. Ecologically-Centered Vegetation Management

Introduction – Integrated Pest Management

The U. S. Congress defined Integrated Pest Management (IPM) under FIFRA, 7 U.S.C 136r-1, as “a sustainable approach to manage pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health, and environmental risks.” The definition recognizes IPM as a scientific methodology that has been developed with input from all sectors of society. Under FIFRA, risk reduction is the ultimate goal and guiding principle of IPM.

In 2000, New York State incorporated these philosophies into 6 NYCRR Part 325 when it defined IPM as “a systematic approach to managing pests which focuses on long-term prevention or suppression with minimal impact on human health, the environment and non-target organisms. IPM incorporates all reasonable measures to prevent pest problems by properly identifying pests, monitoring population dynamics, and utilizing cultural, physical, biological or chemical pest population control measures to reduce pests to acceptable levels.”

While both federal and state regulations use the terms “cultural, physical, biological and chemical,” neither establishes their definition. Drawing from IPM’s agricultural model, examples of cultural measures might include crop rotation to minimize the risk of increased pest populations. Examples of physical controls include tillage or cultivation, and hand picking the pest. A classic biological control involves the introduction of a natural predator or vector to reduce or control the pest. Chemical controls are the use of pesticides.

In 1996, IPM Associates defined IPM as “a pest management system designed to provide long term management of pests, not temporary eradication of them,” in their work “Introduction of Integrated Pest Management (IPM) for ‘Urban’ Landscapes,” located on the Internet at www.efn.org/~ipmpa/ipmintro.html. They describe IPM in broader terms than the classic agricultural definition. Their description includes:

- a decision making process
- intensive information management methods and systems
- site specific prescriptive actions
- a multiple methods approach
- a core risk reduction strategy
- cost effectiveness

Integrated Pest and Vegetation Management on Rights-of-way in New York

IPM has its roots in agriculture, and a framework for the principles of IPM can be traced back to the 1940's and 1950's. As a result, the terminology and examples that are often used to describe key elements of a successful IPM program commonly draw upon this agricultural model. However, it can be difficult to borrow "off-the-shelf" programs and ideas from one discipline and apply them intact to another management system. Some modification or adaptation of terms is necessary, while still remaining faithful to the model and true to the intent of the regulation.

The introduction of the philosophies and principles of IPM into regulations for management of power line corridors is a more recent phenomenon of the 1990's. However, as described in Chapters 3 and 4 of this document, right-of-way managers in New York State have been applying the core tenets of IPM to electric transmission rights-of-way for much of the last quarter century. In fact, the model that has been evolving among right-of-way managers more closely matches the "Urban" model set forth by the IPM Associates, while remaining faithful to its agricultural roots.

For rights-of-way in New York, we began to see the first adaptation of terms related to IPM in the mid-1980s. It is difficult to describe the mighty oak or the sugar maple, which is the State tree, as a "pest" to a concerned landowner or citizens group. But oaks and maples are components of tall growing "vegetation," or pests that are capable of growing into overhead transmission lines and causing outages. Thus the term "Integrated Vegetation Management" (IVM) was coined in 1986 to describe the management processes associated with electric transmission corridors.

Subsequently, the terminology has evolved into a "position paper" on right-of-way vegetation management for the members of the Environmental Energy Alliance of New York (EEANY). A copy of this paper, entitled "Applications of Integrated Pest Management to Electric Utility Rights-of-way Vegetation in New York State" is included as Appendix 3.

IVM for rights-of-way traces its roots to the 1970's when the adoption of selective management strategies aimed to reduce or eliminate the need for wide-scale broadcast herbicide treatments such as aerial spraying and high-volume ground broadcast. Today's strategies are based on science and have been developed with input from society. The ultimate goal is risk reduction, while still including the "core" cultural, physical, biological and chemical control methods. However, as the concept of IVM continues to evolve, it will perhaps be more accurately described as an "Ecologically-Centered Vegetation Management" philosophy that incorporates the basic tenets of IPM in a broader context, while better defining and describing the dynamics of ROW vegetation management.

The Ecological System

National Grid's right-of-way management policy is to provide safe and reliable transmission of electric power to its customers in an economic and environmentally compatible manner. To accomplish this, each right-of-way manager applies a broad ecological overview ***to*** the principles of Integrated Vegetation Management.

Plant succession can be described as a process whereby a forest opening reverts from its bare ground state through time to an array of evolving plant cover types and communities, until a forest ultimately occupies the site once again. Some stages of succession may be relatively stable for periods of time, and some community complexes may be more resistant to further invasion by trees than other communities over time. Natural forces and disasters may interrupt this continuum, but on most sites the ultimate plant community will always be the forest.

Most transmission corridors cross a variety of land management practices and cover types, including areas of active management (e.g. cultivated fields, orchards, pastures, and the managed landscapes of homes and businesses), and areas of less active management (e.g. abandoned fields, shrub lands, and adjacent forest). At times, the activities of others will eliminate the need for ROW management intervention. At other times, it may increase the need for intervention. Typically, there are more acres of brush in the early stages of plant succession than there are acres that are actively cultivated or managed by others. However, it is the natural sites that offer the greatest opportunity for management intervention to create a rich, diverse array of compatible species that can be relatively stable and resistant to new tree invasion, and provide the greatest ecological benefits.

The opportunity for conflict arises when tall growing trees and shrubs are planted in the landscape or occur naturally through plant succession. When resurgent trees are allowed to grow into or fall on overhead transmission lines, a flashover and electrical fault to ground will occur, interrupting critical service and posing a risk to public health and safety. The sensitivity of the transmission system to tree outages that may occur under higher loading conditions was illustrated in 1996, when tree outages interrupted the Western transmission grid on two separate occasions, causing blackouts throughout the Pacific Coast and Rocky Mountain regions.

Regrowth problems that arise from stump sprouts and root suckers after clearing have been explored earlier in this document. No successful, economic alternative to herbicides has been developed that will prevent this reinvasion. At the same time, right-of-way managers have come to know that herbicides are simply one tool, and that the successful program can reduce its reliance on herbicides over time. This is accomplished through successful management of the right-of-way ecosystem, as explained in this chapter and in the "Cycles and Trends" chapter earlier in this document. Finally, managers have also learned that adherence to a well-planned cycle of inspection and scheduled maintenance is essential to optimize the timing of herbicide treatments and to the effective implementation of a herbicide reduction strategy.

Field experience and research has found that the “optimal” ROW vegetation condition is a blend of ferns, herbaceous plants (forbs and grasses), and shrub communities. This rich, diverse blend of smaller plants and plant communities maximizes the competition for sunlight, water, and soil nutrients that in turn tend to retard reinvasion and suppress tree seedlings in their under story for a number of years. Such communities can also develop tight, dense root systems making it more difficult for some tree seeds to germinate and develop. A blend of herbaceous and shrub communities also provides important habitat to a number of animals such as field mice, meadow voles, rabbits, and deer which in turn feed on tree seeds and small seedlings. Seed predation and herbivory by small mammals has been demonstrated to destroy tens of thousands of seeds and seedlings per acre over a management cycle. This mixture of low growing ferns, herbs, and shrubs also provides nesting and other habitat features for a number of other species, including grass and shrub nesting songbirds, insects, and a host of other game and non-game animals.

In this ecological model, the ultimate control program is one in which vegetation itself, together with the entire ecosystem, resists tree invasion and reduces the need for chemical intervention. Treatments then become more and more selective, targeting the scattered trees and taller shrubs that escape competition and predation to eventually emerge above the canopy of the compatible communities. The optimal ROW management policy embraces these principles and practices, while applying the traditional IVM methods to achieve the system reliability and cost goals. This approach requires a full understanding of natural processes and systems that is based on science and research, balancing these with knowledge of land use patterns, individual landowner requirements, public perceptions, and regulatory constraints.

A Comparison of Historic Agricultural IPM to ROW IVM

The application of traditional IPM definitions from the agricultural model IVM methods within the ROW might include:

- Cultural methods: The ROW is converted from tree growth to a compatible use, through cooperative agreements with adjacent landowners to enable pasturing or cultivation, or Christmas tree production. It could also be converted to wildlife food plots or special habitat through partnerships with conservation and wildlife groups. In a more urbanized setting, cultural methods might include easement agreements that establish a managed landscape or even paving the ROW.
- Physical methods: The use of traditional hand cutting and pruning, as well as mechanized clearing such as mowing or grubbing. Physical methods that have been studied include the general use of fire for controlled burns, as well as “flame thrower” type equipment to destroy the cambium area of the tree with basal fire treatments.

- Biological controls: The introduction of natural enemies. To date, forest and ROW management programs have been unsuccessful at introducing natural diseases or predators, such as insects, due to the difficulty in keeping the vector or predator within the bounds of the right-of-way. In addition, while some research exists on the naturally produced herbicides of some plants, known as allelopathy, many believe that the effectiveness of these natural herbicides in reducing or eliminating other species is small when compared to the forces of natural competition for sunlight and available soil nutrients. Except for limited work on the use of natural decay fungi for stump treatment, little field experience or research exists for developing either natural herbicides, or insect or disease pathogens for field application.
- Chemical controls: The selective application of a number of herbicide products, mixtures, and delivery methods, with individual treatment regimens prescribed on a site-by-site basis. High-volume, broadcast operations have not been used extensively since the first cycle, when initial ROW reclamation efforts were completed. The near elimination of the site conditions that require high-volume treatments today is a testament to the success of ecologically centered management that employs IVM methods.

A Comparison of IVM to the Core Principles of Urban IPM

In its "Introduction to IPM for 'Urban' Landscapes," the IPM Associates, Inc., set forth that "IPM in theory and practice is guided by an established set of principles." These principles describe IPM as:

- an ecologically sophisticated management process
- information intensive
- employing all available pest control methods
- mitigating negative environmental impacts
- requiring appropriate standards for pest control
- emphasizing prevention of pest problems
- promoting the use of methods that provide long-term pest control

The IVM policies and practices for a Transmission Right-of-way Management Program incorporate these guiding principles for "urban IPM" as follows:

1. IPM is an ecologically sophisticated management process.

   This principle establishes that *"IPM programs utilize an ecological approach to pest management that employs extensive knowledge of individual pests and their relationship with their environment. This holistic view of the pest management system is essential in managing the variety of factors that influence the development of pest problems."*

   To achieve this, the ROW manager must be familiar with the growth habits and differences of the multitude of tree and shrub species encountered on the ROW, together with their relative stability or instability, and the species regrowth characteristics. They must thoroughly understand the response of different species and communities to various management practices, and they must know the ecosystem dynamics each community generates. The manager must then balance these values with system reliability requirements, operational constraints, social values, and public perceptions.

The sophistication and success of the IVM approach has already been demonstrated. This could not have been accomplished without a commitment to research that is designed to fill the gaps in our knowledge and understanding of natural systems, and the response of these natural systems to a variety of management alternatives. Over the years, National Grid and the New York utilities have relied heavily upon research to expand their knowledge of natural systems and to base their management practices on science. As a result, they have become industry leaders in IVM research, completing more than 13 studies since 1974, at a cost of over $3 million. A summary of this research is included in Appendix 4.

2. IPM is information intensive.

The Urban IPM framework states, *"IPM decisions depend on detailed information about a variety of important factors such as: pest life cycles, site conditions where pests are located, the maintenance history of individual sites or features, previously applied pest control techniques, and the presence of predatory agents. An IPM program's database is one of its major assets and requires a collection and processing system so this information can be used effectively for implementing pest management activities, for evaluating the program, and for developing programs improvements."*

The importance of information systems to facilitate the collection, reporting, and analysis of data in a successful integrated vegetation management program was recognized as early as 1980, when the Program was first developed. The information system was originally designed to capture and report data at the site level, while building hierarchical reports to the ROW, Region, and even System levels. This computer system became known as the Transmission Right-of-way (TROW) program. It provided a hierarchy of data that enables managers to readily analyze local, regional, and system data to determine species conditions, treatments and treatment response, costs, herbicide use, and effectiveness trends over the years. While the system has been periodically updated to facilitate field collection and data processing, the data elements that are reported have remained relatively constant. The essential field data includes site location, land use characteristics, environmental and public sensitivities, desirable and undesirable species conditions, past or present management prescriptions, treatment dates, and herbicide quantities. This information is carried from one cycle to the next and is regularly used to review and evaluate the effectiveness of management activities in meeting the program goals and objectives.

3. IPM employs all available pest control methods.

"The integrated use of multiple management options is a key to cost-effectiveness of IPM. While permissible, pesticide use is minimized through development and application of other pest management methods. In addition, careful evaluation and selection of pesticide materials is done to promote maximum utilization of products that are least toxic to non-target organisms and the environment."

"Conventional pesticide based programs have relied principally on only one method of treatment for effective pest control."

While no effective alternative to herbicides exists for controlling undesirable, tall growing woody growth within utility rights-of-way once these species become established, a successful ecologically-centered management program that employs IVM methods will foster and encourage smaller, compatible plants and plant communities. These desirable communities then become the primary non-pesticide management option for effectively reducing undesirable stem density. The ultimate control is a condition where the vegetation itself, together with the entire ecosystem seeks to resist tree invasion through natural competition and predation, thereby retarding reinvasion and limiting the need for chemical intervention.

As undesirable stems begin to appear above the herbaceous or shrub layer, the ROW manager relies on regular field assessments and sound cyclical programming to optimize treatment schedules, and achieve maximum selectivity and effectiveness, while minimizing herbicide use and treatment costs. Once tall growing vegetation escapes the herbaceous and/or shrub layer, the ROW manager draws upon an array of treatment options, tailoring herbicide prescriptions to specific site conditions. On ROWs that have been converted to a relatively stable mix of smaller herbaceous and compatible shrub communities, herbicide applications will be highly selective; targeting low densities of the tall growing species that are scattered among the compatible communities before they invade the wire security zone.

National Grid has actively worked with manufacturers, industry experts, and research scientists since the 1970's to evaluate, test, and develop new herbicide products and delivery systems, and to understand their effects on desirable, natural systems. This program has a history of increased selectivity and continuous reduction in herbicide use. This has been accomplished by continually monitoring and testing herbicide products, mixtures, treatment methods and delivery systems, and implementing those methods that have reduced environmental risk. The result becomes an array of effective treatment methods and mixtures that can be tailored to specific site conditions and that pose the least toxic risk to non-target communities and the environment. While the program continually evaluates new products and delivery systems, investigations of non-herbicide alternatives are ongoing, weighing their ability to eliminate and control undesirable tree growth against the requirements for reliability and cost effectiveness. Areas of active research have included hand cutting, mechanical mowing, and grub and seed. Additional field plots were tested with fire (backpack flamethrowers) and controlled burn. Data for sheep grazing has also been reviewed and discussed with researchers.

4. IPM mitigates negative environmental impacts.

"IPM minimizes pesticide use and other environmentally disruptive pest control treatments to promote environmental quality, preserve the natural ecosystem, and reduce undesirable effects on non-target organisms."

The successful implementation of IVM strategies have converted the rights-of-ways to more stable herbaceous and shrub communities over the past 25 years and have reduced herbicide use by 84% since 1978. Additionally, today's management costs are at their lowest levels ever. The establishment of compatible communities has further enabled the ecosystem itself to become the primary control mechanism. As a result, treatments today can be prescribed to maximize the use of low-volume, stem specific methods, and further maximize the retention of natural communities. In addition, buffer zones and non-herbicide methods are prescribed to protect sensitive resources.

The use of habitat destructive methods such as grubbing is avoided, and mowing is restricted to work areas, access routes, and conversion sites to the extent practicable.

5. IPM requires appropriate standards for pest control.

"IPM promotes tolerance of non-damaging pest populations and appropriate thresholds for pest control that reduce unnecessary treatments. This enhances program efficiency and minimizes the application of undesirable treatments."

The National Grid Program uses regular field visits to audit and monitor crew performance and treatment effectiveness. This insures that all undesirable, tall growing stems that have "broke canopy" and emerged from the herbaceous or shrub layer, are controlled and resprouting is prevented. Small, undesirable stems that are suppressed within the herbaceous or shrub communities may remain unseen in the under story at the time of treatment, and yet succumb to natural competition or predation before emerging above the canopy.

While the Program's cycle length is broadly constructed around an eight-year cycle, individual cycles may vary from four to six years for lines in more sensitive areas, and up to eight years on other ROWs. Key factors in determining actual cycle length for a particular site or ROW include reliability requirements, construction and conductor clearance conditions, vegetation height and density, and visual and environmental sensitivity. Treatments are timed to minimize visual and environmental impacts, minimize long-term herbicide use requirements, ensure reliability, and maximize cost effectiveness. This is accomplished by scheduling treatments when most vegetation is within the optimal treatment height range for each right-of-way and before undesirable vegetation can grow into the “wire security zone.”

The wire security zone is the **vegetation free zone** that must be obtained between the conductor and the top of vegetation at the time of treatment. The program also utilizes regular patrols and field assessments to monitor growth conditions and determine optimal timing for the next treatment cycle. Factors weighed in the scheduling decision include the heights and density of undesirables, undesirable re-growth patterns (e.g. stump sprouts and root suckering vs. seedling growth), age since last treatment, past treatment effectiveness, selectivity and herbicide use requirements, the impact of prescribed treatments on nearby desirable vegetation, and other factors.
For example, a site or line that exhibits poor control and rapid regrowth after topping or pruning or from stump sprouts or root suckers may be rescheduled on a shorter cycle. “Short cycling” in this example may actually treat smaller sized undesirable regrowth than waiting for the “normal” cycle, effectively reducing herbicide use with less impact on desirable vegetation and greater long-term effectiveness. The treatment cycle for another line may be extended if the average height of target vegetation is smaller than the optimum treatment height, or if the line has taller construction and the target stems are light and scattered with adequate wire security zone clearances. The lengthening of the cycle in these examples will actually reduce the herbicide requirements over time.

While National Grid’s current cycle represents one of the longer treatment cycles in the State, the use of selective, low-volume treatments has enabled the Program to minimize costs, maximize effectiveness, and provide one of the lowest application rates in the State.

6. IPM emphasizes prevention of pest problems.

“Effective utilization of IPM design and site modification practices reduces the need for pest control treatments, helping to minimize pesticide use requirements and making resources available for other maintenance priorities. In turn, these benefits promote environmental quality and facilitate improvements in the aesthetic quality of the resource system. It also reduces life-cycle maintenance costs of specific landscape features.”

An effective IVM program strives to reduce or eliminate those site conditions that require the use of high-volume broadcast treatments over large segments of the entire right-of-way. This is accomplished through implementation of selective treatment practices that will effectively control undesirable tall-growing stems while fostering a rich, diverse, competitive mix of herbaceous and woody shrub plants and communities. The most successful programs modify their management practices to encourage this ecosystem design, and strive to reduce and minimize adverse impacts to the natural system itself.

IVM on New York's rights-of-way has been a quietly evolving success story that can be directly attributed to the adoption of long-range management plans in the late 1970's and early 1980's. These plans have been designed to accomplish this ecosystem approach and:

- foster and encourage the development of low-growing, compatible vegetation
- utilize site specific prescriptive application methods
- adhere to sound cyclical programming guidelines
- receive consistent funding

Most high-volume broadcast treatments have been replaced by selective, low-volume methods as the rights-of-way have been converted from a medium to dense tree condition into relatively stable communities of compatible species. For example, the last use of helicopter application on the National Grid system occurred in 1982 and very few lines or sites today have undesirable densities that require extensive high-volume broadcast treatment.

Moving forward, the vegetation management practices will strive to preserve the ecological quality that has been achieved; minimize adverse impacts on desirable communities and cover types; and prevent or avoid soil disturbances that may lead to an increased erosion potential or seedbed preparation, including re-invasion by undesirable tall growing species. For example, improvements to clearing and tree removal equipment are enabling a shift toward tracked excavators and tree harvesters for danger tree removal in some areas. This equipment reduces the ROW scarification and disturbance along the edge that may be caused by turning when conventional bulldozers with brush rakes are used for danger tree removal operations. At the same time, there are clearly instances when the use of conventional skidder buckets and bulldozers represent the most effective option for danger tree removal, and seeding and mulching may be required to mitigate disturbance.

The implementation of a tree replacement program in 1998 has helped to soften the need to remove problem trees from the landscaped setting, enabling cooperation with property owners to maintain important aesthetics and landscape values while reducing future maintenance problems and increasing reliability.

7. IPM promotes the use of methods that provide long-term pest control.

"Like IPM practices that prevent pest problems, those methods which provide long-term pest control benefits also enhance program efficacy, promote environmental quality by reducing the need for undesirable treatments such as pesticide use, and enhance the aesthetic quality of the resource system components."

"Conventional pesticide-based management programs provide only short-term pest control and, in the long term, potentially involve negative impacts on program efficacy and environmental quality."

The transition from high-volume broadcast methods designed to eradicate all woody brush to selective treatments of isolated, scattered or light individuals or clumps within the right-of-way landscape, have in fact provided the long-term control benefits described above. These practices have led to continued reductions in undesirable species densities from cycle to cycle, and promoted continued reductions in herbicide use and costs while greatly enhancing system reliability.

The success of today's program is reinforced by a number of research projects that found the right-of-way to be a biologically rich, diverse array of plants, birds, and small animals that exist because of past treatment methods. In fact, with the continued conversion of old farms into forest lands, the utility right-of-way has become one of the last remaining areas of shrub habitat in New York today.

Summary and Conclusions:

The right-of-way management policies and procedures, first implemented in 1978 and continually refined over the past two decades, have evolved into a fully integrated vegetation management program. National Grid has relied upon both the science and art of ROW management, striving to become a recognized industry leader in right-of-way management practices. This has been accomplished through active participation in research and the continual review and implementation of recognized best management practices.

The success of the Program in achieving herbicide reduction strategies while improving the quality of the ecosystem is clearly documented, as is the ability of the Program to effectively reduce maintenance costs and improve system reliability performance. National Grid has been a statewide leader in the development and successful implementation of an ecologically centered management philosophy that truly embraces the principles and practices of Integrated Vegetation Management.

Additional proof that today's vegetation management practices and procedures are industry best practices is illustrated in the adoption of similar management principles and philosophies by the top performing utilities nationwide, together with the incorporation of these philosophies into a national right-of-way management policy. One of the best examples for the national adoption and inclusion of these principles has been the development of the Pesticide Environmental Stewardship Program (PESP) by the Edison Electric Institute Vegetation Management Subcommittee, a copy of which can be found in Appendix 5. The strategies of this PESP have in turn become the cornerstone for a voluntary partnership between utilities nationwide and the US Environmental Protection Agency on integrated vegetation management. The IVM position paper for the New York utilities played an integral part in the development of these national strategies.

VI. Transmission Right-of-way Management Program: Goals, Objectives, and Strategies:

Right-of-way Vegetation Management Policy

National Grid's Transmission Right-of-way Management Program is designed to provide for the safe, reliable transmission of electric energy in an economically efficient manner that protects the environment and is consistent with sound integrated vegetation management practices and philosophies. The Program shall support compliance with ISO 14001 standards and incorporate appropriate industry best management practices into daily operations, while ensuring that the Company remains a good steward of the environmental resources it manages. The Program shall incorporate good customer and public relations, and continually seek sound, practical avenues for improved customer relations and public education.

All right-of-way vegetation is to be maintained in a condition that strives to prevent interruptions caused by trees and tall growing shrubs. In addition, the natural and man-made ROW features are to be maintained in a stable condition that assures environmentally compatible access for routine and emergency line operations. This will continue to be accomplished through routine monitoring of right-of-way conditions, sound vegetation management planning, and implementation of the appropriate vegetation control techniques. The Program shall also seek continuous improvements in its state-of-the-art management systems and treatment methods.

Rights-of-way Included in the Program

National Grid shall include all electric sub-transmission, transmission, and bulk transmission (23kV and above) within this long-range Program. In addition, while rights-of-way constructed since the mid-1970's may have been subject to the environmental siting and construction provisions of Article VII of Public Service Law, including special clearing and construction requirements, the Company has actually incorporated future maintenance activities into the provisions of this Program. This incorporation enables uniform and consistent application of the same guiding policies, procedures, and practices to all rights-of-way regardless of when they were constructed. Special environmental terms and conditions that were established for a particular line or site through the Article VII process, and are relevant to protecting the resource today, have been included in Appendix 1, and are included for future maintenance consideration.

The provisions of this Program shall also be incorporated into gas transmission rights-of-way activities when the occasional use of herbicides becomes necessary to control undesirable woody growth that cannot be managed through regular mowing or when performing activities related to environmental protection or permitting. During discussions with PSC environmental staff, it was agreed that field inventories are not required for spot or occasional herbicide applications on gas facilities. A listing of Article VII gas transmission rights-of-ways is provided in Appendix 2, including identification of any special environmental protection measures that may have been established for these ROWs.

Cycle Length

Even though the company has exceeded its original vegetation management goals of improved reliability and habitat while managing cost and decreasing herbicide use through the first three cycles, continuous improvement and enhancement shall remain a top priority. As introduced in the second and third cycles, selected transmission facilities in visually sensitive areas on narrow corridors or through predominately residential areas, will continue to be scheduled on shorter cycles of four-to-six years. Wide corridors through predominantly rural areas where vegetation has successfully been maintained on a longer cycle will continue to be scheduled on no more than an eight year cycle. Results of treatments will continue to be assessed with respect to cycle length and overall Program goals.

Reliability Improvements and Program Enhancements

Trees and tree limbs falling onto the electric system from beyond the right-of-way edge are the main causes of tree outages. Prior to 1995, danger tree removal efforts focused primarily on pruning and removing scattered edge trees rather than extensive widening. Beginning in 1995, the reduction in undesirable stem densities created through the Integrated Vegetation Management (IVM) program began to generate significant cost savings. These savings have been reinvested in an expanded danger tree removal and widening program. Today's widening effort focuses on high-risk and critical segments of the transmission asset. This effort has reduced the probability that a tree will reach or hit the transmission system when it falls and has helped significantly reduce the number of tree-caused outages. While the adoption of IVM practices has been the greatest contributor to the success of today's Transmission ROW Management Program, problems with shrub retention practices have gradually developed. In the earliest days of the program, the regulatory community strongly supported the premise that dense, woody shrub communities provided the ideal landscape for ROW management. Additionally, crew training was simplified to target "big and green" trees while retaining "small and green" shrub communities. The long-range Program itself embraced these concepts.

However after more than two decades, some of these "small" shrubs have become too tall in some areas, invading the mid-span "wire security zone." The shrub community may then hide or mask undesirable tall growing species from the sight of treatment crews. As shrub communities become denser over time, they restrict access to large areas of the right-of-way, further increasing the chance of skips or missed stems during treatment. Shrub intrusion into the wire security zone reduces the vegetation free space between the conductor and brush. This increases the risk that as undesirable tree species emerges above the shrub canopy, or "escapes," a stem can quickly grow into the conductor area and cause an outage. In the last decade, outages caused by trees growing into the lines on either the 115 kV or the bulk transmission systems were attributed to the masking of an undesirable stem by a shrub community. There continues to be a high risk of not identifying the situation at the time of inspection.

This revision to the Transmission ROW Management Program emphasizes the need to modify the philosophy that dense shrubs create the ideal ROW condition, and to introduce elements of the "wire zone/border zone" concept first proposed by Bramble and Byrnes in their Gameland's 33 research in central Pennsylvania. The "border zone/wire zone" approach encourages a herbaceous condition under the conductor. The Company through this revision proposes to adopt a modified "border zone/wire zone" approach to managing its ROWs. The modified approach will target removal of certain tall growing shrubs in the wire zone while continuing to encourage low growing shrubs and herbaceous species in the wire zone. The detailed list of undesirable and desirable species to promote in the wire and border zones of the ROW is presented in Chapter 7.

As applied here, a modified "wire zone/border zone" will encourage a mosaic or blend of herbaceous species with smaller shrubs that may exist in the site and still be compatible with the height and reliability requirements of the wire security zone. This mosaic will strive for a maximum shrub density on most sites of about 70%. This will facilitate crew access to the under wire area and increase treatment efficiency, while still maximizing habitat and environmental values, and minimizing herbicide use requirements over the life of the right-of-way. While the lower profile of some lines or sites may require a predominately herbaceous wire zone, other lines or sites with taller design may tolerate a dense shrub condition. Where shrubs have already invaded the wire security zone, they will be selectively removed following the appropriate selection criteria defined in Chapter 7, Section F "Implementing the modified 'Wire Zone/Border Zone' Concept," and Section G "Definitions and Criteria of Vegetation Management Techniques" of this document.

Since shrubs are generally taller than most herbaceous communities, the competitive value of shrubs generally tends to be higher as well. However, a ROW dominated by shrubs can create access, reliability, and treatment problems as discussed above. Research has shown that shrubs provide maximum competitive value along the edges of the ROW, nearest the seed source. At the same time, researchers from the SUNY College of Environmental Science and Forestry Strategy (ESF) have identified the richness and diversity of the herbaceous communities as well, including finding more than 300 total species on the ROW. That study found 50 different grass species, together with 160 herbaceous, 15 ferns, 40 shrubs and 30 tree species in a single 15-mile section of a ROW near Rome, N.Y. This, together with other studies suggests the importance of these other, non-woody species in a fully ecological approach to vegetation management.

In the ESEERCO Report EP 85-38 entitled "ROW Vegetation Dynamics Study," which was done in the Hudson Valley, researchers identified the important roles of both herbaceous and shrub communities in maximum seed and seedling predation. That study found that white-footed mice contribute to heavy seed predation in shrub communities while the meadow vole contributes to predation of tree seedlings after germination. Field mice were primarily residents of shrub habitat, while the voles were found in herbaceous habitat. As a result, the Company believes that a blend of herbaceous and shrub communities may provide the optimal blend for predation.

Recent field observations by researchers investigating nesting success of field and shrub nesting songbirds within the Volney–Marcy ROW suggested an optimal blend of shrub and herbaceous communities of approximately 30-70% shrub cover may maximize the nesting success of shrub nesting songbirds within the right-of-way. Shrub densities above 70% may actually reduce nesting success for some shrub nesting species by increasing nest predation, while densities below 30% may tend to favor grass nesting bird species. When applied to the wire zone a mosaic of herbaceous and shrub communities could increase plant diversity and benefit wildlife, and while also improving crew access, reducing skips and eventual escapes, and improving reliability.

Looking ahead over the next decade, the long-range Program will continue to strive to:

- minimize herbicide use
- control costs
- continually improve worker and emergency access
- enhance system reliability performance
- control regrowth and invasion of undesirable species
- reduce undesirable densities
- implement an effective wire zone/border zone approach for appropriate mid-span areas
- manage for an optimal shrub-herbaceous mosaic across the ROW
- enhance customer and public communication and education
- meet or exceed all regulatory requirements

<u>A. Goal:</u> **To manage the right-of-way in a manner to assure the integrity of the transmission facility.**

The goal of assuring the integrity of the transmission system encompasses the long-term stability of right-of-way vegetation and the interaction of vegetation on system reliability. It also incorporates the requirements for ease of access by maintenance or emergency response crews, environmental stability of the land resource, and reporting adverse use.

1. **Objective:** Sustain the long-term stability of desirable plant communities across the right-of-way mosaic, and use natural interference and predation to maintain or reduce the density of undesirable, tall-growing tree species. Seek to maintain undesirable species densities predominately within a range of very light to light density.

   All vegetation maintenance activities shall be completed in a manner that effectively controls regrowth, while striving to minimize herbicide use. Treatments shall minimize adverse impacts to adjacent compatible vegetation and prevent damage to environmentally sensitive resources.

   Strategy: a. Apply sound IVM principles to foster and encourage the development and expansion of a relatively stable mix of herbaceous and shrub communities within the ROW, and to selectively treat undesirable vegetation.

   b. Use site-specific prescriptive programming of proven, effective control techniques; employ properly trained and certified personnel; and maintain appropriate monitoring systems.

2. **Objective:** Continuously improve electric system reliability by reducing the risk of tree caused interruptions from trees growing into the wire zone from beneath the conductor.

   Strategy: a. Apply the “wire zone/border zone” principles at appropriate mid-span areas, where the mature height of shrubs or shrub communities may grow into and significantly reduce the wire security zone clearances. The wire zone/border zone methods shall be selectively applied to sites or lines where tall growing shrubs increase the risk of a tree caused outage. These sites shall be managed as to maximize their conversion to a stable mosaic of herbaceous and smaller shrub communities.

3. **Objective:** Continuously improve system electric reliability by reducing the risk of tree caused interruptions from trees falling onto the transmission lines from beyond the ROW edge.

Strategy: a. Monitor transmission edge conditions and system performance to identify potential high-risk facilities, and widen and remove the danger tree edge to the extent permitted by existing easement and landowner agreements.

Strategy: b. Establish and implement a comprehensive transmission danger tree program.

4. **Objective:** Improve and maintain clear access routes along the ROW to all electric and gas infrastructure to facilitate routine and emergency vegetation management and transmission line operations.

Strategy: a. Maintain all existing access routes and travel paths keeping them free of all woody growth, and establish a 15-foot wide access route to all electric tower sites.

b. Utilize the wire zone for the travel path wherever possible in an effort to improve conductor-to-vegetation clearances.

c. Improve structure access by increasing the work zone at the base of each electric structure to a 15-foot radius that is free of woody growth.

d. Remove vines and vegetation growing on the electric and gas structures at the time of routine maintenance operations.

e. Repair existing access roads when erosion threatens future accessibility and environmental quality.

f. Periodically establish permanent access roads into remote or difficult access areas to improve working conditions for day-to-day and emergency line operations.

g. Maintain or install cross-drainage devices, swales, ditches, and other improvements to prevent water damage to access routes, facilities, and other environmental features.

5. **Objective:** Work with adjacent property owners to restrict adverse ROW uses and exercise control over vegetation growth, access, erosion control, and all other activities that could effect reliable transmission service.

Strategy: **a.** Encourage fee ownership of all 115 kV ROWs and above, and obtain easements for existing ROWs when it is determined no easement exists.

b. Promptly report encroachments, dumping, and other adverse use conditions identified through routine patrols and monitoring activities to Security, Environmental Affairs, Right-of-way, Engineering, and other departments as required.

B. Goal: **To manage the right-of-way vegetation in the most cost effective manner commensurate with other right-of-way management goals.**

The goal of economic vegetation management is dependent upon the principles of sound, ecologically-centered maintenance to optimize natural ecosystem controls, maintain environmental quality and respond to social sensitivities, while reducing undesirable densities, improving worker efficiencies, and providing effective cost controls. The goal is also accomplished through periodic field assessments and optimizing the treatment schedule, and through the ROW inventory process and close supervision of management crews to assure the maximum use of prescriptive, stem specific treatment methods. Maintaining good access further helps to reduce costs by improving crew movement through the shrub communities and enhancing productivity. Costs are monitored by System/Divisional Forestry Strategy.

1. **Objective:** Identify and utilize the most cost effective vegetation management techniques.

Strategy:

a. Remain an industry leader in the development and implementation of an ecologically-centered maintenance program, stay abreast of the most recent industry research, and incorporate recognized industry best management practices.

b. Work in accordance with all safety, environmental, and public constraints.

c. Utilize crew training, field assessment and monitoring of treatment efficacy to assure site-by-site prescriptive assignment and completion, and accurate reporting of vegetation management activities.

d. Use the field inventory and work completion report to establish metrics for evaluating costs, treatments, herbicide use, and efficacy.

2. **Objective:** Establish and maintain cost-effective treatment schedules for each electric ROW.

Strategy:

a. Maintain "ROW Master Schedules" for each cycle to identify the optimum schedule year for every ROW within the overall cycle.

b. Shorter cycles (e.g. four and six years) may be established for ROWs that follow highly visible highway corridors, or on lines passing through predominately residential areas that require more selective or more frequent pruning and non-herbicide methods.

3. **Objective:** Establish and maintain cost-effective treatment schedules for each gas ROW.

Strategy: a. Maintain gas line rights-of-way by mowing.

Strategy: b. Incorporate the appropriate selection criteria and best management practices for herbicide application used on electric ROWs to gas ROWs when occasional or spot treatment is required to control undesirable woody growth not controlled by mowing.

4. **Objective:** Keep sufficient records to monitor ROW conditions, including long-term density trends for desirable and undesirable vegetation, herbicide use, and cost effectiveness.

Strategy: a. Continue to use the Transmission Right-of-way (TROW) computer program, which was developed during the first maintenance cycle and then enhanced in 1993 and again in 2000, to record and monitor costs, production, and performance; and also to schedule completions and monitor herbicide usage.

b. The system itself will continue to be measured against information technology improvements to continually provide essential information and data requirements for program analysis.

c. Compile and provide standardized reports to meet the PSC and the Department of Environmental Conservation (DEC) annual reporting requirements.

d. Utilize the historic reporting capabilities of the system to identify and share program performance, results, and success with regulators, researchers, and other vegetation management professionals through regional and national conferences and workshops.

C. Goal: **To manage the right-of-way vegetation in a manner that continues to encourage the development of a rich, diverse blend of stable herbaceous and compatible shrub communities, and to maximize the benefits of the total ecosystem in resisting tree invasion.**

The goal of managing right-of-way vegetation to encourage diversity and stability applies a broad ecologically-centered overview to the principles of IVM, to create and maintain a mosaic of compatible, low growing plant communities. This mosaic in turn provides the optimal condition to resist reinvasion by undesirable vegetation, and maximize access for routine and emergency vegetation management and line operations. It facilitates site-specific prescription and selective application of the appropriate IVM principles and strategies in a manner that effectively controls undesirable trees and manages tall growing shrubs, while minimizing impacts on desirable shrubs and herbaceous species.

1. **Objective:** Maximize the competitiveness and benefits of various low-growing plant communities.

   A. Strategy: a. Apply site-by-site prescription of vegetation management methods and selective application of approved herbicide products in a manner that effectively eradicates undesirable, taller growing species and prevents their re-growth from stumps and existing root systems.

2. Objective: Better understand the ecosystem dynamics of IVM, the response of desirable and undesirable components of the ecosystem to various management methods, and identify and examine data gaps in the knowledge base.

   Strategy: a. Remain abreast with the latest research developments into the environmental and ecological benefits and impacts of various herbicide and non-herbicide treatment alternatives, and strive to remain an industry leader in vegetation management research and expertise.

   b. Actively seek strategic partners in the development and completion of research initiatives to equitably share the benefits and economic burden of research with all parties.

   c. Publish, disseminate, and share results and experiences for peer review.

3. **Objective:** Improve crew identification of shrub and small tree species that are capable of invading the wire security

zone or otherwise interfering with reliable operation of the facility.

Strategy: a. Retrain field crews and supervision in shrub identification and mature shrub heights.

b. Train crews to recognize mid-span clearance conditions and apply selective clearing and treatment practices to those mid-spans and species that will invade the wire security zone at an early stage.

c. Encourage the development of smaller growing, stable herbaceous and shrub communities at an early stage in order to minimize future herbicide use requirements.

4. Objective: Continue a core pesticide reduction strategy to reduce long-term herbicide use requirements.

Strategy: a. Actively seek and test new products, treatment methods, and delivery systems to provide greater environmental compatibility, reduced environmental risk, increased public and worker safety, while meeting or exceeding system reliability and effectiveness requirements.

b. Utilize test plots, field studies, industry workshops, research and other sources to keep abreast of products, treatment methods, and delivery systems.

c. Optimize the selectivity of all herbicide treatment methods so as to reduce the gallons per acre use requirements and minimize the "zone of effect" on adjacent shrub and herbaceous vegetation.

D. Goal: **To maintain the environmental quality of sensitive resources and areas of the right-of-way.**

The goal for maintaining environmental quality encompasses the way in which the program is administered and the vegetation is managed. It requires that the program and its related activities are applied in a manner that is compatible with sensitive resource requirements such as areas of high visibility, sensitive wetland or aqueous resources, endangered species or unique cultural resources, and similar significant resources.

1. **Objective:** Foster and maintain visual screens of naturally occurring compatible vegetation at locations with high visual sensitivity.

   Strategy: **a.** Foster buffer zones of natural low-growing vegetation at high use road crossings or other areas of high public use sensitivities. Manage the height of vegetation in these buffer zones in such a way as to assure transmission line reliability and wire security zone requirements.

   b. The pruning and topping of tall growing trees may be used to satisfy the aesthetic requirements when compatible shrubs and small trees are absent. This is the least desirable screening method and the cost benefit of removal and replacement planting will be considered when pruning costs become excessive or create a potential public safety risk.

   c. Undesirable vegetation will eventually be removed and converted to more compatible species to fulfill the screening requirements up to the limits of the easements.

2. **Objective:** Protect sensitive aquatic resources from the adverse impact of maintenance activities, i.e. herbicide contamination, erosion, or physical degradation.

   Strategy: **a.** Maintain buffer zones of compatible low-growing vegetation at sensitive aquatic resources, including lakes, ponds, and streams.

   b. Utilize highly selective, stem specific treatments within these buffers together with herbicide products that are specifically approved for ditch bank, stream bank, or aquatic use.

c. Employ non-herbicide management methods within the buffer zone when a risk of contamination exists.

d. Obtain permits from the DEC as required for herbicide application in State regulated wetlands and wetland buffer zone areas. Utilize geographic information system (GIS) or other suitable mapping capabilities to provide an annual DEC submittal of lines and wetlands to be treated. Maintain regular communication with the affected DEC departments.

e. Provide each county Department of Health (DOH) with an annual schedule and map of proposed treatment areas, in order to identify public drinking water resources that may be within or adjacent to the right-of-way. Also provide a list of treatment methods and herbicide products to be used. Work with the county DOH director/personnel to appropriately avoid or minimize potential adverse impacts.

f. Identify private drinking water supplies within or immediately adjacent to the ROW through the field inventory process, and establish appropriate buffer zones to maintain and protect water quality.

g. Conduct all treatment activities adjacent to sensitive aquatic resources to maximize the retention of compatible shrub and herbaceous communities and reduce or eliminate the risk of erosion.

3. **Objective:** Work with appropriate state, federal, and private agencies to identify and protect known populations of endangered species resources; understand the risks of vegetation management activities on the species; and prevent incidental damage or take.

Strategy: a. Provide the DEC, by March 31of each treatment year, through the Natural Heritage Program, with an annual GIS or other suitable map submittal that identifies the location of various ROWs scheduled for routine maintenance each year.

b. Use information provided by the DEC and the Natural Heritage Program to identify known locations of New York

State or federally listed threatened and endangered species in proximity to scheduled activities.

c. Act as good stewards of the resource by collaborating with the DEC Endangered Species Unit to review and understand the risks and benefits of vegetation management activities on existing threatened or endangered species populations.

d. Communicate special treatment requirements and treatment timing to field supervision and crews, and implement all reasonable measures necessary to protect the resource.

E. Goal: **To manage the right-of-way in harmony with compatible multiple use practices, including agricultural, recreational, industrial, residential, and wildlife uses.**

This goal acknowledges multiple occupancy of the rights-of-way where such use is consistent with Company use and joint occupancy will not, in the Company's judgment adversely affect the rights of adjoining landowners or occupants.

Multiple uses encompass all uses of the right-of-way including the primary use, which is transporting electric energy or natural gas. Right-of-way uses are grouped into human land use and natural land use. Human land use includes residential activities, commercial, industrial, agricultural, highway, recreational, etc. Natural land uses include environmentally sensitive areas such as wetlands, streams, significant habitat, and less sensitive woodland and brush land areas.

1. **Objective:** Minimize and discourage incompatible uses of the right-of-way to the extent practicable.

Strategy:

a. Identify uses that are not compatible with the safe operation of the line through routine patrols and monitoring, including such activities as encroachments of buildings, structures, and certain adjacent construction activities, as well as logging or removing edge trees.

b. Install appropriate gates and barriers where they are likely to be effective and are needed to discourage unauthorized uses such as vehicular and ATV access that may threaten the integrity of the right-of-way or the environment by damaging access roads, culverts, stream fords, and desirable vegetation.

c. Notify the Environmental Affairs, ROW, Security, and Legal Departments upon identifying unauthorized use such as trespass and dumping. Coordinate with these departments and, where possible, assist adjacent owners to implement reasonable efforts to post and/or discourage these unauthorized or incompatible use and activities.

d. Employ reasonable means to educate, notify, and inform the public concerning the risks and impacts of adverse use. Seek prosecution of known or suspected violators.

VII. Transmission Right-of-way Procedures

A. Identification of ROWs Recommended for Treatment

1. Transmission Line Patrol

National Grid's Electric Operating Procedure (EOP T007) establishes procedures for transmission line patrols. In accordance with this procedure, Regional T&D personnel complete an aerial patrol of the entire system annually. This patrol provides for a visual examination of all transmission lines, and report conditions such as "broken or flashed insulators, towers, or poles; leaning, broken, or damaged cross arms; burned or frayed conductors; and general conditions of the right-of-way." Unusual ROW vegetation conditions, including insufficient tree clearances that are observed during these patrols, are reported to the Divisional Forestry Strategy personnel. Unauthorized dumping activities are reported to the Environmental Affairs, Law, and Security departments.

Comprehensive foot patrols are completed on a five-year cycle with 20% of the system completed each year. Once again, conditions that are within the responsibility of the Forestry Strategy personnel, such as unusual tree or vegetation conditions are reported to the Division Forester for inspection and implementation of the appropriate corrective action.

2. Division Forester's Assessments

Each Division Forester conducts aerial right-of-way assessments of all 115kV, 230kV and 345kV transmission lines within their respective territorial responsibilities each year. The purpose of these annual assessments is to monitor right-of-way conditions so as to protect the lines from interruptions caused by trees and tall growing shrubs. Any other environmental impacts, such as unauthorized or destructive use, are noted. Annual helicopter visual assessments are normally scheduled during the late spring to mid-summer periods as needed to identify critical electric line mid-span and danger tree conditions, and/or to review completion of the previous year's work.

In addition to the routine aerial assessments, Division Foresters or their designee, complete a ground based patrol of all 230 and 345 kV right-of-ways annually. This ground patrol focuses on vegetation both within the ROW and off-ROW danger trees. The annual ground patrol is carried out between September 1 and June 15 (of the following year). The ground patrol is completed as per the, "Procedure for Ground Patrols of 230 &345kV Transmission Lines" in Appendix 13.

The purpose for the Forester's aerial assessments and ground patrols are to:

- review the results of the previous year's work and carefully check for vegetation, herbicide, and treatment effectiveness;
- review the ROW at about mid-cycle to assure timely rescheduling of the next treatment and to look for "escapes" or "misses;"
- confirm maintenance priorities of lines scheduled for the next year;
- assure that potential trouble spots, identified by other sources, are reviewed by a qualified vegetation manager; and
- assure that ROWs requiring spot work or danger tree removal are also reviewed and prioritized.

3. Electric Conductor -to-Vegetation Clearance Requirements

Clearance Standards

National Grid specifies clearance distances to be achieved at the time of vegetation management work and minimum clearances to be maintained at all times. Clearance standards established by National Grid below conform to the following regulatory standards and industry guidelines:

- North American Electrical Reliability Counsel (NERC) Vegetation Management Standard FAC-003-1;
- National Electric Safety Code (NESC) Rule 218; and
- Applicable State and Independent System Operator vegetation management standards or regulations.

National Grid At Time of Vegetation Management Clearance Distances

When performing right-of-way vegetation management, the following At Time of Vegetation Management (ATVM) Clearance Distances, by voltage, shall be achieved. ATVM Clearances apply to incompatible species only

At Time of Vegetation Management Clearance Distances		
Voltage	**Vertical (feet)**	**Horizontal (feet)**
23 to 46kV	12	12 – 38
69kV	14	14 – 42
115kV	18	18 - 50
230kV	22	22 – 50
345kV	26	26 – 50

ATVM Clearance Distances are greater than the Minimum Clearance Distances. In establishing these clearance standards, National Grid considered site-specific conditions such as operating voltage, IVM techniques, fire risks, tree and conductor movement, species types and growth rates, species failure characteristics, local climate rainfall patterns, line terrain and elevation, location of vegetation within the span, worker approach distance requirements and the expected time frame (maintenance cycle) before vegetation management will be repeated at the site.

National Grid Minimum Clearance Distances not withstanding the ATVM Clearance Distances above, the Minimum Clearance Distances specified below shall be maintained. Minimum Clearance Distances shall be maintained at all times in order to prevent flashover between vegetation and conductors. National Grid has chosen to base the Minimum Clearance Distance Table 5 IEEE 516-2003.

Minimum Clearance Distances	
Voltage	**Radial Clearance (feet)**
12 to 46kV	1
60kV	2
115kV	4
230kV	6
345kV	10

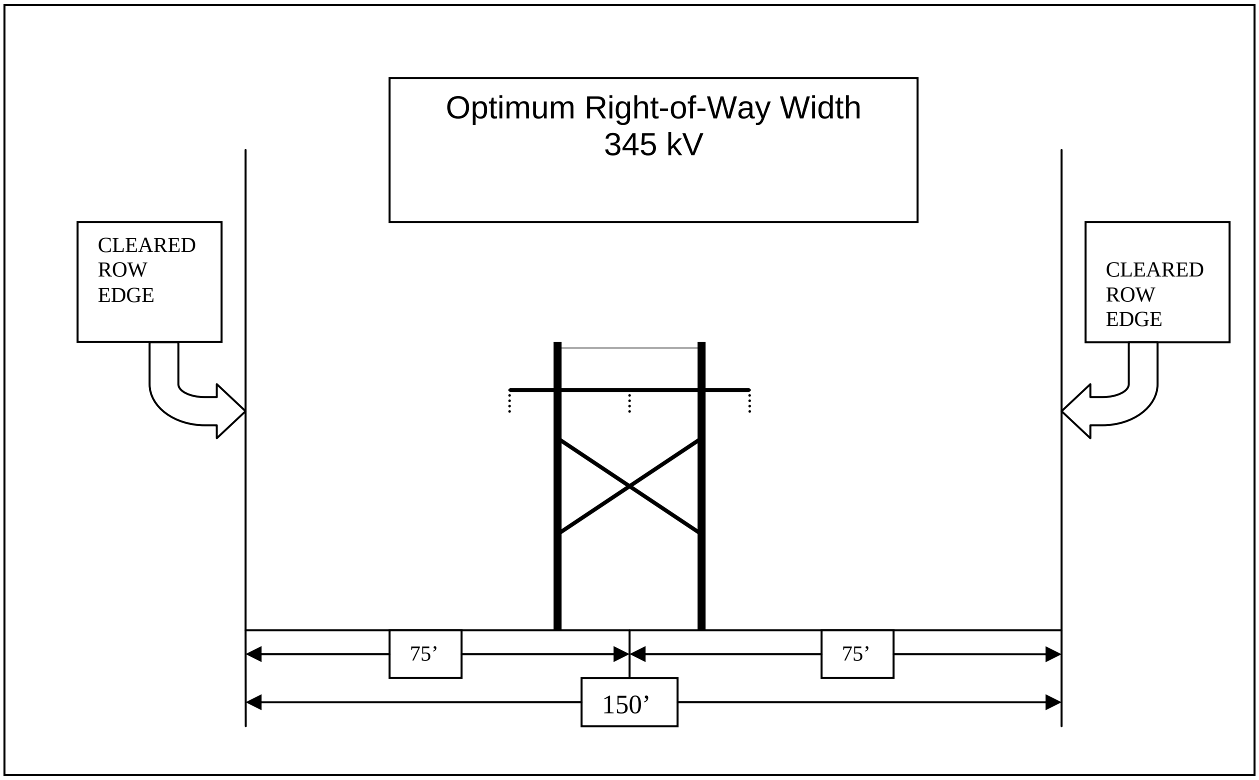
Note: ATVM Distances are under normal operating conditions. Minimum Clearances Distances are at maximum rated operating conditions.

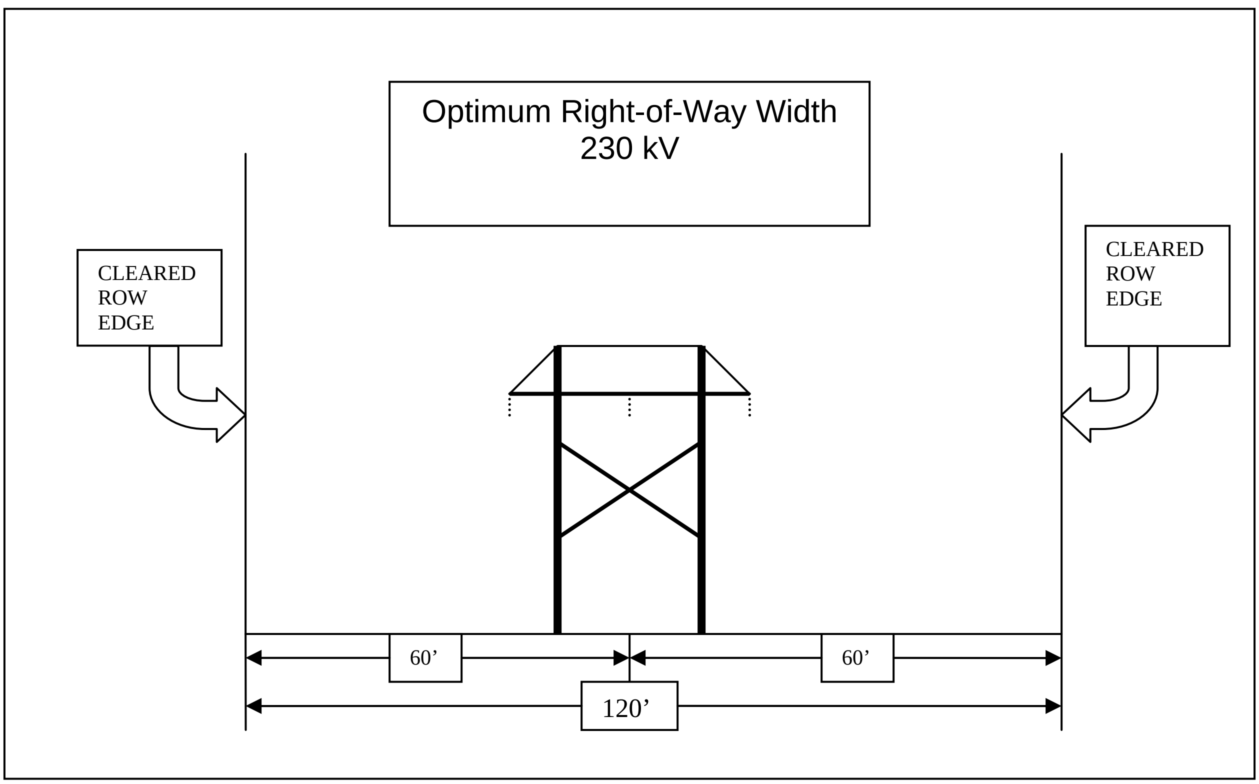
4. Optimum Right-of-Way Width

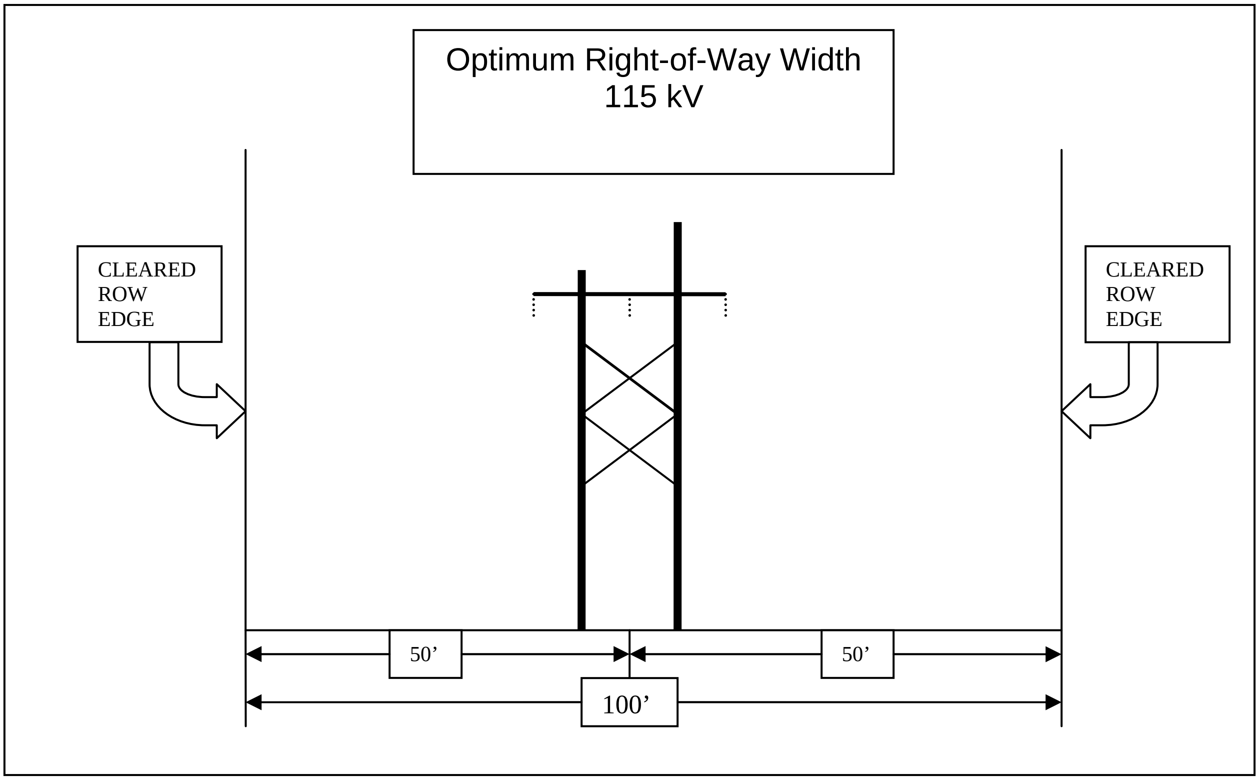
The above ATVM clearance requirements are based on the optimal right-of-way width required for various voltage classes. The optimal right-of width is defined as the linear distance from the center line transmission to the vegetation cleared limit of the right-of-way edge. The vegetation cleared limit is typically provided for by easements/fee owned rights-of-way purchased at the time of initial transmission line construction. A majority of transmission lines on National Grid's system have optimal rights-of-way widths; the remainder does not. This is why the ATVM horizontal distances were specified as a range. The optimum right-of-way widths specified below are those distances proven over 50 years of operational experience to render the combined benefits of good access, public safety, ease of construction and enhanced reliability. When new transmission lines are constructed, the optimal right-of-way width is obtained during right-of-way acquisition.

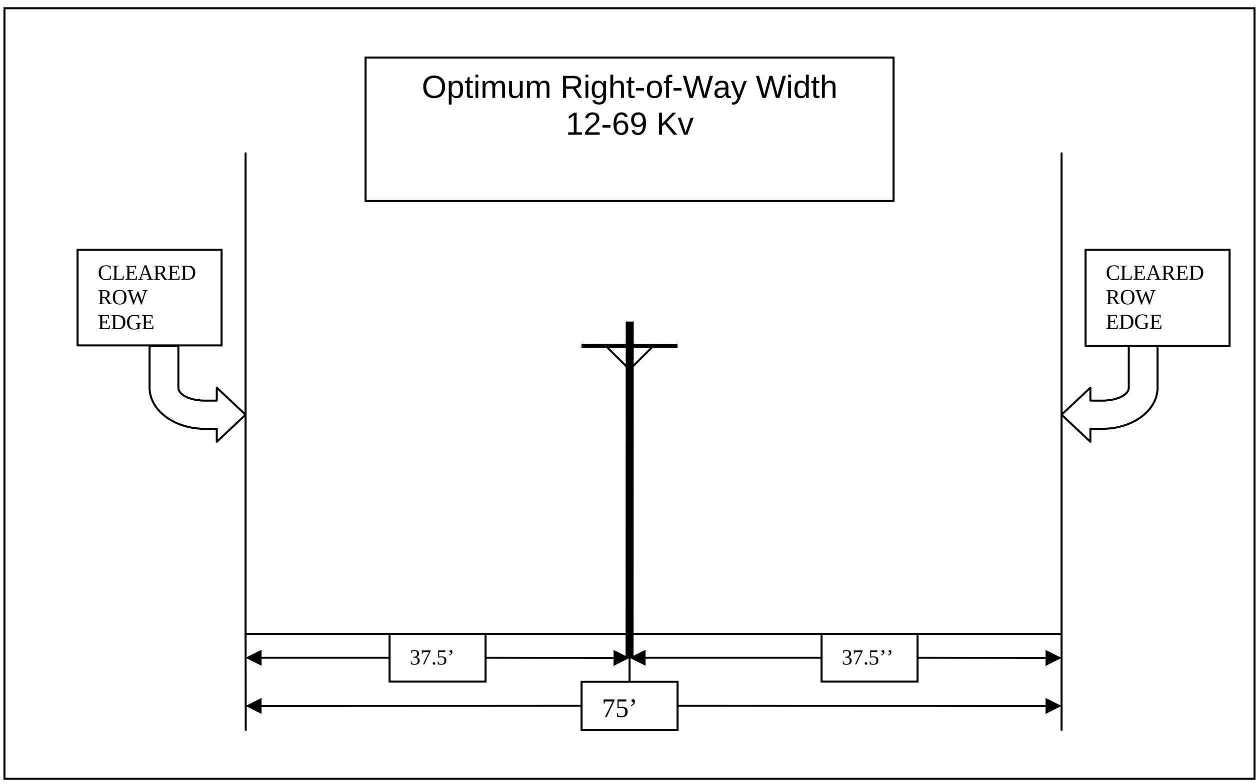
Optimum Right-of-Way Width	
Voltage	**Optimum Width (feet)**
12-46 kV	37.5
69 kV	37.5
115 kV	50
230 kV	60
345 kV	75

Refer to the following diagrams showing optimal right-of-way widths of typical right-of-way cross sections by voltage class.


Optimum Right-of-Way Width
345 kV
CLEARED
ROW
EDGE
CLEARED
ROW
EDGE
75’
75’
150’


Optimum Right-of-Way Width
230 kV
CLEARED
ROW
EDGE
CLEARED
ROW
EDGE
60’
60’
120’


Optimum Right-of-Way Width
115 kV
CLEARED
ROW
EDGE
CLEARED
ROW
EDGE
50’
50’
100’


Optimum Right-of-Way Width
12-69 Kv
CLEARED
ROW
EDGE
CLEARED
ROW
EDGE
37.5’
37.5’’
75’

B. Procedure for Scheduling and Reporting Corrective Action

The Division Forester is directly responsible for implementing corrective action although they may coordinate this work with other Forestry Strategy management personnel within the Division. Corrective work is generally reported through the crew time sheet reports. These time sheets are reviewed by the Forester and filed at the Divisional level.

Trees, brush, and/or unauthorized use that appear to be threatening the safe, reliable operation of the facility is closely evaluated during the Forester's aerial assessment by either circling the area or landing to make an on-site evaluation. If, in the Forester's judgment, immediate action is required, the appropriate field offices are contacted directly so that crews can be dispatched as soon as practicable to remedy the condition. One interim action threshold is sufficient. This threshold should be **Minimum Clearance Distance plus 6 feet**. Any sites with vegetation within these distances will be treated before the next growing season.

C. Determination to Schedule or Delay Maintenance

Following the Division Forester's submittal of proposed work to the Manager of Transmission Forestry Strategy, a determination shall be made to either schedule or delay maintenance. This determination is subject to System approval and budgetary constraints, and is principally based on such priorities as safety, reliability, economics, priorities, long-term ROW stability, and herbicide reduction strategies.

1. **Safety**

Safety relates to the requirement to schedule maintenance before the tree conditions create an unsafe work condition or endanger public safety. Vegetation that violates either EOP 211 Priority A clearance requirements, or the OSHA minimum approach distance requirements for safe removal by a qualified line clearance tree trimmer, may require the line to be de-energized before removal can be completed.

2. **Reliability**

Reliability relates to the effectiveness of the vegetation management program in locating and removing tall growing species and preventing tree caused outages. It also includes assuring access for routine and emergency maintenance. Undesirable vegetation height, danger tree and/or edge encroachment, and the height of buffer zone or residential vegetation may all become reliability factors. While system reliability is associated with the proximity of the incompatible vegetation to the conductor, treatment effectiveness relates to the height at which the undesirable growth can be most reliably controlled. To ensure system reliability, maintenance must be scheduled to prevent invasion of the minimum clearance distance. The program maximizes treatment effectiveness by generally targeting undesirable growth when it is at an average height of 10-15 feet.

Established ROWs consist of a mosaic of shrub and herbaceous communities. These communities effectively suppress and compete with taller growing tree species, reducing undesirable densities to very light to light conditions. However, optimal cycle timing and the height of treated vegetation have increasingly become factors in determining how tall the undesirable species are above the desired canopy and how close those stems are to the line. Effective timing requires continued monitoring of the clearances within the wire zone to insure that the target stems are visible and accessible to the crews, and that they have not grown into the minimum clearance distance and compromise reliability. These conditions may require greater flexibility in treatment heights and schedules going forward.

Conversely, newly cleared ROWs require follow up within one to two growing seasons to effectively control medium to dense regrowth that may not have been effectively controlled with stump treatment at the time of cutting. The objective is to treat these stump sprouts and root suckers when they average two to five feet in height, minimizing the herbicide requirements to achieve initial conversion.

Treatment effectiveness further relates to the dependability of one method versus another in achieving long-term control of the target stem. For example, foliar methods are generally more effective in controlling root suckering species than basal or stump treatments. Additionally, the treatment of taller vegetation on longer cycles is possible today through the development and refinement of low-volume hydraulic foliar applications.

3. **Economics**

Economics relates to the average cost per acre for various management techniques, versus their effectiveness in eradicating undesirable species. Since effective control of taller growing species is paramount to successful right-of-way management, treatments should be scheduled so that the optimum effective control is achieved at the most reasonable cost per acre per year. Additionally, techniques that are not effective in controlling and preventing regrowth or that cause significant damage to or eliminate desirable communities should be minimized.

4. **Priorities**

Priorities relate to the funds available for right-of-way management purposes. The first priority in recommending a right-of-way for maintenance shall be given to lines where undesirable vegetation is approaching the minimum clearance distance.

The Manager of Transmission Forestry Strategy shall review and prioritize local proposals for annual budgeting. A primary objective is to establish level funding requirements and uniform implementation across the System. The historic right-of-way acres combined with actual treatment costs for the preceding year shall become the basis for budgeting routine maintenance activities in the coming year. Mid-cycle spot work and danger tree removal efforts are generally budgeted for on an hourly basis. Once annual budgets are approved, the scheduled rights-of-way are assigned for inventory and completion.

5. **Long-term right-of-way stability**

Long-term stability relates to implementation of right-of-way management practices and procedures that result in an ecological condition that maximizes predation and competition; and minimizes reinvasion, treatment costs, and herbicide requirements. It incorporates the latest research and proven best management practices to sustain a fully integrated, ecologically-centered management program.

6. **Herbicide reduction strategies**

Herbicide reduction relates to the strategies and treatment methods available to effectively manage and control undesirable vegetation that escapes the predation and natural competition of the desirable herbaceous and shrub canopy. It relates to developing and implementing herbicide mixtures, treatment methods, and delivery systems that will continue to provide reductions in the amount of herbicide needed to achieve control, while affording the longest possible time between treatments. It also relates to the public, environmental, and aesthetic constraints of the right-of-way. For example, ROWs in highly residential areas may incorporate more non-herbicide methods, thereby requiring shorter treatment cycles. Similarly, ROWs that are constructed along visually sensitive highways may require shorter cycles to provide effective control without creating significant "brown-out" conditions.

D. <u>Procedure for Budgeting and Scheduling of Routine Maintenance</u>

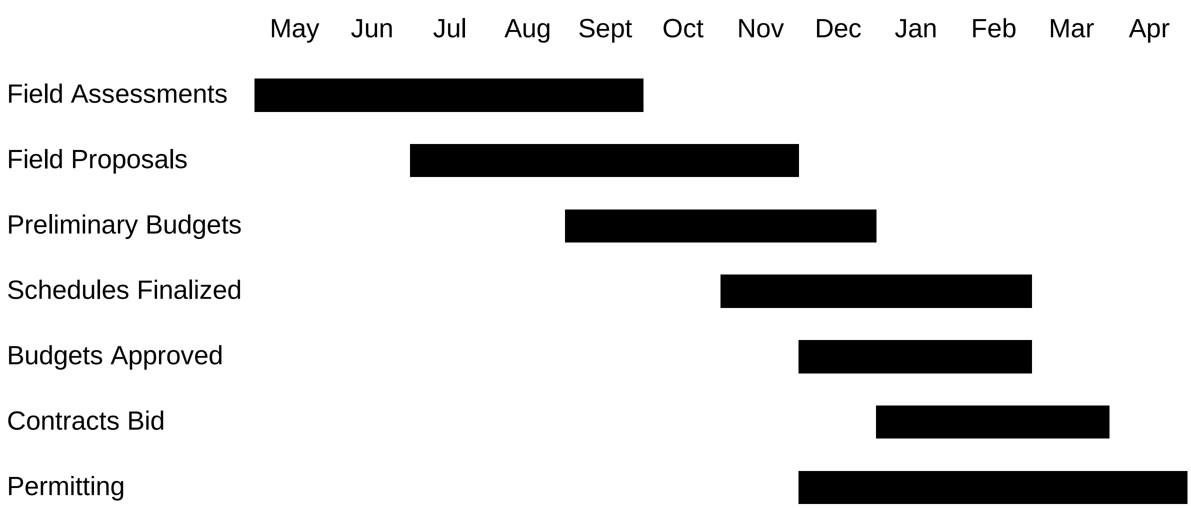
The Manager of Transmission Forestry Strategy shall maintain a master list of all rights-of-way to show the scheduled year for future maintenance activities and the actual acres completed in past years. The master list will be provided to the Division Forester and reviewed and updated annually to adjust for varying field conditions. It will also incorporate the results of the annual field assessment performed by the Division Forester. A copy of the transmission masters for the fourth management cycle showing the management plan for each ROW during the fourth cycle from 2001-2008 are included in Appendix 6.

The Division Forester shall utilize routine field and helicopter assessments to determine vegetation conditions. A right-of-way shall be scheduled for review the year immediately following treatment to evaluate the treatment's thoroughness and effectiveness. The right-of-way shall be scheduled for a general reassessment near mid-cycle, and then again annually as required to monitor growth near the end of the cycle. The Division Forester shall submit proposed revisions to the Manager of Transmission Forestry Strategy each year as required for timely review and incorporation into the budget approval process. The Division Forester shall further identify those lines or activities recommended for mid-cycle spot work, pruning, or danger tree widening for the budget process together with pertinent remarks about priorities, short- or long-cycle requirements, sensitive resources, or special treatments. These annual work plan recommendations are prepared on the basis of ongoing familiarity with local conditions, field review, analysis of right-of-way reports, records of previous treatments, and reports for other departments.

The Manager of Transmission Forestry Strategy shall then review and prioritize the Division recommendations, and prepare a preliminary work plan for the budget year in accordance with the annual schedule format illustrated below. Treatment costs are estimated based on actual unit costs per acre for routine maintenance within the right-of-way, while mid-cycle spot work and danger tree removal efforts are generally estimated on an hourly basis.

The following chart illustrates the timing of various ROW management scheduling and budget activities from the field assessments to contracting when required.

Time Frame
for the
Transmission ROW Maintenance Scheduling Process



Once the work plan is approved through the budget process, the Manager of Transmission Forestry Strategy shall develop an annual work plan for each Region in accordance with the following format. This plan will then be distributed to the Division Forester for review, comment, and implementation. The process is never static and allows room for modification any time field conditions dictate. This process allows for schedule changes to address changing field conditions and reliability requirements.

H E R B I C I D E   S C H E D U L E   R E P O R T
Treatment Year: 2010

ROW #	Region	kV	Short Description	Brush Acres

TYPE:	Sub - Transmission			
12200	NYCA	69	Amsterdam - Rotterdam	175.29
12202	NYCA	69	Rotterdam - Schoharie	239.03
12284	NYCA	34.5	Mechanicville- School St	194.12
12304	NYCA	34.5	Rosa Rd - Vischers	20.24
12602	NYNE	69	Amsterdam - Rotterdam	40.81
12614	NYNE	69	Mayfield - Northville	91.70
12616	NYNE	69	Mayfield - Vails Mills	55.59
12618	NYNE	69	Meco - Mayfield	128.74
12730	NYNE	34.5	Mohican - Hudson Falls	6.16
12742	NYNE	34.5	Spier - Ballston	238.34
12752	NYNE	23	Schenevus - Summit	107.22
Total No. Of Miles : 102.25			Total No. Of Acres : 903.12	

TYPE:	Transmission			
12016	NYCA	115	Albany - Greenbush	33.97
12022	NYCA	115	Greenbush - Churchtown	543.01
12030	NYCA	115	Hoosick - Bennington	52.05
12038	NYCA	115	Menands - Riverside	16.67
12040	NYCA	115	New Scotland - Reynolds Rd	506.30
12046	NYCA	115	Patroon - Albany	264.50
12048	NYCA	115	Riverside - Reynolds Rd	29.84
12060	NYCA	115	Spier - Rotterdam	144.91
12070	NYCA	115	Woodlawn - Pinebush	177.02
12514	NYNE	115	Spier - E.J. West	343.19
12516	NYNE	115	Spier - North Troy	453.67
12530	NYNE	115	Whitehall - Queensbury	50.55
12532	NYNE	115	Whitehall - Blissville (Rutland)	73.00
Total No. Of Miles : 159.60			Total No. Of Acres : 2416.52	

Danger Trees/Spot Work

12036	NYCA	115	Menands - Reynolds Road	Side Trim/DT
12004	NYCA	345	Leeds to Pleasant Valley	Side Trim/DT
12020	NYCA	115	Atlantic Cement-Pleasant Val	Side Trim/DT
12014	NYCA	230	Rotterdam - Bear Swamp	Side Trim/DT
12002	NYCA	345	Edic - New Scotland	Side Trim/DT
12058	NYCA	115	Spier - No Troy*	Side Trim/DT
12022	NYCA	115	Greenbush to Churchtown	Side Trim
12532	NYNE	115	Whitehall to Blissville	Side Trim
12514	NYNE	115	Spier - EJ West	Side Trim/DT
12502	NYNE	230	Porter - Rotterdam	Side Trim
12500	NYNE	345	Edic - New Scotland	Side Trim/DT

E. The Transmission Right-of-way Inventory

1. Inventory Method

The Division Forester shall ensure a detailed; site-by-site inventory is completed for each electric line right-of-way scheduled for regular maintenance either prior to or at the time of actual treatment. Currently, the Division Forester completes the inventories in advance of actual treatment, but in the future, treatment crews may be able to accurately report equivalent field inventory data at the time of treatment, using advanced information technology and handheld geo-referenced systems. Since gas ROWs are generally maintained by mowing, inventories for these ROWs are not necessary.

2. Purpose of the Site-by-site Inventory

A site is an area within the ROW that consists of a common land use pattern or characteristic, or that requires a unique and different treatment method from adjacent areas. Each site may be as large or small as a land use or treatment method requires. The smallest reportable site shall be a tenth of an acre.

The purpose of the inventory is to thoroughly assess site-by-site field conditions, accurately document desirable and undesirable vegetation conditions, insure the assignment of the appropriate prescriptive treatment methods, and record herbicide use requirements. The inventory also identifies special landowner concerns or sensitive site conditions. An example of the right-of-way inventory is included in Appendix 8.

3. Inventory Records

The inventory data is presently collected using handheld data entry systems to record site-specific data. Data collected through the inventory process is then transferred to the master program and summarized for a variety of reports that are used within the maintenance program.

The items documented in the site-by-site inventory include:

a) <u>Location:</u> The inventory shall describe the site in relation to the adjacent structures, assigning a unique management site number to each site. A management area shall be an area of similar vegetation components that warrant a common management technique.

b) <u>Land use:</u> The inventory shall identify the right-of-way and/or adjacent land use categories for each site, together with the site sensitivities that influence the management technique that is selected. In the event of multiple uses or sensitivities, the category having the greatest influence on the maintenance method chosen should be assigned. The special note area can be used to further describe and define sensitivities.

The land use codes have remained unchanged from the beginning of the program, which has allowed for consistent review and performance assessment over the last 23 years. The land use code for a particular site is a combination of numbers assigned to represent the land use activity, height, and density class of undesirables requiring treatment and the density of the retained shrub community.

The land use categories are:

Land use (in the thousands position)

- 1000 – Streams
- 2000 – Wetlands
- 3000 – Road Crossings
- 4000 – Commercial/Industrial
- 5000 – Residential
- 6000 – Active Cropland
- 7000 – Active Pasture
- 8000 – Brush Lands
- 9000 – Woodlands

Height - Undesirable, taller growing species (in the hundreds position)

- 000 – no height
- 100 – small (less than 6 ft.)
- 200 – medium (6 to 12 ft.)
- 300 – tall (over 12 ft.)

Density - Undesirables (in the tens position)

- 00 – no density
- 10 – very light (generally less than 100 stems/acre)
- 20 – light (up to 30% canopy cover, and 100 to 1,500 stems/acre)
- 30 – medium (30 – 65% cover, and 1,500 to 5,000 stems/acre)
- 40 – heavy (greater than 65% cover, and over 5,000 stems/acre)

Density - Compatible shrubs (in the ones position)

- 0 – none
- 1 – light (less than 30% woody shrub canopy)
- 2 – medium (30 – 65% canopy cover)
- 3 – heavy (greater than 65% canopy closure)

Undesirable Tall Growing Species

The following is a list of tall growing tree species that are considered undesirable in most right-of-way situations and should be removed from the right-of-way floor wherever practicable, to the extent permitted by landowner constraints and easement conditions. The primary objective of the Transmission Right-of-Way Management Program is to effectively remove and control the re-growth and reinvasion of these species.

In sites, due to terrain, conductor height, or other ROW variable, where a normally non-compatible tree will never reach the ATVM clearance distances, such tree may be retained on the ROW during routine maintenance as long as there is no undesirable affect or risk to access, construction, reliability or public safety. Such locations will be determined through a combination of field measurements, profile mapping or other technology and will also be routinely reviewed and verified during each inventory cycle

Species	Code	Species	Code
Ash	ASH	Cucumber Tree	CUC
Mountain	MAS	Elm	ELM
Balsam Fir	BAF	Hemlock	HEM
Basswood	BAS	Hickory	HIC
Beech	BEE	Hophornbeam	HOP
Birch	BIR	Maple	MAP
Cherry		Oak	OAK
Black	BCH	Pine	PIN
Choke	CCH	Poplar/Aspen	POP
Domestic	DCH	Red Mulberry	MUL
Pin (Fire)	PCH	Sassafras	SAS
Black Gum/Tupelo	BGU	Spruce	SPR
Black Locust	BLO	Tamarack/Larch	TAM
Black Walnut	BWA	Tree-of-heaven	THE
Butternut	BUT	Tulip/Yellow Poplar	TUL
Catalpa	CAT	Willow	WIL
Cedar	CED	Other	OTH
Chestnut	CHE		

Small to Medium Trees

The following is a list of small to medium trees that may be compatible along the edges of the right-of-way, except on narrower sub-transmission rights-of-ways. They should be removed from under wire areas except where the mature height would not invade the wire security zone, or local conditions do not warrant removal. Any plant on the right-of-way that invades the wire security zone may be removed. These smaller tree species may be preferred for retention in buffer areas and other sensitive sites rather than taller growing tree species.

Species	Code
Apple	APP
Buckthorn	BUC
Common Buckthorn	"
European Buckthorn	"
Dogwood	
Alternate Leaf	ADG
Flowering	FDG
Cedars	CED
American Hornbeam	
"Ironwood"	HOR
Hawthorne	HAW
Mountain Maple	MOM
Pear	PER
Shadbush/Serviceberry	SHD
Shrub Willow	WIL
Speckled Alder	ALD
Staghorn Sumac	SUM
Witch Hazel	WIH

Woody Shrubs

The following is a list of shrub species commonly found on rights-of-way across the service territory. While they are nearly always compatible in the border zone, several may grow tall enough to enter the wire security zone. Any plant that enters the wire security zone may need to be removed.

The conductor to ground clearances, the wire security zone requirements, and the mature height for each species will be key factors in determining which shrubs may be retained in the wire zone at each mid-span. For example, a bulk transmission line, with mid-span conductor-to-ground clearances of 38 feet and a wire security zone of 25 feet can have shrubs with a mature height of up to 13 feet in that site. Shrubs that have invaded the wire security zone will be targeted for removal. As shrub densities in the wire zone exceed 80%, by span, taller growing shrubs may be targeted for removal in an effort to maintain the values and benefits of the herbaceous component.

Species	Code
American Barberry	BAR
Chokeberry	
Black Chokeberry	BCB
Red Chokeberry	RCB
Blueberry	
Low	BLU
Highbush	HBL
Button Bush	BTN
Dewberry	DEW
Dogwood	DOG
Red Osier	"
Stiff (similar to Red Osier)	"
Grey	"
Silky	"
Roundleaf	"
Elderberry	ELD
Hazelnut	HAZ
American Hazelnut	"
Beaked Hazelnut	"
Honeysuckle	HON
Huckleberry	
Juniper	GRJ
Dwarf	"
Ground/Trailing	"
Mountain Holly	MOH
Mountain Laurel	MOL
New Jersey Tea	NJT
Norther Prickly Ash	NPA
Shrub Oak (Bear Oak)	SOK
Privet	PRI
Gooseberry	RIB
Rose	
Domestic	DOR
Multiflora	MUR

Woody Shrubs (continued)

Species	Code
Rubus	RUB
Blackberry	"
Raspberry	"
Silverberry	
American	SIL
Autumn Olive	AUT
Sumac	SUM
Smooth	"
Winged	"
Common Spicebush	SPB
Spirea	SPI
Sweetfern	"
Steeple Bush	"
Sweetfern	SWF
Viburnum	VIB
Arrowwood	ARR
Highbush Cranberry	HCR
Mapleleaf	MVB
Nannyberry	NAN
Northern Wild Raisin	RAI
Hobblebush	HOB
Winterberry Holly	WIN
American Yew	AMY

Climbing Vines

Bitterwseet	CLB
Grape	GRA

Note that some of these species can be classified as exotic or invasive – particularly autumn and Russian Olive. In addition, some of these species are noxious plants – particularly multiflora Rose and Poison Sumac. In some situations management objectives within and adjacent to the right-of-way may warrant the removal or reduction of these species. Future discussions with State and Federal agencies to address invasive and exotic species on a landscape scale may require modifications of the current treatment course of action for some species.

c) <u>Other site conditions:</u> The inventory shall also note areas of significant erosion and locations where failure or deterioration of stream crossing devices may have occurred; also dumping, trespass, or other incompatible uses should be noted. The Forester shall note locations where corrective action is required.

Additional landowner contact or notification requirements together with special terms or considerations shall also be noted in the inventory. A separate herbicide notification registry has been developed to identify adjacent landowners that have requested notification before herbicides are applied.

When the site includes a State regulated wetland, the DEC regulated wetland number shall be included in the special notes. Special notes shall also be used to identify locations with unique habitat, including special endangered species considerations, public and private water resources, etc.

Plan and profile drawings, together with GIS prints may also be utilized to identify specific site concerns.

e) Site specific maintenance prescriptions: Finally, site specific maintenance techniques are assigned to each management area, after careful consideration of all external factors. The acreage for each site is calculated.

F. Implementing the Modified "Wire Zone/Border Zone" Concept

1. Discussion

As previously described, the Program has been highly effective at increasing desirable shrub densities and reducing undesirable tree densities as well as minimizing herbicide use over the past twenty-three years. However, the increased shrub densities are creating greater accessibility problems for routine and emergency maintenance. In some areas, the intrusion of taller shrubs into the "wire security zone" is also reducing the clearance between the conductor and vegetation beneath the line. While the shrub community may never grow into the line, it now masks taller growing trees that are dispersed throughout the shrub layer and competing to emerge above the shrub canopy. When they finally emerge above the shrubs, they may rapidly grow across the reduced air space into the conductors to cause an outage, sometimes within a single growing season.

"Wire security zone" clearance requirements for desirable shrubs have been established to ensure system reliability. These clearance requirements vary by voltage, increasing as voltage increases. They are:

- 15 feet for sub-transmission (23, 34.5 and 46 kV);
- 20 feet for transmission (69 and 115 kV);
- 25 feet for bulk transmission (230 and 345 kV).

The increased clearance requirements of higher voltage lines are designed to reflect the increased importance of these lines, together with the increased sag experienced on these facilities.

While a primary focus of the Program through the first three cycles has been increasing shrub densities, research at both the state and national level continues to point toward a mosaic of herbaceous and shrub communities as providing optimal balance of costs, reliability, and environmental constraints. This, combined with the knowledge that some of these communities have become too tall for the under wire area strongly suggests the need for a change in vegetation management philosophies and practices in New York as it relates to the wire zone area. A review of the research in this area may first help to understand the principles and recommended practices needed to assure system reliability.

The role of herbaceous communities in right-of-way vegetation stability and system reliability has been studied extensively by Drs. Bramble and Byrnes during nearly 50 years of research in Pennsylvania. In 1982 they began to discuss a management philosophy they described as the "wire zone/border zone" concept. This approach encouraged the development of shrub communities along the right-of-way edges to resist tree invasion from the adjacent forest, while maintaining the area under the conductor in a blend of grasses, ferns, and herbaceous plants. And so the "wire zone/border zone" terminology was coined to reflect this management approach. Their work has resulted in adoption of this concept as a best management practice by utilities nationwide, including its adoption into the Pesticide Environmental Stewardship Program, which is a joint effort between the Edison Electric Institute and the U.S. Environmental Protection Agency. National Grid is a participant in the EPA's Pesticide Environmental Stewardship Program.

While the "wire zone/border zone" concept developed by Drs. Bramble and Byrnes encourages shrub communities along the ROW edges, it maintains the under wire area in a mainly herbaceous condition of smaller plants. This maximizes conductor clearances and assures easy access to the facility.

Encouraging dense shrub communities in the border zone, along the edge of the ROW, maximizes the competitive value of these species in resisting tree invasion from the adjacent forest by developing shrubs close to the seed source. The value of the dense shrub edge is affirmed, in the ESSERCO Report EP 91-16, entitled "A 15-year Appraisal of Plant Dynamics," which was a result of research done here in New York. The study identified that seed dispersal is greatest near the forest edge and reduces with distance from the seed source as you move out across the ROW. Therefore, it has been extrapolated from this study that we can maximize the competitive value by fostering dense shrub communities along the edge.

In New York, the right-of-way management philosophies have encouraged the development of shrubs across the entire ROW, believing that these shrubs would not grow into the conductor and that ROWs dominated by shrub communities would optimize ecological benefits and values. However, National Grid experienced seven outages to the bulk transmission system in New York from 1995 to 1999 where shrub communities hid developing tall growing species from the view of treatment crews. As these trees emerged above the canopy of the shrub layer following maintenance, they quickly grew into the conductor area to cause an outage. A review of research findings over the last several years also began to indicate greater ecological benefits when a blend, or mosaic of shrub and herbaceous species, are retained within the right-of-way.

For example, the ESEERCO Report EP 85-38, entitled “ROW Vegetation Dynamics Study,” confirmed the important role of mice in seed predation and meadow voles in the consumption of tree seedlings once a seed germinates. These animals consume thousands of seeds and seedlings each year that would develop into taller, undesirable vegetation if not for the predator. While, the white-footed mouse prefers a shrub habitat, a ROW dominated by shrubs could miss the benefit of seed predation that meadow voles provide. The meadow vole frequents the herbaceous community and eats tree seedlings after the seeds germinate. A ROW dominated by herbaceous species would lack the competitive value of the shrub layer and reduce mouse populations that consume seeds before they germinate. The research begins to suggest an ideal ROW mosaic might incorporate a blend of species conditions, with greater shrub densities along the edges and greater retention of herbaceous species toward the middle of the ROW under the conductor.

Another ESSERCO Report, EP 91-16 includes a study (No. 3) entitled, “ROW Richness and Rarity in Wetlands Study.” This study was among the first to identify the great richness and bio-diversity of wetland plant communities that have been created within the ROW due to past broadcast herbicide applications, including helicopter applications. Several unique, rare and threatened species were found to exist in the ROW due to past broadcast methods. This important richness and diversity may be lost in the future if taller shrub communities are allowed to dominate the ROW.

The State University of New York College of Environmental Science and Forestry Strategy has conducted a National Grid research project entitled, “ROW Management of Karner Blue Habitat.” Utility ROWs in eastern New York have been one of the last remaining areas of significant blue lupine populations. The blue lupine is a critical habitat for the endangered Karner Blue Butterfly. This project investigated the effects of various herbicide treatment methods on remnant blue lupine populations and found no long-term adverse impacts on critical lupine habitat from ROW maintenance activities using herbicides. Continuing work indicates that selective herbicide treatments may aid habitat restoration efforts by effectively controlling unwanted shrub communities, especially scrub oak that have been allowed to expand within the ROW and out compete important shade sensitive lupine and other nectar species.

Most recently, observations and field comments by researchers working on the Volney-Marcy 345 kV project in July of 2000 have begun to suggest an optimal shrub component for songbird nesting success may range from 30-70% shrubs. While still unconfirmed, some songbirds nesting in areas of high shrub densities may experience increased predation by small mammals. At the same time, herbaceous communities with less than 30% shrubs may encourage a shift in songbird nesting success toward grassland or field species. A mosaic of shrub and herbaceous communities would not only maximize worker access and improve their ability to avoid "skips" and "misses" it could also help maximize habitat and nesting values for the broadest range of songbirds.

2. Implementation

The importance of retaining higher density shrub communities along a forested edge of the ROW is clearly documented and shall remain a key goal of edge or "border zone" management. However, the continuum of research increasingly points to improved reliability and ecological benefits when the Program modifies the national definition of the "wire zone" from just herbaceous communities to include a rich mosaic of small shrubs and herbaceous plants. This expansion of the herbaceous component within the "wire zone" will increase the reliability, economic, and environmental benefits of the Program. At the same time this modification will create unique challenges and require enhanced crew training, coordination, and supervision in order to selectively target some shrub species while retaining others.

These challenges include teaching the crews to determine mid-span conductor-to-ground clearances, to apply the wire security zone standards for a facility, and to determine the mature height of shrubs that can be retained in the wire zone. These conductor-to-ground clearances vary with terrain, tower height and design, ambient temperature and sag variation. Some shrubs may be allowed to remain closer to a tower site while having to be removed near mid-span. In addition, crews will need to learn to identify individual shrub species much the same as they identify various tree species today. This information will need to be combined with the mature height of the species, and measured against the mid-span ground clearance and the wire security zone requirements.

Taller mid-spans may not require intervention to remove shrubs, while other low profile sites may require conversion of the entire mid-span if tall growing shrubs have already invaded the wire security zone and are dominating the wire zone. Most sites will only need selective removal to target individual stems or clumps of shrubs that have already grown into the "wire security zone."

For each line, crews will be instructed in the wire security zone clearances at the time of scheduled maintenance. They will strive to create a blend of herbaceous and shrub species where the maximum shrub component in the "wire zone" is generally no more than 70%. To the extent practicable, access routes, paths, and small openings will be created in the taller or more dense wire zones to enable future crew movement through the shrub layer to control the dispersed and emerging tree species.

Today, only a small percentage of the mid-spans have become overgrown with shrub species. This small percentage of sites enhances our ability to train crews to selectively target problem sites and mid-spans while minimizing costs and herbicide use requirements. At the same time, failure to institute corrective measures at this time will only magnify the problem going forward, increasing the threat to system reliability. Failure to act will also result in greater habitat disruption and destruction when remedial measures are finally implemented.

Actual implementation of the wire security zone clearance requirements will require a combination of site specific, selective herbicide and manual treatment methods. Some removal can be incorporated into the routine treatment schedule. Other sites will require off-cycle mowing or clearing to eliminate the initial threat, combined with a follow up herbicide treatment to target smaller resprouts and minimize herbicide use requirements.

G. Definitions and Selection Criteria of Vegetation Management Techniques

National Grid currently recognizes eight vegetation management techniques, with variations thereof to prescribe maintenance based on specific site conditions. A descriptive analysis of each vegetation management technique follows, including a list of site parameters associated with the selection criteria for each method. These guidelines are factored into the right-of-way management inventory and treatment prescription process by the Division Forester.

The Company recognizes that site conditions vary widely and a multitude of desirable and undesirable species conditions may occur within any given mile of line. The following guidelines have been instituted to meet this maintenance requirement in a manner that cost effectively controls undesirable species and retain desirable species whenever practicable, and minimize adverse environmental impacts. The basis of the company's Integrated Vegetation Management (IVM) program is recognition that each technique is suited to certain site conditions and that, given the wide variation in field conditions, no one tool is suitable to all sites.

1. Buffer Zones

Inherent in the National Grid's procedures for selection of treatment methods is consideration of buffer zones, which are designated to minimize the potential for off-target damage. When it becomes necessary to treat in proximity to aquatic resources such as streams, lakes, rivers, ponds, or non-jurisdictional wetlands with standing water, minimum buffer zones for use of non-aquatic herbicides shall be:

- 5 feet for cut/stump treatment
- 15 feet for low-volume backpack foliar
- 25 feet for low-volume hydraulic foliar
- 50 feet for high-volume hydraulic stem foliar

Note: Certain herbicide product label restrictions may be greater than these buffer zones. The more restrictive requirements are always followed.

Herbicides shall not be used within 100 feet of a potable water supply or DEC regulated wetland, unless otherwise allowed by permit, rule, or regulation. The Company is developing a GIS layer within its transmission mapping system that will help identify public water supplies located near our facilities.

Herbicide application within DEC regulated wetlands or the adjacent 100-foot buffer area is done in concert with the Company's statewide freshwaters wetland permit. This allows the Company to use the low-volume hydraulic foliar, low-volume backpack foliar, or the cut-stump treatment methods within regulated wetlands and adjacent buffer zones to control target vegetation. Herbicides with aquatic labeling are approved for use with these three methods.

Buffer zones or no treat zones are also incorporated for sensitive land uses such as active residential, active croplands and orchards, organic farms, active public parks, schools, and public recreational areas including golf courses and athletic fields.

- For all foliar techniques a buffer zone of reasonable size, generally 25-100 feet is maintained around active residential areas depending on site specifics. When herbicide treatment is required within these buffer zones for active residences, cut and stump treatment methods are used.

- For active croplands including active orchards, low-volume hydraulic foliar techniques use buffer zones ranging from 0-25 feet. For high-volume hydraulic foliar applications, the buffer zone range is increased to 100 feet.

- Low-volume backpack foliar and cut and stump treatment methods may be used right up to the edge of active cropland and orchards where appropriate. With the backpack method the applicator will stand and direct the application away from the crop or orchard area.

- For active parks, schools, and athletic fields, the buffers zones for foliar applications range from 10-25 feet for low-volume backpack operations to 10-50 feet for low-volume hydraulic, and 25-100 feet for high-volume hydraulic foliar applications. Note that no work may be completed on the property of public or private schools, or registered day care facilities without advance pre-notification under the NYS DEC pesticide notification regulations.

All of the specific buffer zone applications are included in the individual application method descriptions later in this section. In all cases, National Grid may utilize greater distances when the Forester conducting the field inventory finds aesthetic, public, or environmental reasons to increase the size of a buffer zone. This procedure allows the Forester to consider site specifics like slope, rock outcrops, soil conditions, densities of vegetative ground cover, proximity to water, height and density of undesirables, wire security zone, type and location of crops, natural buffers, and any off right-of-way sensitive areas.

	Buffer Zones in Specific Locations on the Right-of-Way (Feet)				
Treatment Types with Herbicide Application	**Streams, Ponds, Unregulated Waters**	**Regulated Waters**	**Active Residential and Ornamental Plantings**	**Crops and Orchards**	**Parks and schools**
High-Volume Hydraulic Stem-Foliar	50	100	100	100	100
Low-Volume Hydraulic Foliar	25	100	25	25	25
Low-Volume Backpack Foliar	15	100	25	0	25
Cut and Stump Treatment	5	100	0	0	0
Basal Application	15	100	0	0	0
Mowing and Cut Stubble Herbicide Treatment	25	100	NA	NA	NA
Cut Stubble Herbicide Application	25	100	NA	NA	NA

2. Environmental Impacts

Environmental impacts common to all vegetation management techniques are discussed below. The environmental impacts associated with a particular maintenance technique are discussed in the appropriate section.

The procedures outlined in this Transmission Right-of-way Management Program are primarily directed towards minimizing and avoiding any potentially adverse environmental impacts associated with herbicide applications. It has been proven that those adverse impacts to adjacent land, water resources, and off right-of-way vegetation can be minimized or completely avoided using prescription programming, proper buffer zones, appropriate supervision, and responsible, careful herbicide applications.

3. Off-Site Herbicide Movement

A study completed by the engineering firm of Calocerinos and Spina, "Herbicide Mobility Study," analyzed herbicide persistence in soil and movement from overland flow, soil leaching, and drift. The persistence of three herbicides (triclopyr, picloram, and 2, 4-D) used on rights-of-way in upstate New York was found to be no longer than 10 weeks. Since these herbicides biodegrade rapidly, the risk of off-site movement approaches zero, especially when proper buffer zones are established.

According to the "Herbicide Mobility Study" off-site movement of herbicides by overland flow into nearby streams, lakes, ponds, etc. was found to be highly unlikely. Overland flow of herbicides can occur when herbicide applications are immediately followed by rainfall. However, the linear extent of herbicide movement is minimal, as the herbicide degrades rapidly. Vegetation buffer zones are the key to preventing herbicide movement into environmentally sensitive areas.

Herbicide movement into groundwater via leaching is also highly unlikely. The "Herbicide Mobility Study" found that herbicide leaching to a depth of only 10-15 inches is rare. Downward leaching of herbicides is generally caused by rainfall immediately after application, heavy rainfall within a day after application, or through an application method that deposits large quantities of herbicide directly on the soil, such as conventional basal. For this reason, the company seldom uses basal application. The low-volume backpack foliar method has effectively replaced most basal applications today. The potential for herbicide leaching can be better minimized through the use of foliar techniques, since the majority of the herbicide product is targeted and intercepted by the foliage of the plant and does not reach the soil level.

Additionally, a 1994 Tufts University study entitled, "Study of Environmental Fates of Herbicides in Wetlands on Electric Utility Rights-of-way in Massachusetts over the Short Term," investigated the fate of two herbicides, triclopyr and glyphosate when applied in wetlands. That study identified low-volume foliar applications with glyphosate as the method of choice for controlling targeted trees. It also found there was no lateral or vertical movement of glyphosate in the soil, nor was there any accumulation of the herbicide.

Other herbicides used at National Grid, but not included in these studies are fosamine and imazapyr. However, the "Herbicide Handbook, Weed Science Society of America, Seventh Edition–1994" tells us that these products have little to no mobility in soil following application.

Off-site herbicide movement through drift can be avoided through proper application techniques. In fact, herbicides were not found at any off-site locations in this study.

4. Soils

Impacts to soils from vegetation maintenance techniques arise from compaction and rutting caused by maintenance equipment traffic along the right-of-way. An ESEERCO Report 80-5 entitled "Cost Comparison of Right-of-way Treatment Methods," found that soil compaction from wheeled maintenance equipment does occur; however, the amount of compaction is minor. A limited amount of erosion in the wheel tracks occur after treatment then diminishes during the following growing season. Due to the "once through" nature of maintenance equipment, compaction and erosion impacts from vegetation management activities are considered inconsequential.

5. Wildlife

An ecologically-centered approach to right-of-way management, employing IVM methods, promotes the selective retention of compatible vegetation and seldom results in long-term adverse effects on wildlife. Instead, selective maintenance techniques generally increase the abundance and diversity of plant species within the right-of-way that are preferred by wildlife for food or cover. In contrast, non-selective treatment methods such as mowing will cause an immediate temporary reduction in cover and reduce or eliminate many food sources for smaller mammals and birds.

The research of Drs. Bramble and Byrnes on Gameland's 33 in Central Pennsylvania was one of the first studies to identify the benefits to wildlife from herbicide use on rights-of-way. In fact, many wildlife species are known to utilize rights-of-way to meet their habitat requirements for nesting, foraging, bedding, and cover.

The 1982 ESEERCO Report EP 82-13, “The Effects of Right-of-way Vegetation Management on Wildlife Habitat,” identified that while high-volume broadcast methods had the most immediate effect on reducing food and cover available to wildlife, selective methods helped to minimize these impacts. In addition, a successfully managed ROW develops relatively stable shrub/herb/grass communities that benefit a wide variety of species. Furthermore, while the ROW cannot meet the habitat needs of all species, vegetation management on ROWs encourages a broad spectrum of species.

More recent research conducted by the State University of New York at the College of Environmental Science and Forestry Strategy in 2000 and 2001, “Effects on Vegetation Management on the Avian Community of a Power Line Right-of-way,” investigated the site specific effects of vegetation management on songbird communities. This study found that shrub-nesting songbirds respond directly to shrub habitat on ROWs. Songbird nesting increased as shrub density increased. Field observations by researchers suggested there might be an upper limit to this increased nesting as shrub density increases beyond 70%. The study found that once established, the permanence of the plant community that is produced through selective herbicide application may be better for relatively short-lived bird species than the regular destruction of those communities through normal mechanical maintenance methods such as mowing.

Cedar Waxwing sitting on her nest on National Grid's Volney-Marcy ROW.

6. Density Definitions:

The brush density definitions used by National Grid to identify the density of either desirable or undesirable woody plant species are:

- Very Light (undesirable only, generally less than 100 stems/acre)
- Light up to 30% canopy cover
- Medium 30 to 65% canopy cover
- Heavy greater than 65% canopy cover

Another guideline for assessing undesirable densities translates these percents of cover into approximate stem densities as follows:

- Very Light 100 stems/acre or less
- Light 100 to 1,500 stems/acre
- Medium 1,500 to 5,000 stems/acre
- Dense greater than 5,000 stems/acre

7. Height Definitions:

The height definitions used by National Grid to identify the height of vegetation to be treated are as follows:

- Small less than 6 feet
- Medium 6-12 feet
- Tall over 12 feet

The average heights of vegetation to be treated are captured in the site inventory data. Within a site there may be a wide range of vegetation heights. Generally, for sites where the average vegetation height is over 16 feet, a foliar herbicide treatment is not appropriate. On these sites an initial cut and stump treatment, possibly followed by a low-volume backpack operation, may produce more effective control while minimizing the risk of off-target treatment and the total amount of herbicide per acre necessary to achieve total control. While there are situations where the average height of target vegetation on a foliar site may be only 10 feet, there may be scattered stems on the same site that are as tall as 16 feet. It is allowable and appropriate for the crew to foliar treat these taller stems as long as they are away from sensitive environmental resources and areas of high visual sensitivity, and the crew is able to get into close proximity of the target to prevent off right-of-way drift. In these situations the applicator should be riding on the rig 4-6 feet off the ground, and extending their arms and spray guns to effectively reduce the application distance from 20-feet back down to 10-12 feet. This will increase the accuracy and efficiency of the herbicide application onto the target foliage and minimize the potential for off-target damage.

8. Vegetation Management Techniques

The approved vegetation management applications include:

a. High-Volume Hydraulic Stem-foliar
b. Low-Volume Hydraulic Foliar
c. Low-Volume Backpack Foliar
d. Cut and Stump Treatment
e. Basal Application
f. Cutting and Pruning, No Herbicide Treatment
g. Mowing
h. Mowing and Cut Stubble Herbicide Treatment

i. Cut Stubble Herbicide Application

Each method will be discussed in detail in the following pages of this section.

a. High-Volume - Hydraulic Stem-Foliar Application

Application: Target-Selective stem foliar requires full coverage of the target plant's leaves, branches, and stem to the point of runoff. This method is especially effective for controlling medium- to high-density undesirable vegetation, while minimizing herbicide use requirements as much as possible.

Equipment: All-terrain type vehicle, hydraulic tank, pump, hoses and spray guns.

Herbicide: Selective or non-selective products available, approximately 60-120 mixture gallons/acre depending on target species density.

Limitations: In dense brush conditions, walking or hose dragging becomes onerous; therefore, applications from the spray unit are the most efficient and effective method for treating dense or tall stands of undesirable species. Selectivity increases as density decreases and spacing between target and non-target vegetation increases. It is most effective on sites where the average heights are less than 16 feet.

Drift: ***Operating pressure below 150 psi at the nozzle and operator is less than 10 feet from the target plant.*** Mix additives such as surfactants and drift control agents are utilized.

Buffer zones: The use of high-volume hydraulic foliar shall be avoided within:

- 50 feet of streams, ponds, unregulated wetlands, or lakes with standing water and/or running water
- 100 feet of a regulated wetland, unless otherwise allowed by permit (Note that this technique may only be used inside this buffer when treating undesirable stems in seasonally dry wetlands or adjacent area using products approved for aquatic applications in accordance with approved wetland permits. Low-volume hydraulic methods shall be preferred to high-volume methods where ever possible.)
- 100 feet of an active residence or ornamental plantings
- 100 feet of active croplands, orchards, etc.
- 100 feet of active parks, schools, athletic fields, golf courses, etc.

Visual Effects: Some brownout may be caused by dead or dying foliage, which may be mitigated by selective application. The remaining green, compatible vegetation also reduces this effect.

Full discussion of Technique:

The high-volume stem foliar technique is especially effective for sites with high undesirable densities. The higher spray pressures help ensure adequate plant coverage on these sites, while the reduced herbicide concentration in the mixture helps minimize the amount of active ingredient applied per acre. As undesirable densities rarely reach these conditions today, this application method is not required as often as it was in earlier cycles.

Application: A herbicide mix is directed at the target vegetation so as to wet all leaves, branches, and stems to the point of runoff. The applicator should be within 10 feet of the target plant in order to maximize application efficiency and effectiveness and minimize off target damage. To further minimize drift, the operating pressure of the unit should not exceed 150 psi at the nozzle, and the nozzle opening shall be regulated so as to produce a coarse spray of large droplets.

Equipment: The application equipment generally includes an all-terrain type vehicle, either tracked or rubber tired, and mounted with a hydraulically operated pump, a 100-1000 gallon mix tank, two hoses at least 100 feet long, and two spray guns with suitable nozzles. Ground support equipment includes a 500-1000 gallon water resupply truck. Manpower normally consists of 3-4 persons.

Herbicide: The herbicide mix contains ***generally less than 1% active ingredient and is applied at an average of 60-120 mixture gallons per acre***, depending upon undesirable species density. Application rates may run as high as 300-400 gallons per acre on high-density sites. While selective herbicide mixtures are preferred for high-volume applications because they tend to preserve more grass and fern species in the site, non-selective mixtures may be used when the herbicides provide environmental advantages such as aquatic labeling, reduced soil residual, or less active ingredient per acre.

Limitations: When dense brush conditions make walking or hose dragging onerous, or the scattered spacing of desirable or undesirable stems would improve crew efficiency, the crew is authorized to make the treatment while riding on the back of the spray unit. Application from the elevated platform also helps improve selectivity by keeping the applicator closer to the canopy of the undesirable vegetation, often enabling them to treat down onto the target stems. This treatment should not be used on sites where average brush heights exceed 16 feet. Individual trees or small clones of taller vegetation up to about 20 feet may be treated when the applicator can get in close proximity to the target with the vehicle and spray from the elevated deck to reduce the potential for over spray and off-target damage.

Environmental Considerations:

Drift: High-volume hydraulic applications have the greatest risk of drift due to the high operating pressures and increased application rates. Mix additives, including surfactants and drift control agents, are required to eliminate small droplets and prevent drift. In addition, limits on the height of target vegetation, treatment distance, and the size of the nozzle opening helps minimize the potential for off-target damage.

This method has the greatest “zone of effect” on adjacent under story vegetation of all the approved foliar methods, due to the higher pressures and application rates. However, this increased pressure is necessary to achieve effective control in medium to dense stands and has been one of the foremost reasons for the past success of the program. The broader zone of effect is also helpful for economically converting tall or dense woody stands to the more compatible herbaceous stands in the wire zone, while using less herbicide than either low-volume foliar or cut and stump treatment in these higher densities.

Buffer zones: Where site conditions warrant larger buffers, the Forester shall so designate as part of the site-by-site assessment and/or ground follow-up.

Visual Effects: The short-term visual effect from the high volume hydraulic stem-foliar technique is the variable brownout condition caused by dead or dying foliage. The green, non-target, and compatible vegetation remaining on the treatment site mitigate the overall brownout effect. A long-term visual impact associated with this technique may be the sight of dead stems following the treatment.

Site Conditions Favorable for this Technique:
High-volume hydraulic stem-foliar application may be specified when the treated portion of the right-of-way:

1. has dense undesirable species (65-100%); **or**

2. has moderate (30-65%) to dense (65-100%) undesirable species, with light to medium desirable species (1-65%); **or**
3. is within the mid-span, wire zone site that contains tall or dense shrubs. High-volume treatment with more diluted mixtures would provide proper coverage and reduce herbicide use, while converting the site to a stable mix of grass and herbaceous species; **and**
4. site proposed for treatment is accessible to ground equipment; **and** the site is sufficiently removed from environmentally sensitive sites so as to minimize potential impacts unless otherwise allowed by permit.

b. Low-Volume Hydraulic Foliar Application

Application: Target-Selective Foliar requires coverage to lightly wet the leaves, all growing tip areas, and the entire terminal leader area of the target plant.

Equipment: All-terrain type vehicle, hydraulic tank, pump, hoses, and spray guns.

Herbicide: Selective or non-selective products available at rates of approximately 10-40 mixture gallons/acre depending on target species density.

Limitations: In dense brush conditions, undesirable densities may be too high to insure adequate coverage. Walking or hose dragging may become onerous. Selectivity is dependent on density and spacing of target/non-target vegetation. Use on lower density sites with average heights of less than 16 feet.

Drift: ***Operating pressure below 50-pounds/square inch (psi) at the nozzle with the operator within 10 feet of the target plant.*** Mix additives such as surfactants and drift control agents are necessary.

Buffer zones: The use of low-volume hydraulic foliar shall be avoided within:

- 25 feet of streams, ponds, unregulated wetlands, or lakes with standing and/or flowing water
- 100 feet of a regulated wetland, unless otherwise allowed by special wetlands permit
  (Note that this technique may only be used inside this buffer when treating undesirable stems in seasonally dry wetlands or adjacent area using products approved for aquatic applications in accordance with approved wetland permits.)
- 25 feet of an active residence or ornamental plantings
- 25 feet of active croplands, orchards, etc.
- 25 feet of active parks, schools, athletic fields, golf courses, etc.

Visual Effects: Some brownout may be caused by dead or dying foliage, however, it may be mitigated by increased selectivity. The remaining green, compatible vegetation on the treatment site will also mitigate this effect.

Full discussion of technique:

Low-volume hydraulic foliar is currently the predominate treatment prescribed by the Company for all non-sensitive, upland sites. This method was used to treat 100% of the brush acres receiving hydraulic foliar application in 2001, which completely replaced the high-volume technique. This conversion to highly selective, low-volume methods across nearly all of the ROW system was possible due to the effectiveness of past methods and reductions in undesirable densities over the past two decades.

Application: A herbicide mix is directed at the target vegetation so as to lightly wet the leaves in all growing tip areas and across the entire terminal leader area of the target plant. The applicator should be within 10 feet of the target plant in order to maximize the accuracy of the application and minimize off-target damage. To further minimize drift, the operating pressure of the unit should not exceed 50 psi at the nozzle, and the nozzle opening shall be regulated so as to produce a coarse spray of large droplets.

Equipment: The application equipment generally includes an all-terrain type vehicle, either tracked or rubber tired that is mounted with a hydraulically operated pump, a 100-1000 gallon mix tank, two hoses at least 100-feet long, and two spray guns with suitable nozzles. Ground support equipment includes a 500-1000 gallon water resupply truck. Manpower normally consists of 3-4 persons.

One highly specialized variation of this method includes low-volume foliar applied through a Radiarc nozzle mounted on four-wheel ATVs for access roads, designated wire zone areas, and narrow ROWs, such as gas rights-of-way. This method limits the application width to approximately 20 feet. The method uses a small pump and 15-30 gallon tank.

Herbicide: The herbicide mix contains ***generally 1-2% active*** ingredient and is ***applied at an average of 10-40 mixture gallons*** per acre depending upon undesirable species density. Either a selective or non-selective herbicide can be used. A selective herbicide will tend to preserve more ground cover vegetation such as grasses, herbs, and ferns on the right-of-way floor, which may be preferential. However, some non-selective herbicide products may have a lower environmental risk or may require less active ingredient per acre.

Limitations: Since much of the Company's rights-of-way now contain medium to dense populations of compatible vegetation, walking or hose dragging has become difficult. For that reason, crews generally make this foliar application from the deck of the vehicle. By working from this elevated position, targeting the undesirable stems is improved by enabling the applicator to work from above the target. The lower pressures require the applicator be within approximately 10 feet of the target stem. However, the crew must not increase nozzle pressures to extend their reach or herbicide use will increase. This technique should not be used to control high-density sites, because the lower pressures and lighter wetting will result in poor coverage of dense vegetation. Increasing the pressure will rapidly increase the gallons/acre requirements.

Low-volume hydraulic foliar should not be used on sites where average undesirable brush heights are above 16 feet. Individual trees or small clones of taller vegetation up to about 20 feet may be treated when the applicator can get in close proximity to the target with the vehicle and spray from the deck to reduce the potential for over spray and off-target damage.

Environmental Considerations:

Drift: Effectively controlled and prevented with low-volume hydraulic applications through reduced pressures and control of nozzle openings to create large, course droplets. Mix additives such as surfactants are required to improve surface wetting and adherence of the herbicide on the leaf together with thickening or drift control agents that help to eliminate the formation of small droplets or "fines" and prevent drift. Drift and off-target damage can be minimized by limiting the applicator's distance from the target stem by reducing the height of the target vegetation and by decreasing spray pressures.

The phrase "zone of effect" has been coined to describe the "shadow effect" of the spray pattern on adjacent under story vegetation. Whenever herbicides are foliar applied to wet the leaf surface of the target plant, some mixture falls on adjacent under story vegetation within the right-of-way. As long as the spray pattern is contained within the right-of-way, this zone of effect of the spray pattern is ***not*** considered a drift problem.

Different application methods will have different “zones of effect.” The size or extent of the impact on adjacent under story vegetation increases as operating pressures, treatment rates, and distance increases from the nozzle to the target vegetation. The Program has always weighed and balanced the loss of compatible vegetation against the requirements for effective control and long-term reliability. As treatments have become more selective over the years, the “zone of effect” has become much smaller. When compared to past helicopter or high-volume foliar applications for dense brush, today’s low-volume foliar methods have a vastly reduced “zone of effect” within the total right-of-way.

Recent studies on the Volney–Marcy ROW have begun to investigate this effect for a variety of treatments. Preliminary results indicate that most of the spray pattern that falls on adjacent, under story vegetation is intercepted by the foliage of those plants with very little herbicide actually reaching the soil. In addition, the effect on the herbaceous communities varies with different herbicide mixtures. Most sites experience a temporary setback but begin to recover within the same growing season and are fully revegetated by the next growing season.

Buffer zones: Where site conditions warrant larger buffers, the Forester shall so designate as part of the site-by-site assessment and/or ground follow-up.

Visual Effects: The short-term visual effect from the highly selective low-volume foliar technique is the variable brownout condition caused by dead or dying foliage. High selectivity and the green, non-target compatible vegetation remaining on the treatment site mitigate the overall brownout effect. A long-term visual impact associated with this technique can be the sight of dead stems that remain in the treatment site for a few years following treatment.

Site Conditions Favorable for this Technique: Selective low-volume hydraulic foliar applications may be specified when the right-of-way is:

1. a wide right-of-way (150+ feet) where backpack foliar operations become inefficient; **or**
2. a right-of-way with medium to dense desirables that are too tall for back pack operations, and very light to light tall growing stems where riding the unit would place the applicator on an elevated platform above the desirable shrub layer, improving treatment effectiveness, **or**
3. a right-of-way with medium to heavy undesirable species densities and average heights of 16 feet or less, where the high-volume stem foliar treatment is neither appropriate, practical, or necessary; **and**
4. the site proposed for treatment is accessible to ground equipment; **and**
5. the site is sufficiently removed from environmentally sensitive sites so as to minimize potential impacts unless otherwise allowed by permit.

c. <u>Low-Volume Backpack Foliar Application</u>

Application: Target-Selective Foliar requires very light wetting of the leaves, especially in the growing tip and terminal leader areas of the target plant.

Equipment: Hand powered or motorized backpack tank and spray gun with a two-way nozzle to apply either a cone or stream pattern.

Herbicide: Selective or non-selective products available in a variety of different tank mixes and modes of action. Mix generally at 4-6% active ingredient, apply at approximately 3-6 gals per acre.

Limitations: Selectivity is dependent on density and spacing of target and non-target vegetation. Use on sites with average heights of less than 12 feet and very light to light target densities.

Drift: Relatively low pressure application at close target distances. Surfactants are required and drift control agents may be utilized.

Buffer Zones: The use of low-volume backpack methods shall be avoided within:

- 15 feet of streams, ponds, unregulated wetlands, or lakes with standing and/or flowing water

- 100 feet of a regulated wetland, unless otherwise allowed by permit (Note that this technique may be used as a preferred treatment method within wetland buffers when treating undesirable stems with approved aquatic products in seasonally dry wetlands or adjacent areas, in accordance with approved wetland permits.)
- 25 feet of an active residence or ornamental plantings
- 25 feet of active parks, schools, athletic fields, golf courses, etc.
- No buffer is required for this technique next to crop fields or orchards when the treatment can be directed away from the crop area.

Visual Effects: Some scattered, variable brownout caused by dead or dying foliage may be mitigated by high selectivity and the effect of the green, non-target, compatible vegetation remaining on the treatment site.

Full discussion of Technique:

The low-volume backpack method is especially effective on narrower ROWs in very light to light density sites where desirable densities are low enough to allow the applicator to traverse the site by foot. This treatment is also preferred for the treatment of sensitive buffer areas as research has shown that less herbicide is deposited on the soil surface as compared to cut and stump treatment.

Application: The herbicide mix is directed at the target vegetation so as to very lightly wet the leaves in the growing tip and terminal leader areas of the target plant using a very low pressure application method. The applicator should be within a few feet of the target plant, but not more than 10 feet, in order to maximize application and minimize off-target damage. To further minimize drift, the operating pressure of the backpack unit should be maintained around 25-30 psi and should never exceed 50 psi at the nozzle. The nozzle opening should be regulated so as to produce a coarse spray of large droplets. The spray gun may be equipped with a two-way nozzle to provide a “cone” pattern for the treatment of smaller vegetation as well as a “stream” pattern for the treatment of taller target plants.

Equipment: Manpower normally consists of two or more persons. The most common backpack system consists of a hand operated simple diaphragm or piston-pump backpack equipped with a spray wand and one nozzle (either a flat fan or adjustable cone). As an added feature many applicators utilize a dual nozzle spray gun that allows the operator to switch between a narrow-angle “stream” nozzle for longer distances or a wide-angle “cone” tip for shorter distances and wider coverage.

Herbicide: The herbicide mix contains generally 4-6% active ingredient and is applied at an average of 3-6 mixture gallons per acre depending upon undesirable species density. Either a selective or non-selective herbicide can be used. A selective herbicide will tend to preserve more groundcover vegetation such as grasses, herbs, and ferns on the right-of-way floor, which may be preferential. However, some non-selective herbicide products may have a lower environmental risk or may require less active ingredient per acre.

Limitations: This treatment should not be used on sites where average heights exceed 12 feet. Occasionally, individual stems or clones of stems upwards of 15 feet can be treated using the "stream" pattern nozzle as long as the applicator can get into a good position for treatment and minimize off-target damage. Low-volume backpack should not be used to treat continuous areas of moderate to dense undesirables since the application rates as measured by active ingredient may be too high for the higher density sites. The low-volume or high-volume hydraulic methods would reduce the application rates for those situations.

Environmental Considerations:

Drift: The close proximity of the applicator to the target, along with the low pressure of the backpack equipment makes the risk of drift virtually non-existent. Mix additives such as surfactants are required for uniform spreading of the herbicide mix over the leaf surface, and drift control agents may be necessary when using motorized backpacks.

The reduced pressures and close proximity of the application make the "zone of effect" for this treatment smaller than what is experienced with the hydraulic foliar methods.

Buffer zones: Where site conditions warrant larger buffers, the Forester shall so designate as part of the site-by-site assessment and/or ground follow-up.

Visual Effects: The short-term visual effect from the low-volume backpack foliar technique is the variable brownout condition caused by dead or dying foliage. High selectivity and the green, non-target, compatible vegetation remaining on the treatment site mitigates the overall brownout effect. A long-term visual impact associated with this technique may be the presence of dead stems that remain in the treatment site for a few years following treatment.

Site Conditions Favorable for this Technique:
The selective low-volume backpack foliar application may be specified when the treated portion of the right-of-way:

a. consists of very light to light undesirable species (0-30%) with average heights below 12 feet and light to medium desirable densities that can be traversed by foot; **or**

b. consists of any density of undesirable species where the only access to the site is by foot; **and**

c. is sufficiently removed from environmentally sensitive sites so as to minimize potential impacts unless otherwise allowed by permit.

d. Cut and Stump Treatment

Application: Target-Selective Cutting is when the stem is cut and the stump is treated with herbicide to prevent resprouting.

Equipment: Chainsaw and small squirt bottle or backpack tank.

Herbicide: Water-base or oil-base products.

Limitations: Most effective when applied immediately after cutting and during the active growing season.

Drift: Drift is not a significant problem due to low pressures and low-volume applications.

Buffer Zones: The use of non-aquatic products shall be avoided within:

- 5 feet of a stream, pond, regulated wetland, or lake with standing and/or flowing water.
- 100 feet of a regulated wetland unless otherwise allowed by permit.
  (Note that herbicides that have been registered for use in aquatic settings may be used in wetlands and adjacent areas, by permit, with no direct spray into standing water.)

Visual Effects: The cut slash is the primary visual effect. Various slash disposal methods may be prescribed by the Forester to minimize the impacts on adjoining land uses.

Full discussion of Technique:

Cut and stump treatment is the preferred method to control undesirable stems within the buffer zones for foliar applications next to residential, active cropland, orchards, public parks, schools, athletic fields, golf courses, etc. It also is the most common method used to control tall growing vegetation near standing water, when using approved aquatic herbicides. It may also be used to clear taller vegetation that has become too tall for the foliar techniques. Finally, this method may be prescribed by the forester for sites that have high visual sensitivity.

Application/Equipment: Cut and stump treatments are designed to remove individual stems and chemically control the root system. The technique is most widely employed inside buffer zones for foliar treatment, for cutting of vegetation that is over the foliar height restrictions, or in visually sensitive areas. The cutting is primarily accomplished using either a chainsaw or brush saw. Variations in the manner of slash disposal recognized by National Grid include:

- Cut and stump treatment is where the slash remains lopped where it falls.
- Cut and stump treatment and windrow is when the slash is disposed of by hand piling or windrowing.
- Cut and stump treatment and chip are where the slash is disposed of by chipping. The chips may be disposed of on site or hauled away.

Note that in all cases, slash may not be left in an identifiable watercourse.

Herbicides: There are two approaches to herbicide materials and applications. One method uses water-borne products that are applied directly to the cut surface immediately following cutting, while the other uses oil-based products that may be applied to the entire stump surface any time following clearing, including days or weeks later.

1). Water-based herbicide application is accomplished through use of hand-held squirt bottles or small capacity hand or backpack pressure sprayers. The material is either pre-mixed from the manufacturer or field mixed by diluting the concentrate by 50% with water, and applying it to the outer circumference of the cut surface with emphasis on the cambium layer. The application must be made ***immediately*** after cutting. The mode of entry is through direct uptake into the water-based system of the tree and transported by the phloem tissues down into the roots. Delaying treatment after cutting may allow formation of air bubbles or drying at the cut surface, blocking the trees transport system and preventing effective translocation of the herbicide into the roots.

2). Oil-based herbicide application uses a backpack hand sprayer to deliver the oil-based herbicide mixture onto the bark surface of the stump and all exposed roots. The mixture is applied to the point of run down and puddling at the root collar. Following application, the herbicide penetrates the bark to disrupt the cambium and prevent emergence of dormant buds within the exposed bark and root collar zone. Translocation of oil-based mixtures into the root system is poorer than other methods, because these oil-based products will not dissolve as easily and enter the water-based transport systems of the tree.

Limitations: Experience has shown that stump treatment methods often produce unreliable results when used on stumps of root suckering species. Seasonal differences in the plant physiology and herbicide transport mechanisms, as well as human error, also cause variations in results of this technique. Special slash disposal methods like windrowing or chipping escalate per acre maintenance costs beyond the basic cut and stump treatment method where the slash remains lopped where it falls.

Environmental Considerations:

Drift: The high selectivity of this technique causes little or no damage to non-target shrub species. Drift is non-existent due to the low-pressure, close-hand application equipment. Non-target herbaceous vegetation within 6 inches-2 feet from the treated stump may be damaged by herbicide that splashes from the stump during application and from the over spray of the spray pattern falling on adjacent grasses, herbaceous material, and shrub stems. Off-target herbicide movement via root uptake can also occur when using water-based treatments on some species during cut and stump treatment applications. Herbicide applied to the cut stumps can be transported through interconnected root systems and damage or kill trees beyond the edge of the right-of-way. Root suckering tree species that grow in clones are especially susceptible to damage from root uptake.

Buffer Zones: Where site conditions are so sensitive that cut and stump treatment cannot be completed, the Forester may elect to only cut or prune and not use herbicides.

Visual Effects: The short-term visual impacts associated with this technique may be the sharply defined cut edge of the right-of-way or the sight of drop and lopped or piled brush. The remaining non-target vegetation within the treatment site often mitigates these visual effects.

Site Conditions Favorable for this Technique: Cut and stump treatment should be specified when the proposed site for treatment is:

1. inside the buffer zone area for any of the foliar techniques; **or**
2. an area of high visual sensitivity, such as heavily-used highways or public park areas, where the undesirable growth requires removal; **or**
3. an area immediately adjacent to residential areas where, due to intense land use practices, stem removal is warranted over appropriate foliar applications; **or**
4. an area within the limits of a public water supply or immediately adjacent to a

domestic water supply, where an aquatic herbicide can be approved and prescribed for that use; **or**

5. within the buffer zone and adjacent area of a regulated wetland and aquatic herbicides are approved for use on the permit; **or**

6. where individual target plant heights exceed acceptable limits for foliar applications and must be removed.

e. Basal Applications

Application: Target-Specific Basal is a spray application applied to the lower portion of individual standing woody stems. The application requires a thorough wetting of the lower 12-15 inches of the stem down to ground line including the root collar zone.

Equipment: Most commonly applied with a 1-5 gallon, hand-held or backpack unit equipped with a hand pump and spray wand. Various mixtures may also be applied with small, hand-held squirt bottles or even larger hydraulic units, dragging hoses, and using low pressures. Manpower normally consists of a 2-3 person ground crew.

Herbicide: Today, mainly ready-to-use products that contain specially developed penetrants are used, rather than the old, conventional fuel-oil basal mixtures. Various herbicides are diluted in these penetrants at rates of 10-50%.

Limitations: Most effective when used in very small areas during active growing season. Increased skips and misses as site density and size increase, and when snow covers the base of the stem. Oil-based products have reduced translocation, with poorer control of root suckering species.

Drift: Drift is not a factor because of the relatively low pressure application and close target distances.

Buffer Zones: The use of basal applications shall be avoided within:

- 15 feet of a stream, pond, regulated wetland, or lake with standing or flowing water
- 100 feet of a regulated wetland, unless otherwise allowed by permit

Note: Use of basal applications is allowed up to the edge of residential areas, active croplands, orchards, public parks, schools, athletic fields, golf courses, etc.

Visual Effects: Brownout will occur when basal applications are made in either the active growing season or the dormant season. The brownout associated with dormant season treatments actually occurs the following summer. The visual impact is softened by the high selectivity of this treatment that retains a high percentage of the compatible shrub species on the site.

Full discussion of Technique:

The basal method has evolved over the past two decades, specifically in regards to the herbicide products used for this treatment. The old, conventional basal method employed a herbicide diluted in a fuel oil carrier, generally at a rate of 1-4 gallons of herbicide per 100 gallons of mixture (a 1-4% solution). The application was targeted at the lower 12-18 inches of the stem, saturating the basal area to the point of rundown and puddling at the root collar zone. There were several disadvantages to the conventional basal application method including:

- **The method utilized large quantities of fuel oil, requiring as much as 150 gallons per acre or more, adding greatly to the cost, difficulty of handling, and environmental concerns with the application.**
- Higher herbicide concentrations were generally required to achieve even minimal effectiveness.
- Poor agitation and mixing frequency also lead to spotty results.
- **The low solubility of the oil-borne solution within the plant's water system reduced translocation and led to poor root control of root sprouting species.**
- **Additionally, this limited mobility required more exact application to insure complete coverage and rundown. If the back or side of the stem was missed and not completely encircled, "green streaking" occurred whereby food and nutrients were still able to continue through the thin untreated strip keeping the stem alive. If the stem was circled, but not puddled at the root collar, dormant buds below the treated area would sprout to maintain life within the plant system.**
- Application when the bark is wet may result in herbicide/oil mixture run-off of the plant, and ultimately poor or no control.

More common and appropriate today is the use of the concentrate basal application method involving the use of specially developed penetrants to replace the fuel oil of conventional basal mixtures. These penetrants are designed to more effectively penetrate the waxy suberin of the bark, carrying the herbicide into the cambium area. These product advancements have helped minimize the effects of many of the issues stated above. The basal method still requires some of the highest rates per acre of herbicide concentrate to achieve effective control. As a result, basal is used only sparingly in the program.

Application: Basal-bark treatments can be effectively used to control brush and trees up to six inches in diameter. Application is made as a fine mist that is used ***to lightly wet the bark, rather than wetting to the point of rundown.*** The method is useful for selectively removing very light to light density undesirable vegetation where the applicator can traverse the site by foot, and where the right-of-way is not over-grown with shrub species. The number of skips or misses related to this operation increases as shrub density increases due to the difficulty in locating the target stems within a moderate to dense shrub understory. Conventional basal treatments primarily control woody brush by chemically girdling the stem. Treatments can be made any time of the year including the dormant season as long as snow depths do not prevent access to the lower portion of the stem. However, best results occur during growing season treatments between April and October. With some herbicide products, trees treated in the dormant season may leaf out in the spring since the buds are set, and then wilt and die once stored food reserves are burned up. This brownout can be a problem in visually sensitive areas.

Equipment: Equipment used for this application can vary from small, hand-held squirt bottles to 1-5 gallon, hand-held or backpack units equipped with a hand pump and spray wand. Although uncommon today, it can also be applied using the hydraulic type spray unit normally associated with ground foliar treatments. The treatment is directed at the lower 12-15 inch portion of the stem and is made with very low pressures using a solid cone or flat fan nozzle. Manpower normally consists of a 2-3 person ground crew.

Herbicide: Various herbicide ingredients can be formulated by combining them with basal bark penetrants at rates of 10-50% to create a concentrated basal ready-to-use formulation. As this is a low-volume approach, one gallon of concentrate basal solution replaces the equivalent of 10-12 gallons of the old conventional basal mixture. The newer concentrate basal products also provide a systemic mode of action that significantly improves effectiveness by controlling the plant’s root system. The combination of the penetrants with a higher herbicide concentration results in more rapid and consistent basal treatments. The higher herbicide concentrations may also tend to avoid the problems of mixing oil-borne and water-borne solutions.

Limitations: The treatment is recommended for stems under six inches in diameter, on sites with low densities of undesirable brush. The exact, tedious coverage requirements of this application often result in complete misses or only partial control of the target stems. Once within the plants, the degree of mobility and translocation is limited by the poor mixing of oil-based products with the water transport system of the tree. Time of year, tree species, herbicide, carrier, mixture rate, solubility, and other factors all effect control and performance. Basal applications cannot be made when snow prevents the spraying of the stem down to the ground line.

Environmental Considerations:

Drift: The high selectivity of this technique causes little or no damage to non-target vegetation. The basal technique utilizes low pressures, because the mixture must be delivered within approximately two feet of the stem. As a result, drift is not a factor.

The “zone of effect” for this application is greater than the zone associated with cut and stump treatment, due to the heavier application rates, fine spray pattern, and the high concentration of the material. Since this application is directed at the base of the target stem and uses the highest application rates of all methods, it places the greatest amount of herbicide at the ground level. This may result in a high level of herbicide actually reaching the soil and may increase the depth of herbicide leaching. Low-volume backpack foliar methods have generally replaced basal methods in the field, because they require greatly reduced application rates and most of the over spray or shadow of the spray pattern is intercepted by the foliage of the herbaceous under story and never reaches the ground.

Buffer Zones: Where site conditions warrant larger buffer zones, the Forester shall so designate them as part of the site-by-site assessment and/or ground follow-up.

Visual Effects: The short-term visual effect from the basal technique is brownout caused by dead or dying foliage. The overall brownout effect is somewhat mitigated by the high selectivity and retaining compatible shrub and herbaceous vegetation within the site. A longer-term visual effect may be the standing dead stems.

Site Conditions Favorable for this Technique: Selective basal applications should be specified when the site proposed for treatment is:

1. A relatively small area, such as a hedgerow, road crossing, or similar buffer zone, where undesirable densities are very light to light and desirable densities are low, and the crew can easily move through the under story to identify and treat the tall growing stems.

f. Cutting and Pruning, No Herbicide Treatment

Application: Target-Selective Cutting cuts vegetation as close to the ground as possible and no herbicides are applied.

Equipment: Chainsaw

Limitations: No control of root system. Most northeastern hardwoods will resprout following hand cutting, some prolifically.

Buffer Zones: None

Visual Effects: The cut slash is the primary visual effect. Various slash disposal methods may be prescribed by the Forester to reduce visual impacts depending on adjoining land uses and sensitivities.

Full Discussion of Technique:

Application/Equipment: Cutting without herbicide treatment is primarily used to clear undesirable species in areas of high sensitivity such as lawns, parks, and other buffer zones where only cutting or pruning is allowed due to deep public concern about herbicides, or easement or regulatory restrictions apply. In the absence of sufficient desirable vegetation, some tall growing species can be temporarily retained and pruned if necessary. The decision to prune, rather than cut, undesirable vegetation within a visual buffer zone should be made after considering the following criteria:

- conductor clearance at the site
- density and height of desirable vegetation
- how visually sensitive and at what angle will the right-of-way be viewed (residence, park, road, river, etc.)
- the relative number of individuals who may be exposed to view the site and the duration of their exposure
- the probable activity of individuals at the time of view exposure

Once adequate cover of desirable species is established on the site, the pruned vegetation may be systematically removed. In some instances the cost to prune or re-cut a site may become fairly high. In those cases, the Forester will evaluate the costs of removing undesirable trees and replanting with desirable species.

Hand cutting is primarily accomplished using either a chainsaw or brush saw. Variations in the method of slash disposal recognized by National Grid include:

- Cut only is when the slash remains lopped where it falls.
- Cut and windrow is where the slash is disposed of by piling or windrowing.
- Cut and chip is where the slash is disposed of by chipping. The chips may be disposed of on site or hauled away.

Note that in all cases, slash may not be left in an identifiable watercourse.

<u>Limitations</u>: Hand cutting is very labor intensive. When combined with the fact that tall-growing, undesirable species may be retained or rapidly regrow, hand cutting results in high per acre costs and shortened maintenance cycles. The lack of herbicide stump treatments to control sprouting (while warranted under certain site conditions) greatly reduces the long-range effectiveness of this technique.

Environmental Impacts:

<u>Buffer Zones</u>: The high selectivity of this technique causes little to no damage to non-target shrub species. However, the heavy resurgence of stump and root sprouts may cause the loss of compatible shrub and herbaceous cover over time, as undesirable stems increase in density and eventually suppress more desirable species.

<u>Visual Effects</u>: The impacts associated with this technique are the clearly defined cut edge of the right-of-way and the accumulation of drop and lopped or piled brush. These visual effects may be mitigated on some sites by the retention of desirable vegetation where it exists in the right-of-way.

<u>Site Conditions Favorable for this Technique</u>: Cutting without herbicides and/or pruning may be proposed when the site is:

1. a lawn, park, or other highly sensitive area; or
2. a no-herbicide zone to protect sensitive resources such as streams, ponds, lakes,
 or wetlands; or
3. a no-herbicide buffer zone adjacent to registered organic farm fields.

g. Mowing

Application: Non-Selective includes cutting and mulching of all vegetation.

Equipment: Large all-terrain vehicles with specialized mowing attachments or a heavy-duty 4x4 tractor with rear mounted brush-hog type mower.

Limitations: All other vegetation, both desirable and undesirable, is generally cleared by this operation. Selective management is limited to the operator's ability to save clumps or patches of vegetation by driving around them. Rough or rocky terrain cannot be mowed, and the heavy equipment may cause severe rutting on soft terrain. It does not control root systems and may result in prolific resprouting. Flying debris creates a hazard, limiting where the method can be used.

Buffer Zones: Vehicles should not be used in sensitive resource areas, including streams and wetlands, unless they are dry at the time of treatment.

Visual Effects: Completely removes all cover vegetation and produces a drastic short-term effect. Wilted, mulched vegetation, together with some exposed soil and rutting are the primary visual result of this treatment.

Full Discussion of Technique:

Mowing is a non-selective method that clears and removes all vegetation, including trees, shrubs, and herbaceous material by mulching and disposing of the slash on-site. In some instances, the operator may be able to save clumps or patches of vegetation but only on a limited scale. Trying to avoid numerous patches of vegetation with this large machinery quickly becomes impractical and inefficient and will push the cost of the operation up.

Application/Equipment: Mowing is primarily intended for maintenance of the right-of-way in areas that have been deemed to be “too sensitive” for herbicide application or where easement restrictions prohibit the use of herbicides. When terrain permits, mechanical mowing is more economical than hand-clearing methods. However, the lack of root control results in frequent reclearing, which then increases cyclical costs. The equipment includes a tracked or rubber-tired, all-terrain type vehicle mounted with a cutting device capable of mowing small, woody vegetation.

Limitations: The treatment is limited to areas with flat to moderate topography and dry soil moisture conditions that will support the vehicle. The site must be free of big stones, logs, and large stumps. The hazard of flying debris limits where this method can be used. Use is restricted especially near highways or other public use areas where injury or property damage could occur. Land uses such as pasturing may create problems with fencing, slash disposal, and the stubble, limiting the effective use of this technique. Vegetation that has become too big can also interfere with effective mowing.

Mowing is more suitable for gas rights-of-way where the management objectives require the removal of all woody materials for cathodic testing and leak patrols. For example, woody vegetation can mask a gas leak from detection during routine aerial patrols. National Grid utilizes a three-year, cyclical mowing program to establish and maintain gas rights-of-ways in a grassy or herbaceous condition. The higher safety standards together with the need for increased accessibility justify the cost of mowing to maintain the gas rights-of-way.

Mowing can only be selective by application. In other words, the operator may choose not to mow specific clumps or patches of vegetation. However, since the mower’s cutter head itself ranges from 6-10 feet in diameter, depending on the model, selectivity down to the plant level is not practical. It is also impractical and inefficient for the operator to retain numerous patches of vegetation within the right-of-way. The risk of working around poles, towers, guy wires, fences, and other obstructions that require frequent backing and turning of the equipment, outweighs any benefit from vegetation retention. This will also increase the price of the treatment to a point where hand cutting would become more appropriate.

Environmental Considerations

Buffer zones: Mowers should not be used in sensitive areas such as streams and wetlands, unless they are seasonally dry, due to the risk of excessive rutting. The hazard from flying debris limits the areas where this treatment may be used, and increases the buffers that are needed between the mowing equipment and highways and other high-use public sites.

Wildlife: Mowing is a non-selective technique that eradicates desirable species as well as undesirable species. Mowing carries a distinct disadvantage in that it causes drastic change in the vegetative conditions on the right-of-way. It is one of the most destructive vegetation management techniques for wildlife habitat.

Spill Potential: Mowing equipment has a high risk for spills and leaks from petroleum products, because of the intensity and vibration of the operation, and the numerous hydraulic lines and fittings that must constantly be monitored and maintained.

Visual Effects: The effects associated with this technique are sharply defined right-of-way edges, the loss of all woody vegetation, and the sight of shredded brush and stubble on the right-of-way floor.

Soil Erosion and Compaction: There is an increased risk of soil erosion and compaction with mowing operations as compared to the other maintenance techniques. This occurs due to the extensive travel along and across the right-of-way with heavy mowing equipment, as well as the occasional scuffing action of the mower along the surface. Both rutting and compaction can be minimized if mowing is accomplished when soil moisture is low. However, this often means mowing during the summer months when wildlife nesting and other ROW use is at its peak.

Site Conditions Favorable for this Technique:

Mowing should be specified when:

1. public concerns or easement restrictions prevent the use of herbicides, **and**
2. the cost of hand cutting is prohibitive, **and**
3. the site has been or should be maintained through mowing; **or**
4. the site has extremely dense undesirable vegetation that would require high volumes of herbicide to control, and mowing with a follow-up foliar treatment would reduce herbicide requirements and control resprouting, **and**
5. access with a heavy-duty all-terrain mower unit is feasible.

Note that mowing is the method of choice to maintain gas rights-of-way and allow access for testing, inspecting, and patrolling.

h. Mowing and Cut Stubble Herbicide Application

Application: Non-Selective cutting and removal of all vegetation with concurrent herbicide application to the cut stubble.

Equipment: Heavy-duty 4x4 tractor with a rear mounted Brown Brush Monitor mower unit.

Herbicide: Selective or non-selective products may be used at rates of approximately 15-30 mixture gallons/acre.

Limitations: Selective only by application. Rough or rocky terrain cannot be mowed. The simultaneous cut stubble herbicide application does control the root systems and minimize resprouting. Flying debris creates limitations on where the method can be used.

Drift: Drift is not a problem with this method due to the enclosed nature of the treatment.

Buffer Zones: Vehicles access into or through areas of sensitive resources, including streams and wetlands, is not permitted unless they are dry or stable at the time of crossing or treatment. The use of herbicides shall be avoided within:

- 25-50 feet of streams, ponds, lakes, or wetlands

Visual Effects: Complete removal of cover vegetation produces a drastic short-term effect. A sharp ROW edge and wilted, mulched vegetation are the primary visual impacts.

Full Discussion of Technique:

As with conventional mowing, the Brown Brush Monitor is non-selective, clearing and mulching all woody vegetation it encounters. The unit is capable of cutting stems up to three inches in diameter and immediately wipes a small quantity of herbicide onto the freshly cut stubble. This equipment may be particularly effective for sites with high-density, undesirable vegetation where brownout from conventional foliar methods may be a problem, or where other methods could actually increase herbicide. It may also be effective for converting mid-span wire zone sites from tall, dense shrub stands to more compatible herbaceous communities.

In some instances the operator may be able to save clumps or patches of vegetation, but only on a limited scale. Trying to avoid or work around numerous patches with this machinery becomes impractical and inefficient and will increase operation costs. The use of this method is limited by the mower deck's inability to cut brush larger than 3 inches in diameter.

This method may also be effective to convert gas ROWs that have become overgrown by resprouting woody brush, and for establishing or maintaining access routes along electric ROWs. The use of this equipment, combined with the cut stubble application, may lengthen the maintenance cycle and reduce future costs on sites that were either mowed or cut without herbicides in the past.

Application/Equipment: This cut stubble method may be used to maintain sections of the right-of-way that are sensitive to the brownout of conventional foliar methods, by mowing the undesirable woody growth and immediately wiping a herbicide mixture onto the cut surface. Where terrain allows, mechanical mowing is more economical than hand-clearing methods and with the herbicide application resprouting is minimized. The equipment includes a heavy-duty 4x4 tractor with a rear mounted Brown Brush Monitor mower unit. The mower deck includes a separate herbicide application compartment, immediately behind the mower compartment, where herbicide is wiped onto the freshly cut stubble by a system of brushes.

Herbicide: The herbicide mix is a 4-6% mix that is applied at approximately 15-30 gallons/acre depending upon density. Either a selective or non-selective herbicide can be employed. However, selective products that retain grasses or minimize impacts on the remaining herbaceous communities are preferred. At times a non-selective herbicide product may have a lower environmental risk or may require less active ingredient per acre and could become the preferred mixture.

Limitations: The treatment is limited to areas with flat to moderate topography and low soil moisture conditions to support the vehicle. The site must be free of large stones, logs, and big stumps. The hazard of flying debris is much lower with this type of brush mower as compared to the larger hydro-axe type mowers, because the discharge chute better directs the slash out and away from the unit on one side. However, it still limits the use of this treatment near highways or areas where public injury or property damage could occur. This method should not be used in active pastures when there are label restrictions associated with herbicide use in pastures. Large sized vegetation, over three inches in diameter, can prevent effective use of the mowing treatment.

Environmental Considerations:

Drift: The Brown Brush Monitor applies herbicide to the freshly cut surface by wiping the mix onto the cut stubble in a separate compartment, immediately behind the mowing chamber. The application does not involve any airborne exposure, thereby eliminating the risk of drift.

Buffer zones: The Brown Brush Monitor mower shall not be used in sensitive areas such as streams and wetlands, and the application shall observe a 25 foot shut-off or buffer zone in these areas. These buffers can then be hand cut, or hand cut and stump treated with approved aquatic products in accordance with permit requirements and the parameters discussed with each method.

Wildlife: As discussed in the section that describes mowing without herbicide use, the mowing technique is non-selective and eradicates desirable as well as undesirable species. It has a distinct disadvantage in that it dramatically changes the vegetative conditions on the right-of-way. In regards to wildlife habitat, mowing is the most destructive of all the treatments used.

Spill Potential: Mowing equipment has a high risk for spills and leaks from petroleum products, because of the intensity and vibration of the operation, as well as the numerous hydraulic lines and fittings that must be constantly monitored and maintained.

Visual Effects: The effects associated with this technique are a sharply defined right-of-way edge, and the sight of shredded brush and stubble on the right-of-way floor. Additionally, the herbicide application may cause a brownout effect to the remaining herbaceous vegetation immediately following treatment. This effect is generally short-term, and reduces as grasses and the herbaceous plants redevelop within the ROW.

Soil Erosion and Compaction: There is an increased risk of soil erosion and compaction from mowing operations compared to the other maintenance techniques. This is caused by the repeated travel along and across the right-of-way with mowing equipment as well as the occasional scuffing action of the mower along the surface. Both rutting and compaction can be minimized if mowing is accomplished when soil moisture is low.

Site Conditions Favorable for this Technique:

Mowing with a cut stubble treatment should be specified when the site:

1. has required mowing in the past and a cut stubble herbicide application is permissible; **or**

2. is within the wire zone, and mowing with cut stubble would reduce the herbicide requirements needed to convert the ROW to more compatible herbaceous species; **or**
3. requires maintaining or establishing access routes along existing transmission ROWs; **or**
4. is an existing gas ROW where undesirable woody vegetation has become a problem through repeat clearing without herbicides, **and**
5. is accessible with a heavy-duty 4x4 tractor and mower unit is feasible.

i. Cut Stubble Herbicide Application

Application: Non-Selective herbicide application to the cut stubble following mowing.

Equipment: The spray mix would be applied by backpack or four wheel all terrain vehicle (ATV) mounted low pressure sprayers.

Herbicide: Selective or non-selective products mixed at 2-3% may be used at rates of 5-25 mixture gallons per acre.

Limitations: The treatment can be used in non-sensitive locations on the ROW only. Stream buffers, wetlands, and areas adjacent to lawns or ornamental plantings cannot be treated.

Drift: Drift is minimized with this method, since the applicator treats using low pressure, spraying the ground within 2 feet, aiming the nozzle down.

Buffer Zones: The use of herbicides shall be not allowed within 25 feet of streams, ponds, lakes, or wetlands.

Visual Effects: Complete removal of cover vegetation produces a short-term effect. Grasses return in the next season's growth.

Full Discussion of Technique:

In many areas, removal and conversion to lower growing shrubs and herbaceous vegetation may be desirable because of conductor height or voltage classification. This conversion can be facilitated by mowing followed by herbicide application. Cut stubble treatments may be the technique of choice where the size and density of undesirables is high. The brown brush monitor is efficient for mowing brush that has stem diameters below 3 inches. Where brush stem diameters are greater, a heavier duty mowing machine, such as the hydroax must be employed. The hydroax does not have the ability to apply herbicide as the brown brush monitor. In this circumstance, a separate cut stubble herbicide application is needed. The environmental considerations of this technique are the same as discussed above for mowing and cut stubble herbicide treatment.

Application/Equipment: The equipment includes a large all-terrain vehicle with a specialized mower deck. Herbicide is applied with hand powered or motorized backpack tank and spray gun with a two-way nozzle to apply a cone pattern or a four wheel ATV, appropriate sized hydraulic tank, pump, hoses and spray nozzles. A specialized variation of the herbicide application may be employed with a Radiarc nozzle mounted on a four-wheel ATV.

Herbicide: The herbicide mix would be representative of the application method previously described as either Low volume Hydraulic Foliar or Low Volume Back-pack foliar.

Limitations: The treatment is limited to areas with flat to moderate topography and low soil moisture conditions to support the vehicle. The site must be free of large stones, logs, and big stumps. The potential for flying debris limits the use of this treatment near highways or areas where public injury or property damage could occur.

Environmental Considerations:

Drift: Drift would be the same as that represented in the description of the application method previously described as either Low volume Hydraulic Foliar or Low Volume Back-pack foliar.

Buffer zones: Buffer zones would be the same as that represented in the description of the application method previously described as either Low volume Hydraulic Foliar or Low Volume Back-pack foliar.

Wildlife: As discussed in the section that describes mowing without herbicide use, the mowing technique is non-selective and eradicates desirable as well as undesirable species. It has a distinct disadvantage in that it dramatically changes the vegetative conditions on the right-of-way. In regards to wildlife habitat, mowing is the most destructive of all the treatments used.

Spill Potential: Mowing equipment has a high risk for spills and leaks from petroleum products, because of the intensity and vibration of the operation, as well as the numerous hydraulic lines and fittings that must be constantly monitored and maintained.

Visual Effects: The effects associated with this technique are a sharply defined right-of-way edge, and the sight of shredded brush and stubble on the right-of-way floor. Additionally, the herbicide application may cause a brownout effect to the remaining herbaceous vegetation immediately following treatment. This effect is generally short-term, and reduces as grasses and the herbaceous plants redevelop within the ROW.

Soil Erosion and Compaction: There is an increased risk of soil erosion and compaction from mowing operations compared to the other maintenance techniques.

This is caused by the repeated travel along and across the right-of-way with mowing equipment as well as the occasional scuffing action of the mower along the surface. Both rutting and compaction can be minimized if mowing is accomplished when soil moisture is low.

Site Conditions Favorable for this Technique:

Mowing with a cut stubble treatment should be specified when the site:
1. requires mowing and a cut stubble herbicide application is permissible; **or**
2. is within the wire zone, and mowing with cut stubble would reduce the herbicide requirements needed to convert the ROW to more compatible herbaceous species; **or**
3. requires maintaining or establishing access routes along existing transmission ROWs; **or**
4. is an existing gas ROW where undesirable woody vegetation has become a problem through repeat clearing without herbicides, **and**
5. is accessible with a heavy-duty all terrain vehicle and mower unit is feasible.

H. Field Completion and Reporting

Transmission work activities for vegetation management and danger tree removals are generally completed by contractor work forces. All contractor work is awarded based on approved System Purchasing procedures to the low price vendors.

Contractor work completions are reported on the field inventory/work completion report and include site-by-site treatment methods, herbicide use, treatment dates and landowner requirements. The completed reports are submitted to the Division Forester for entry into the Corridor Manager GIS system. An example of a completed inventory with contractor completions can be found in Appendix 8.

The computerization of this site-by-site data for each right-of-way provides effective analysis and tracking of work activities and herbicide effectiveness on each right-of-way. The system further provides a hierarchy of reports, summarizing information at the right-of-way, Regional, Division, or System level, for each scheduled year or for the entire cycle.

I. Landowner Notification

National Grid acquires its transmission rights-of-way through fee purchase or easement, providing the right to conduct routine maintenance activities such as vegetation management, danger tree removal, and ingress and egress. All easement and fee ownership agreements that are made with property owners are documented and retained by the Right-of-way Department.

All retained documents are made available to affected parties upon request.

The company strives in every way possible to maintain good relations with the general public as well as adjacent or underlying property owners. As a matter of courtesy, reasonable attempts are made to contact and notify nearby residents when the movement of equipment or work operations may directly impact them.

National Grid requires all vegetation management personnel to comply with Article 33 of the New York Environmental Conservation Law related to herbicide notification and posting requirements for landowners and the general public. These requirements are directly incorporated into the transmission Right-of-way Maintenance Specifications. In addition, informational brochures have been developed to help the public understand the program and the role of herbicides in vegetation management. Copies of the brochures are included as Appendix 9.

J. Customer Inquiry, Complaints and Planting Criteria

1. Reporting

Customer inquiries and complaints are initially received through the Customer Service Center or via customer e-mail on the National Grid website. Inquiries and complaints are then forwarded to the appropriate Division Forester for prompt customer contact and investigation.

2. Assessment

Upon notice of a customer inquiry or complaint, the Division Forester shall promptly contact the customer to schedule and coordinate a field investigation, making the first attempt to resolve the concern. Based on initial contact, the Forester may direct the contractor completing the work to complete an incident investigation and make the first effort to resolve the inquiry in accordance with the terms and conditions of the contract. When an inquiry or complaint is handed off to the contractor, the Division Forester shall insure that the customer's concerns are promptly, thoroughly, and courteously addressed.

When property damage is involved, a field investigation is performed, and the Division Forester completes a claims report and forwards this report to the Claims Department for assessment and resolution with the property owner. If the claim involves significant property damage or alleged herbicide misapplication, the Division Forester shall notify the Manager of Transmission Forestry Strategy. In addition, if the complaint involves regulatory agencies, the Division Forester shall notify both the Manager of Transmission Forestry Strategy and the Environmental Affairs Department, together with local managers.

Complaints or problems of unauthorized dumping shall be handled in accordance with the Environmental Guidance EG-502, “Unauthorized Dumping" that is included in Appendix 11.

3. Planting Criteria

Although vegetation management on utility ROWs has a goal of reducing undesirable vegetation where property rights permit, National Grid is committed to being a good steward of the environment and a good neighbor. The following criteria will be used to determine if replanting is warranted during or following vegetation management:

a. When resulting work was a or will be a significant deviation from specification, property rights or landowner agreement and requires planting as a compensation for damages with details to be negotiated between the corporation and the underlying fee landowner of the transmission line easement.

b. When the required vegetation removal is necessary however the company's property rights are determined to be unsupportive of the work required.

c. In public park-like settings where replacement is reasonable and prudent as determined by the company and supported by the property administrator.

d. Where government or public/private organizations support the planting of vegetation as an environmental type project. This criteria includes cooperation with that organization either monetarily or through workforce contribution.

In all cases of replanting, the resulting vegetation must be in conformance with all elements of this Transmission Vegetation Management Program.

K. Program Implementation

1. Determination of Work Force

Transmission work activities are generally completed through contracting. The Manager of Transmission Forestry Strategy shall provide ROW maintenance specifications, together with inventories and the necessary maps to initiate the contract bid process in accordance with Supply Chain Management procedures. National Grid has implemented a unit price bid process for maintenance of the ROW floor, under long-term, multi-year contracts. Specialized maintenance work, including danger tree removal and environmental restoration activities, are generally completed using hourly crews that are established through a multi-year bid process.

2. Crew Training

National Grid requires contract supervision to be DEC fully certified applicators in accordance with the provisions of Environmental Conservation law 6NYCRR, Part

325. In addition, National Grid requires that there be at least one fully certified applicator on each crew. This person is generally the crew leader. All other application personnel are required to be qualified at either the apprentice or technician level, as defined by these pesticide regulations.

Certified applicators provide direct supervision to all applicators on each treatment crew. They also provide required training to commercial pesticide apprentice applicators. Certified technicians may work under indirect supervision of certified applicators when using general use pesticides. Certified technicians cannot supervise or train apprentice applicators.

All certified applicators and technicians are also required to complete regular re-certification training, in order to renew their pesticide applicators license. Transmission foresters work with other utilities, as well as the Department of Transportation, the DEC, the PSC, Cornell Cooperative Extension, chemical manufacturing representatives, and other educators to develop and sponsor an annual refresher training program for right-of-way applicators known as Category 6 training. This training exceeds the minimum DEC requirements by annually providing applicators with up to eight hours of training on regulatory updates, landowner notification and posting, and DEC reporting. The training also includes changes and enhancements to treatment methods, and provides updated information on new technologies and products. Category 6 is also used to keep crews current with continuing or new research developments in right-of-way management.

The Manager of Transmission Forestry Strategy and/or the Division Forester shall also conduct annual crew training with all treatment personnel and supervision at the start of each season. This training reviews the approved application methods, herbicide mixtures, and criteria for matching a treatment method to the site requirements. It emphasizes attention to environmentally or visually sensitive areas, and shows how to implement appropriate buffer zones. Special requirements, such as DEC wetlands or endangered species considerations are discussed, and DOH public health issues related to drinking water supplies are identified. The inventory is reviewed to identify site location and treatment requirements, including any special notes incorporated on a particular site. In an effort to achieve continuous improvement, the success and the problems related to previous year’s work are reviewed, with special emphasis on areas of concern related to public or customer notification, communication, or sensitivity. In the future this training will also incorporate detailed training in mid-span clearances requirements, shrub identification, and selective implementation of the wire zone/border zone concept.

The Division Forester will continuously monitor the success of this training, and initiate remedial training as required to enhance crew knowledge, skills, and performance. The success of the Program in achieving these training goals is further incorporated into the annual field review process of the Manager of

Transmission Forestry Strategy, Division Forester, and the PSC environmental staff.

The emphasis of the training is to inform and educate field crews and their supervision in the overall goals, objectives, and strategies of this long-range Program, and insure its successful implementation.

3. Contract Specifications

The Transmission Right-of-way Maintenance Specification is designed to insure the successful implementation of the terms and conditions of this long-range management Program. This specification is periodically reviewed and revised to incorporate program modifications and enhancements. These changes are then set forth in contract documents and communicated to contractors through the pre-bid and crew training processes. The commitment of the program to an ecologically balanced approach, using highly selective herbicide application methods and following the principles of integrated vegetation management, are also communicated to all vendors through the pre-bid process.

Following the award of maintenance activities to the successful bidder(s), in-field training is conducted by Division Foresters and the Manager of Transmission Forestry Strategy to ensure full training and communication of program goals, objectives, and strategies, together with specification requirements down to the applicator level. In order to abide by specification requirements, contractor personnel must have the ability to distinguish between undesirable and compatible species. Various levels of National Grid and contractor supervision closely monitor field treatment activities to insure compliance with the specifications.

4. Supervision

The Program requires various levels of responsibility and supervision to be successful. It also requires all levels of supervision to by actively involved in the training, implementation, and monitoring processes. Of these, proper training is the most important element for successful implementation.

<u>Manager of Transmission Forestry Strategy</u>

The Manager of Transmission Forestry Strategy is responsible for the development and implementation of system vegetation management policies and procedures, as defined by this long-range Transmission Right-of-way Management Program. This includes system oversight of the measures and activities necessary to meet the requirements of the program.

Division Forester

The Division Forester is responsible for the field implementation of transmission right-of-way management activities and practices necessary to accomplish the goals, objectives, and strategies of the long-range Transmission Right-of-way Management Program. This includes completing field inventories and/or supervising the inventory reporting process. They direct and supervise all right-of-way maintenance, clearing, tree pruning, danger tree removal, environmental restoration, and other related activities within their assigned Division, to assure compliance with the specifications and the Program.

Division Foresters are experienced professionals that hold 2-year or 4-year degrees in Forestry Strategy, urban Forestry Strategy, arboriculture or related field. Other qualifications may include NYS-DEC certified pesticide applicator license, ISA Certified Arborist, utility industry line clearance and/or vegetation management experience or significant experience in contract and contractor management. All Division Forester tasks may be carried out by in-house staff or professional level contractors holding equivalent qualifications. On-the-job-training for Division Forester tasks may occur under the direct supervision of a Division Forester or Manager with at least 5 years of utility experience.

Contract Supervisor

Each vegetation management contractor shall provide a trained and qualified supervisor that fully understands the goals, objectives, and strategies of the program, as defined by the specifications. Each supervisor shall be a DEC fully certified applicator who is capable of distinguishing between desirable and undesirable species.

Spray Crew Leader

Each vegetation management crew shall be directed and coordinated by an on-site, DEC fully certified applicator that has specific responsibility for direct supervision of those individuals assigned to clearing and treating. The crew leaders shall be fully knowledgeable in species identification and selective IVM principles and practices. Spray crew leaders are responsible for assuring that nozzle operators are trained and proficient in carrying out the specifications. The supervisor for the crew leaders is responsible for assuring that each crew leader is properly handling their duties and responsibilities.

On-the-job Training of Nozzle Operators

Each crew leader spends sufficient time with each new applicator when they start work to assure they are trained in the appropriate application procedures and identification techniques. Nozzle operators are trained on the job and are constantly supervised by the full-time crew leader during treatment operations.

Generally, each site or right-of-way contains a mixture of species that must be controlled and others to be retained. The range of targeted species often changes from site to site along the ROW, with some small tree species and taller growing shrubs being too tall to be retained under some mid-span sites. These same species may be compatible at other mid-span sites or along the ROW edge. Woody plant lists are incorporated into the specifications to serve as a guide in determining whether or not to treat. It is the responsibility of the crew leader, together with contractor supervision and the Division Forester, to train and instruct each member of the crew in the proper implementation of the wire zone/border zone principles and IVM practices. The crew leader generally accomplishes the site-to-site training by routinely pointing out these species and clearance differences as the treatment process moves along the ROW.

This method of training has widespread use throughout the industry and has proven highly effective. The degree of effectiveness fluctuates with the degree of emphasis placed on this issue by supervision. National Grid is committed to selective treatment following sound IVM and ecological principles and intends for our applicators to implement practices and procedures that fulfill those objectives.

5. Program Monitoring

The Division Forester is responsible for monitoring day-to-day field maintenance activities. The frequency of field visits depends upon the type, location, and complexity of the work.

L. <u>Measurement of Program Effectiveness</u>

The effectiveness of the program is continually monitored, tracked, and reported through a number of indices, including reliability, costs, herbicide use, desirable and undesirable densities, and cycle length. Costs are accurately measured by costs per acre, per year for maintaining the right-of-way over the length of the cycle and life of the line. Herbicide use continues to be measured in terms of gallons of herbicide concentrate per treated brush acre. National Grid has used concentrate gallons and concentrate gallons per acre since it was first required to submit an annual herbicide use report to the PSC in 1978.

National Grid is required to submit an annual report to the PSC by March 31 of each year. This report shall include the following:

- A summary of the acres scheduled for each year and the actual acres treated by line.
- A summary of the acres treated by technique.
- A summary of cost per acre by technique.
- A summary of herbicide use for each technique.
- A summary of spot trim and danger tree work activities.

- A summary of environmental restoration and access road activities.
- A copy of the tentative IVM work plan for the year ahead.
- A summary of acres treated by technique within the Adirondack Park.
- A summary of the danger tree program completed that year.
- A summary of non-storm tree-caused outages on voltages 115kV and above.

A copy of the 2008 annual report is included in Appendix 10.

M. Regulations, Permits and Approvals

This program incorporates the special environmental and vegetation management concerns of various Article VII electric and gas projects into the management goals and objectives of this Program. It will continue to uniformly and consistently apply industry best management practices for environmental and vegetation management to all electric and gas transmission facilities, including Article VII projects. Appendix 1 identifies the special Article VII concerns for each electric project and Appendix 2 addresses the gas projects.

Appendix 12 includes special conditions which apply within the Adirondack Park.

National Grid policy requires compliance with all applicable federal, state, county, and municipal laws, rules, and regulations; and these requirements are incorporated into the terms, conditions, and specifications of all contracts. Article 33 of the New York State Environmental Conservation Law form the basis for Part 325 and 326 of New York State Code of Rules and Regulations are regulations that pertain to herbicide use for vegetation management activities. Other pertinent regulations govern herbicide application in wetlands and compliance with endangered species regulations.

Article 24 of the NYS Environmental Conservation Law (ECL) covers right-of-way maintenance activities in wetlands, while Article 15 of the ECL addresses activities in other regulated water bodies. A combination of a Standard Activity Permit for herbicide applications (see below), a General Permit for other "minor" maintenance activities, and occasionally, a U.S. Army Corps of Engineers Nationwide Permit #3 are necessary before completing maintenance activities in wetlands, streams, or other water bodies. The Army Corp Nationwide Permit is needed for fill or excavation activities associated with the operation and maintenance of the line, including maintenance, repair, or replacement of culvert and stream crossing devices. New installations may require a Nationwide 12 Permit, or even an individual permit.

It is the specific responsibilities of the Environmental Affairs and System Transmission Forestry Strategy Departments to ensure and expedite compliance, including fulfilling any public posting and notification or regulatory permit requirements. The Company has developed two Environmental Guidance documents to ensure that all pesticides and herbicides are handled and applied in accordance with the regulations and that herbicide spills are promptly reported. Copies of the Environmental Guidance "EG-504, Pesticide and Herbicide Application," and "EG-202 Herbicide Spill Reporting" are included in Appendix 11.

The Manager of Transmission Forestry Strategy is charged with primary responsibility for business registration, herbicide training and safety, and annual herbicide use reporting under existing pesticide regulations.

1. **NYS DEC Herbicide Application Permit for Wetlands**

   National Grid was the first New York State utility to submit for and receive a "Standard Activities Permit" for its annual vegetation management program in regulated wetlands. This process was first initiated by the EAD in 1999, and its terms and conditions remain in effect.

   In accordance with this "Standard Activities Permit," the Environmental Affairs Department prepares annual regulated wetlands permit submittal to the DEC that includes the tentative annual schedule of lines planned for maintenance in the year ahead. It will include an electronic geographic information system (GIS) or equivalent map file that identifies the line route, road crossing, and other pertinent land features, and the location of regulated wetlands that are crossed by or in proximity to the right-of-way. EAD shall also publish any public notice announcements required by the wetlands permitting process. EAD will obtain the required DEC permit and forward it to the Manager of Transmission Forestry Strategy who will, in turn, distribute it to the appropriate Division Forester and contract supervisor.

   Once field applications begin, the Division Forester provides weekly updates to the Regional DEC offices identifying lines that are scheduled for work in that particular week. This report will be submitted to the Regional DEC Natural Resource Manager and Pesticide Inspector. The report is generally submitted at the beginning of the week to communicate anticipated work plans. Actual work can vary from the expected work plan due to changes in weather conditions, crew performance, etc.

2. **NYS DEC Wetlands and Streams General Permit 98-01**

   In 1998, Niagara Mohawk negotiated a General Permit for routine utility work activities with the DEC, replacing a burdensome process that required individual permitting of activities. This permit was the first of its kind, incorporating 44 separate maintenance activities into a single permitting process. Each minor activity included in this permit is associated with a set of best management practices and is annually measured for compliance and reporting.

NYS DEC Endangered Species Notification

National Grid shall also prepare a voluntary submittal to the DEC Natural Heritage Program to provide an electronic GIS or equivalent map file that shows the line route, road crossings, and other pertinent land features. The Natural Heritage Program will use this information to identify known populations of rare, threatened, or endangered species that may be found within 150 feet of the right-of-way and then communicate those locations to the Company.

The Transmission Forestry Strategy Department shall then work collaboratively with the DEC Endangered Species Unit to determine the potential risks and benefits of right-of-way management activities. The program's procedures and practices strive to protect known populations of threatened or endangered species so as to avoid and prevent incidental take. The program is committed to the philosophy that most ROW management activities will either have a positive effect on endangered species and critical habitat, or can be modified slightly to enhance critical resources.

Once a plan of action is identified, the Manager of Transmission Forestry Strategy and the Division Forester are responsible for training the treatment crews in the appropriate work methods.

3. Voluntary Department of Health Notification

The Division Forester shall prepare a voluntary submittal to the NYS Department of Health (DOH) to communicate routine transmission maintenance activities, line locations, treatment methods, and herbicide mixtures. The notification shall be provided to the appropriate county or region by early spring. The submittal shall include a list of lines scheduled for maintenance in the coming year together with the annual herbicide code sheet that identifies approved treatment methods and herbicides or herbicide tank mixtures. Copies of the work specifications will be available upon request. The plan shall also include a GIS map or other suitable map file showing the line route, that the DOH may use to identify known public water supplies located near the proposed work. The name and contact number for the appropriate Division Forester shall be included to provide each DOH officer with a direct communication point for questions concerning the proposed work and to help identify well points to the Forester.

Information that is provided about drinking water resources will be communicated to the field crews by the Division Forester.

In order to insure that “clean” water resupply trucks are used, field crews will not be permitted to transport herbicide or other herbicide application equipment on these units. In addition, all equipment used to draw water from any water source shall be equipped with an effective anti-siphon device or water break to prevent back flow.

4. Public Notification and Posting Procedure for Herbicide Application

The program requires compliance with all DEC pesticide notification, posting, and annual reporting requirements through its specifications.

Each contractor shall submit reports to the DEC for their application work on National Grid rights-of-way. They shall also provide sufficient, timely reports to the Division and System Foresters to enable preparation of all work completion, herbicide use, and annual PSC reports.

5. ISO 14001 Considerations

In preparing the Company for ISO 14001 certification of its transmission and distribution system, the above regulatory requirements have been summarized into a Corporate Environmental Guidance document. A copy of this document is included in the Company’s Electric Operating Procedures and is available for review on the Company’s web page.

N. Testing of New Material and Mixtures

National Grid is committed to use only properly labeled herbicides the have been approved for the specific uses by the appropriate state and federal authorities, and to use them in a prudent, economic, and environmentally conscious manner.

Under approved experimental conditions, National Grid has and will continue to field test and research promising new herbicide and non-herbicide products, treatment methods, and application equipment for approximately two growing seasons. Upon successful field testing, new products, tank mixes, methods, or equipment will then be introduced into the program on a more operational basis. The Manager of Transmission Forestry Strategy will cooperate with suppliers, researchers, and others to design, apply, and evaluate field tests.

O. Research

The success of vegetation management programs in New York today is directly related to the research that has been jointly conducted through ESEERCO over the past two decades. The importance and role of research in the development of this Program is integrated throughout this document and a complete summary of the ESEERCO and National Grid funded research is included in Appendix 4.

National Grid will stay abreast of regional and national research developments related to the environmental and ecological benefits of herbicide use, as well as and the impacts of various herbicide and non-herbicide treatment alternatives. Where gaps in right-of-way management knowledge and data exist that may improve Program performance, we will seek strategic research partners from across the state and the region to share and equitably distribute the benefits and economic burdens of research.

P. Program Review

While the program is under continuous review and improvement, National Grid will periodically review and assess the plan no less than every six years or two complete treatment cycles, which ever comes first. Areas of assessment will include but not be limited to reliability, cost, herbicide use and complaints. Any changes proposed to the plan will be brought to the attention of DPS Staff. Staff will refer those minor changes, which will not cause significant adverse impacts to the environment (including public health) or reliability, to the Secretary of the Commission. All other changes will be considered major and will be referred to the Commission for action pursuant to the State Administrative Procedure Act.

VIII. Danger Tree Program

The danger tree program addresses trees located off the right-of-way. A danger tree is defined as any tree located off the right-of-way that could upon failure contact the electric conductors (ANSI A-300 part7-2006 IVM). A danger tree has to be simply tall enough to hit the line. Hazard trees are any structurally unsound trees rooted outside the right-of-way that could strike an electrical conductor when it fails (ANSI A-300 part7-2006 IVM). This is a tree, due to its proximity and physical condition (i.e. mortality, lean, decay, cavities, cracks, weak branching, root lifting, or other instability), poses a particular danger to a conductor or other key component of a transmission facility, (see New York Public Service Commission Case 04-E-822). In addition to the above definitions, tree species with known inherent weaknesses that have a history of failing either statewide or regionally ie: red maple or balsam fir, are considered danger trees regardless of their condition.

Trees located off the right-of-way have branches that can grow into minimum clearance distances, but may or may not be danger trees. Such trees will be pruned or removed to achieve At Time of Vegetation Management Clearance distances.

National Grid’s strategic approach to manage danger trees is to prune and/or remove danger trees, where property rights allow; and to seek permission from landowners for pruning and/or removal, where such rights are limited.

Danger trees falling into the lines present the greatest risk of tree caused outages on transmission circuits. The risk is primarily related to 2 non-biotic variables, 1) distance from conductor to the adjacent tree line (clear width), and 2) conductor distance above the ground; and 3 biotic factors; 1) height of trees, 2) tree species, and 3) tree health and condition. National Grid seeks to mitigate risk of outages from danger trees through site specific management of these variables.

Risk can be quantified using the Optimal Width Calculator (OWC) software licensed to National Grid by Ecological Solutions, Inc. The OWC calculates a Risk Factor based on the variables discussed above. Data was collected in 2004 across NG's NY 115 kV, 230 kV and 345 kV transmission system to calculate average Risk Factor by voltage class. Data are presented in the table below:

Voltage Class	Risk Factor
345 kV	0.19
230 kV	2.30
115 kV	6.19

NG will prune or remove trees adjacent rights-of-way to 1) achieve At Time of Vegetation Management Clearances, and 2) reduce the Risk Factor for each voltage class. The Side Line Tree Risk Assessment and Mitigation Strategies study conducted by National Grid indicates that <u>reduction of Risk Factor to equal or less than the average Risk Factor for each voltage class, will result in a 50% to 80% reduction in the Risk Factor for each voltage class</u>. Essentially this approach targets the pruning and removal of danger trees to areas where it will be most effective in reducing risk.

1. Danger Tree Inspections:

Inspections for danger tree problems will be part of routine Division Forester ground based and aerial inspections discussed in Section A

2. Ranking by Voltage Class:

High voltage transmission lines, 230 kV and 345 kV, are ranked above lower voltages in terms of allowed risk to the system from trees. These circuits are also subject to the NERC Vegetation Management Standard FAC-03-001. These lines are built with greater ground clearances and clear widths, resulting in the much lower Risk Factors shown above. The present tree condition and Risk Factors result in very few outages. Due to their importance to system reliability and minimal exposure to danger trees, these lines will be the first lines treated under the danger tree protocol presented above. All 230 kV and 345 kV circuits will be treated in the first 5-8 year maintenance cycle (2006-2013).

Sub-transmission lines, 23 kV to 69 kV serve customer load. Tree caused outages on these circuits contribute to about 4% (2006 data) of customer non-storm SAIFI. Given the contribution to SAIFI, National Grid has prioritized this group of circuits below bulk (345 and 230 kV) but above 115 kV transmission lines. As mentioned above, National Grid plans to complete the right-of-way widening program by 2012. In addition, routine danger tree and hazard tree work will continue on the regular DT maintenance cycle one year prior to IVM work.

115 kV transmission lines also serve customer load. While customer load is very important to National Grid, tree caused outages on these lines contribute very little to customer non-storm SAIFI – significantly less than 1% (2006 data). Risk Factors for 115 kV lines clearly reflect the lower conductor height and smaller clear width on these lines (compared to high voltage transmission lines). A much higher percentage of the system will require danger tree work than on high voltage transmission lines. National Grid proposes to carry-out the danger tree protocol on these 115 kV lines over 2 maintenance cycles (2006-2022).

3. **Prioritization within Voltage Classes**:

National Grid determines a Line Importance Factor (LIF) for all 115 kV, 230 kV and 345 kV circuits. The LIF takes into account impacts to generators, customers, redundancy of supply, etc. The LIF will be reviewed and serve as one factor including reliability history, maintenance history and system configuration to prioritize lines within these transmission voltage classes.

Prioritization of work on the Sub-Transmission voltages, 23 kV to 69 kV, is a collaborative effort between the Transmission and Distribution Forestry Strategy Groups. Transmission Forestry Strategy generates a list of lines to be worked on each year. The Distribution Forestry Strategy Asset Management group reviews, adjusts and approves the list. Factors such as the numbers of customers served, reliability history, maintenance history, and system configuration (radial or redundant feed) are considered during this process. Transmission Forestry Strategy, being the service provider for distribution, then schedules the work for the approved lines.

4. Danger Tree Program Protocol for 230 kV and 345 kV Transmission lines:

a) Off right-of-way trees will be pruned or removed to achieve ATVM clearances.

b) Off right-of-way trees that could strike the line that meet the ANSI A300 hazard tree definition will be assessed for risk and pruned or removed where rights or landowner permissions allow.

c) For danger trees, National Grid staff determines areas with above average Risk Factors.

5. Danger Tree Program Protocol for 115 kV Transmission lines:

a) Off right-of-way trees will be pruned or removed to achieve ATVM clearances.

b) Off right-of-way trees that could strike the line that meet the ANSI A300 hazard tree definition will be assessed for risk and pruned or removed where rights or landowner permissions allow.

c) For danger trees, National Grid staff determines areas with above average Risk Factors.

6. Danger Tree Program Protocol for 23 kV to 69 kV Sub-Transmission lines:

The most critical factor for lower Sub-Transmission lines is clear width. National Grid began a sub-transmission widening program in the mid-1990's. Approximately 1,500 miles of the 2,600 miles of sub-transmission was widened through 1998. Beginning in late 2005, National Grid renewed the sub-transmission widening program. National Grid will complete the widening program on approximately 1,000 miles of Sub-Transmission by 2012.

Where rights or landowner permissions allow, Sub-Transmission right-of-ways will be widened to achieve a clear width of not less than 30 feet. Note: 37.5 feet from center line of circuit.

Routine danger tree and hazard tree pruning and removal will continue on a 5-14 year cyclic basis during the same time frame.

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APPENDIX 1

ELECTRIC CASES

Case Number and Date	Specific Field Conditions	Case Name	Facility Operating Name
26573 May 16, 1975	No	FINDLEY ROAD – FALCONER	DUNKIRK – FALCONER 160
26520 December 15, 1975	No	HOMER CITY - STOLLE	HOMER CITY - STOLLE 37
26729 December 12, 1976	No	WELLSVILLE - ANDOVER	SOUTH WELLSVILLE - ANDOVER 541
26923a July, 22, 1976 & August 19, 1977	Yes	ADIRONDACK LINE; Tower 15 to Warrensburg	WARRENSBURG – SCOFIELD ROAD 10
26923b December 15, 1986	No	ADIRONDACK LINE	NORTH CREEK – WARRENSBURG 5
70073 April 18, 1980	No	COFFEEN - WEST ADAMS 2	COFFEEN - WEST ADAMS 2
70137 August 8, 1983	No	COLTON - DENNISON 4 & 5	DENNISON - COLTON 4 & 5
26465 February 7, 1975	Yes	MCINTYRE – BROWNING	ALCOA – NORTH OGDENSBURG 13 – MCINTYRE 9
27290 August 14, 1978	Yes	LAKE COLBY - LAKE PLACID	LAKE COLBY - LAKE PLACID 3
26251a February 8, 1974	Yes	VOLNEY - MARCY	VOLNEY - MARCY 19
26251b February 8, 1974	No	OSWEGO – DEWITT	CLAY – DEWITT 13; OSWEGO – LAFAYETTE 17
26251c February 8, 1974	No	OSWEGO - VOLNEY	OSWEGO - VOLNEY 11 & 12
26251d February 8, 1974	No	OSWEGO – DEWITT	DEWITT – LAFAYETTE 22
26482 March 22, 1976	No	LAFAYETTE - OAKDALE	LAFAYETTE - OAKDALE 4
70346 September 4, 1986	No	ONEIDA - CORTLAND	ONEIDA - CORTLAND 3
70068 August 12, 1983	Yes	NINE MILE 2 - VOLNEY	NINE MILE 2 - SCRIBA 23 – VOLNEY 20 & 21 - CLAY 6
92-T-0114 August 20, 1992	Yes	INDEPENDENCE - CLAY	INDEPENDENCE - SCRIBA 25 - CLAY 26
26423 August 1, 1974	No	NEW SCOTLAND - REYNOLDS ROAD 3 & 17	REYNOLDS ROAD – ALPS 1

WESTERN REGION ELECTRIC TRANSMISSION LINES:

HOMER CITY - STOLLE 37 (Case 26520) {Homer City – Stolle Road 37}

There are no specific issues that are not folded into the current long-range ROW Vegetation Management Plan for this 37.5-mile 345 kV facility.

FINLEY [sic FINDLEY] ROAD – FALCONER (Case 26573) { DUNKIRK – FALCONER 160}

There are no specific issues that are not folded into the current long-range ROW Vegetation Management Plan for this 27-mile 115 kV line off the DUNKIRK – SOUTH RIPLEY 68 line.

SOUTH WELLSVILLE – ANDOVER (Case 26729) {WELLSVILLE – ANDOVER 541}

There are no specific issues that are not folded into the current long-range ROW Vegetation Management Plan for this 11-mile 115 kV line.

CENTRAL REGION ELECTRIC TRANSMISSION LINES:

COFFEEN STREET – WEST ADAMS 2 (Case 70073)

There are no specific issues that are not folded into the current long-range ROW Vegetation Management Plan for this 14.2-mile 115.

COLTON - DENNISON 4&5 (Case 70137) {DENNISON – COLTON 4 & 5}

There are no specific issues that are not folded into the current long-range ROW Vegetation Management Plan for this 27.2-mile 115 kV line.

INDEPENDENCE – SCRIBA 25 – CLAY26 (Case 92-T-0114)

ITEM 1: Order № 28 for this 29-mile 345 kV line stated that *'there shall be no brushhogging or mowing within a DEC regulated wetland except where the treatment site is dry at the time of mowing, and as provided in the EM&CP or long term right-of-way management plan approved by the Commission.'*

ACTION: The Company will not mow in wetlands if wet.

LAKE COLBY – LAKE PLACID (Case 27290) {LAKE COLBY– LAKE PLACID 3}

ITEM 1: An Order precludes the use of herbicides in a section of this 10.3-mile 115 kV line in the Four Corners "Forever Wild" Area, making reference to a Temporary Revocable Permit needed for that vegetation management.

ACTION: The Company will not apply herbicides between Structure 82 and Structure 83.

MCINTYRE – BROWNING (Case 26465) {ALCOA – NORTH OGDENSBURG 13 – MCINTYRE 9}

ITEM 1: An Order restricted the use of herbicides near stream crossings on this 38.5-mile 115 kV line based on NYSDEC concerns.

ACTION: The ROW Vegetation Management Plan contains an explicit discussion of wetland and streamside buffer zones for herbicide application. Applications will be conform to our long-range ROW Vegetation Management Plan and NYSDEC Standard Activities Permit.

ITEM 2: An EM&CP restricted the use of stem foliar herbicide treatments on certain areas pending listing of those sites and approval in the specific ROW management plan.

ACTION: The ROW Vegetation Management Plan revision updates and supercedes the individual plan, and identifies the criteria by which site-specific treatments are implemented.

NINE MILE 2 – SCRIBA 23 (Case 70068) {Nine Mile 2 – Scriba 23 - Volney 20 & 21}

ITEM 1: An Order required that brushland was to be retained from 100 feet west of the rail line and south of Lake Road for a distance of 50 feet.

ACTION: The Company will retain a scrub shrub vegetative screen in front of the Scriba Substation.

ONEIDA – CORTLAND 3 (Case 70346)

There are no specific issues that are not folded into the current long-range ROW Vegetation Management Plan for this 45 miles of 115 kV ROW.

VOLNEY - MARCY 19 (Case 26251a)

ITEM 1: The line is constructed on a NYPA easement.

ACTION: The Company acknowledges

ITEM 2: 'No herbicide' use restrictions are placed on sections of the line in accordance with NYPA rules.

ACTION: The Company has identified these segments and their special treatments in our operating documents and inventories.

ITEM 3: Several long-term R&D project commitments have been made in Oneida County segments.

ACTION: The Company has identified these segments and their special treatments in our operating documents and inventories.

OSWEGO – DEWITT (Case 26251b) {CLAY – DEWITT 13; OSWEGO – LAFAYETTE 17}

There are no specific issues that are not folded into the current long-range ROW Vegetation Management Plan for this 50-mile 345kV line that was approved with several others in this Case.

OSWEGO – VOLNEY 11&12 (Case 26251c)

There are no specific issues that are not folded into the current long-range ROW Vegetation Management Plan for this 13.5-mile facility that was approved with several others in this Case.

DEWITT - LAFAYETTE 22 (Case 26251d) {LAFAYETTE – DEWITT 22}

This 345 kV line was compartmentalized in this Case. On this segment there are no specific issues that are not folded into the current long-range ROW Vegetation Management Plan.

LAFAYETTE – OAKDALE 4 (Case 26482) {LAFAYETTE – DEWITT 4}

There are no specific issues that are not folded into the current long-range ROW Vegetation Management Plan for this 40-mile 345 kV facility.

EASTERN REGION ELECTRIC TRANSMISSION LINES:

NEW SCOTLAND - REYNOLDS ROAD 3 &17 (Case 26423) {REYNOLDS ROAD – ALPS 1}

There are no specific Article VII requirements or conditions affecting vegetation maintenance for this 12-mile 345kV facility. Vegetation management shall conform to the System-wide plan.

ADIRONDACK LINE (Case 26923) {Tower 15 to Warrensburg *aka* WARRENSBURG – SCOFIELD ROAD 10 and NORTH CREEK - WARRENSBURG 5}

ITEM 1: The Case directed that in the section of this 37.5-mile 115 kV line between Tower 15 and the saddle between Swears Mountain and Birds Nest Mountain, identified as visually sensitive, specific treatment plans were to be described for each future management cycle.

> ACTION: The Company will satisfy this requirement pursuant to GOAL D, OBJECTIVE 1 of this revised long-range right-of-way vegetation management plan.

ITEM 2: The Case precluded the Company from using foliar applications of herbicide.
ACTION: The Company will not use high volume foliar applications on these sites. It will manage vegetation in accordance with revised long-range right-of-way vegetation management plan GOAL D, OBJECTIVE 1 and the site selection criteria for highly selective low-volume (backpack) or stump treatment methods

nationalgrid

APPENDIX 2

APPLICATIONS OF INTEGRATED PEST MANAGEMENT TO ELECTRIC UTILITY RIGHTS-OF-WAY VEGETATION MANAGEMENT IN NEW YORK STATE

Environmental Energy Alliance of New York Land Use Subcommittee Committee Position Paper

The Environmental Energy Alliance of New York is an association of electric and gas Transmission and Distribution (T&D) companies and electric generating companies that provide energy services in the State of New York. This position paper was prepared by the Land Use Subcommittee of the T&D Committee, which currently represents the following members: Central Hudson Gas & Electric Corporation, Consolidated Edison Company of New York, Long Island Power Authority, New York Power Authority, New York State Electric & Gas Corporation, Niagara Mohawk, Orange & Rockland Utilities, and Rochester Gas & Electric Corporation. For more information about this Position Paper please contact Kevin T. McLoughlin, the System Forester for the New York Power Authority at P.O. Box 200, Gilboa, New York 12076. Tel. (607) 588-6061 ext. 6903, Fax (607) 588-9826 or e-mail Kevin.Mcloughlin@nypa.gov.

Executive Summary

As a matter of public safety and system reliability, electric utility rights-of-way (ROW) vegetation managers have a continuing need to preclude the establishment and subsequent growth of tree and tall woody shrub species that are capable of growing up into or even close to overhead electric lines. The members systems of the Environmental Energy Alliance of New York (EEANY) Transmission & Distribution (T&D) Committee employ the process of Integrated Pest Management (IPM) to ensure that tall growing trees and woody shrubs do not interfere with these critically important electric power transmission facilities. IPM balances the use of cultural, biological, physical and chemical procedures for controlling undesirable tall growing woody species on utility ROW. These IPM procedures, as practiced by the New York State electric utility industry, can be more appropriately referred to as an Integrated Vegetation Management (IVM) strategy. One of the important components of the IPM/IVM process is the selective use of herbicides to curtail the growth of undesirable tall growing species while preserving, to the extent practical, the lower growing vegetation on the ROW to act as a biological deterrent to the future re-establishment of trees.

The EEANY Land Use Subcommittee members have been practicing IVM policies and programs for well over two decades on those portions of the approximately fifteen thousand circuit miles encompassing over one hundred thirty thousand acres of overhead transmission line ROW that require the vegetation to be managed. IVM is an environmentally compatible activity that is cost effective and has all the elements of a conscientiously applied IPM strategy. This paper discusses the application of IPM to contemporary electric utility ROW vegetation management practices in New York State today as a truly ecologically based approach to pest management.

APPLICATION OF INTEGRATED PEST MANAGEMENT TO ELECTRIC UTILITY RIGHTS-OF-WAY VEGETATION MANAGEMENT

Integrated Pest Management (IPM) is a process that balances the use of cultural, biological, physical and chemical procedures for reducing pest populations to tolerable levels. Rather than relying solely on chemicals (or eliminating chemicals completely) IPM seeks to produce a combination of pest control options that are compatible with the environment, economically feasible and socially tolerable. The control of vegetation, i.e., the contemporary management of vegetation, on electric utility line rights-of-way (ROW)[1] readily accommodates itself to an IPM process. This paper describes how the member electric systems of EEANY T&D Committee have been actually practicing an IPM strategy for about two decades. However, that strategy can be more appropriately referred to as an Integrated Vegetation Management (IVM) strategy.

BACKGROUND

In New York State after a forested landscape is cleared, or when a cultivated field is abandoned, the natural vegetation type that will ultimately re-occupy the site and dominate the area will be tall growing trees. When the cleared area is an electric utility ROW, these resurgent trees can grow too close to the overhead electric lines. When this occurs, there is the potential for an electrical discharge from the electric line through the air to the tree and then to the ground. This is known as a "line to ground fault" or "flash-over." The result of a line to ground fault is an instantaneous break in electric service and a potentially very dangerous situation on the ground in the immediate vicinity of the high voltage discharge. Therefore, as a matter of public safety and system reliability, utility ROW vegetation managers have a continuing need to preclude the establishment and subsequent growth of those tree species including some tall growing woody shrubs that are capable of growing into or even close to the electrical lines.[2] Utilities ensure that tall growing species do not interfere with electric lines by committing to a long-term ROW vegetation management program.

INTEGRATED VEGETATION MANAGEMENT AS AN IPM STRATEGY

IPM has been described as a system of resource management that attempts to minimize the interaction between the pest and the management system through the integrated use of cultural, biological, physical and chemical controls. Implementation of an IVM program utilizing modern ROW vegetation management techniques meets this definition completely; IVM is a system of resource (vegetation) management that minimizes interaction between the pest (tall growing trees) and the management- system (safe and reliable electric service) through the integrated use of <u>cultural</u> (mechanical and manual methods that <u>physically</u> remove tree stems), <u>biological</u> (low growing plants and herbivory), and <u>chemical</u> (herbicides) controls.

Utilities use three general routine procedures for removing tall growing trees from the ROW: (1) mechanical methods such as mowing with large machines and hand cutting with chainsaws, (2) chemical treatments, i.e., the selective application of herbicides and (3) combinations of both mechanical and chemical methods.

Mechanical methods of tree removal alone will clear the ROW of tree stems temporarily. However, employment of these mechanical methods allows trees to physiologically respond by regenerating quickly from the energy reserves contained in their undisturbed root systems. This tree regrowth occurs through such mechanisms as "stump sprouting" and/or in some species "root suckering." This regenerative capacity is characteristic of virtually all hardwoods,[3] e.g., maple, beech, birch, aspen, oak, ash, cherry, etc. and is

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1 Electric utility ROW are strips of land, from 30 yards to over 300 yards in width that are used by electric utilities as corridors for the transmission of electric energy.

2 The electrical facilities being discussed herein are for the most part high voltage transmission lines and only those lower voltage distribution lines that have a discernible cleared ROW. There are more than 15,000 circuit miles of overhead transmission lines at or above 34.5kV belonging to the member systems of EEANY. ROW vegetation management under these electric transmission facilities is quite distinct from roadside tree trimming around distribution lines and these street tree-pruning operations are not the subject of this paper.

3 Hardwood is a conventional term for all deciduous (broad-leaved) trees belonging to the botanical class "Angiosperm." Softwoods, also commonly referred to as evergreens and conifers, belong to the botanical class "Gymnospermae" (and are practically confined to the order "Coniferae") do not posses this regenerative trait (with one lone partial exception in the northeast – young pitch pine), and once cut below the lowest whorl of live branches will not resprout.

particularly pronounced in the juvenile or sapling stage of tree maturation resulting in the eventual production of many more stems than were originally cut. By drawing upon the food reserves in their undisturbed root systems and through a series of complex compensatory physiological plant responses, the resurgent growth from the remaining portions of the tree (stump and/or roots) is actually enhanced when a tree stem is severed. It is through the production within the plant of naturally occurring stimulatory substances together with the loss of growth inhibitors (caused by the removal of the above ground growth centers) which then exert their influence on the remaining vegetative structure to promote excessive new tree growth. These new, more numerous stems, growing much faster than when left uncut, (e.g., five to ten feet or more the first year after cutting) makes subsequent tree removal from the ROW more frequent, laborious, hazardous and costly.

The selective application of herbicides to only the tall growing target tree species can in most instances eliminate completely the resurgent tree growth problem because the herbicide when properly deposited on the target species translocates throughout the tree (including the root system) and arrests all future growth and development, i.e., killing the entire target plant not just temporarily removing the above ground portion. Selective herbicide application involves two general techniques:[4] a basal application to the lower stem of the tree and a foliar application to the leaves. Selective application of herbicides only to the targeted tall growing species allows retention of nearly all the desirable low growing vegetation on the ROW. The elimination of the tall growing trees from the ROW will also encourage the further growth and development of all the indigenous low growing woody shrubs, herbs (forbs and grasses), ferns, etc. by removing the trees that would otherwise begin to directly compete with and eventually "crowd out" the low growing species over time. With effective minimally disruptive tree removal, these lower growing desirable plant species will expand into the ROW areas formerly occupied by trees and produce a thick dense plant cover that will discourage the invasion of new tree seedlings and/or the future growth of any remaining tree seedlings. These desirable low growing plant communities act as the "biological controls" in this IPM/IVM scenario. The establishment and the preservation of these low growing plant communities on ROW serve to reduce over time the amount of work required and cost incurred by the utility to maintain the ROW each treatment cycle while coincidentally diminishing the amount of herbicide necessary for adequate coverage of the target species.

Mechanical and chemical controls are often used together with favorable synergistic results. For instance, a tree is manually cut with a chain saw and the resulting freshly severed stump is treated with a herbicide formulation to prevent resprouting. This procedure removes the immediate physical threat to the overhead electrical line as well as the future tree growth with little disruption to the surrounding desirable plant cover while requiring very limited use of herbicides in a highly efficacious spot application.

ESSENTIAL ELEMENTS OF AN IPM STRATEGY
ILLUSTRATIONS & EXAMPLES

Traditional IPM programs consist of five basic elements: (1) preventive measures, (2) biological controls, (3) monitoring, (4) assessment, and (5) control measures. These essential elements of a sound IPM/IVM program are illustrated in the following examples.

1. Preventive Measures

When the land use of a ROW is altered to preclude the establishment and growth of trees, the utility has little, if any, ROW vegetation management activities to perform. This advantageous situation occurs when a ROW fee owner or adjacent land owner productively uses the ROW in a manner compatible with the electrical facilities, and this use usurps the potential development of tall growing trees. The most common ROW multiple uses often involve various types of agricultural[5] activities, i.e., crop production, pastures for grazing livestock,

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[4] Many variations of these two techniques exist.

[5] It should be noted that most agricultural pursuits require the use of significant amounts of various pesticides, e.g., insecticides, fungicides, herbicides, etc. on an annual basis. Thus, the total quantities of pesticide applications will often dramatically increase on those ROW areas converted to farmland as compared to the spot treatments of herbicides every four to seven years by the utility.

and within certain height limitations even Christmas tree plantations and some types of orchards. Those agrarian activities, as well as many other types of allowable industrial, commercial and residential multiple uses, which effectively curtail the opportunity for any tall growing vegetation to become established can thus eliminate completely the burden for any ROW vegetation management by the utility. However, any use of the ROW that allows even one tree capable of growing up into the electrical lines, e.g., hedgerows between cultivated fields, requires due diligence by the utility to prevent an electrical discharge.

2. Biological Controls

One of the principle goals of ROW vegetation management is to promote low growing relatively stable (long lived) plant communities, which consist of numerous species of woody shrubs, herbs (forbs and grasses), ferns, etc. on the ROW. These low growing plant communities are a very desirable ROW accessory in that they inhibit both tree establishment and their subsequent growth by directly competing with the tall growing species for the available site resources (sunlight, water, and nutrients). Thick low-growing plant communities, which hinder tree seed germination and the early development of the undesirable tree seedlings and small tree saplings, act as the biological control agents in this IPM/IVM strategy.

There may even be some indirect biochemical interactions, called allelopathy, occurring among various plants that result in a chemical competition of sorts between certain lower growing desirable ROW species and some of the tall growing tree species. Allelopathy has been defined as the influence of one plant on another via the production of natural growth inhibitors. Currently there exists only a limited understanding of this ability of plants to produce and release phytotoxic substances that can then be translocated to other plants and used to curtail certain critical physiological plant functions such as growth and reproduction. These naturally occurring "herbicides" offer yet another potential beneficial aspect of the biological controls in assisting the ROW vegetation manager to curb the spread of the undesirable tall growing trees.

In addition to their immediate benefits to the utility of reducing the undesirable tree population, these low growing plant communities offer an assemblage of plant species that provide diverse and productive habitat conditions for a wide variety of wildlife, e.g., birds and mammals. Managed ROW creates habitats that provide wildlife food and cover values that are remarkably different, and oftentimes surpassing, those of the neighboring forest. Also, this juxtaposition of two different, but complementary plant communities (one perpetually kept in a low growing condition and the other usually a forest) produces what is known as the "edge effect." This effect enhances wildlife profusion, i.e., abundance and diversity, in the boundary area transition zone (ecotone) between these two distinct habitat types. Some of the new and more numerous wildlife species attracted to these enhanced ROW created habitats provide yet another beneficial function of further reducing tree establishment and growth through their collective herbivory, e.g., browsing by deer and rabbits on young trees, girdling of tree seedlings by voles, and tree seed predation by mice.

3. Monitoring

As explicitly called for in an IPM program, monitoring of the pest population involves the following items:

- Regularly checking the area
- Early detection of pests
- Proper identification of pests
- Noting the effectiveness of biological controls

The ROW vegetation managers of the EEANY member systems routinely carry out all of these monitoring activities as an integral part of their electric utility ROW vegetation management programs. Monitoring procedures have been integrated into the NYS Public Service Commission approved "Long Term ROW Management Plans" developed by each member system. Monitoring activities include an evaluation of the previous treatments to determine overall program effectiveness as well as the current condition of the ROW so as to ascertain when the next treatment should occur and by what means. All of these procedures are part of a sound IPM/IVM strategy. ROW throughout New York State are regularly inspected to determine the height and density of the tall growing target tree species as well as the condition of the lower growing vegetation. Inspection results help determine, to a large extent, the timing and type of ROW vegetation treatment that the utility implements.

These field inspections also serve another important function, i.e., the fulfillment of a quality assurance/quality control (QA/QC) program. This QA/QC component of the ROW vegetation management program provides feedback as to the conduct of the field crews regarding their adherence to the work specifications as well as to determine the longer-term efficacy of the treatments. In addition to the routine utility monitoring, the Department of Public Service staff annually inspects the results of the company ROW vegetation management programs to insure compliance with all applicable regulatory mandates.

Identifying the undesirable tree species is a critical component of an IPM/IVM program. With hundreds of species present on a ROW, all vegetation treatment personnel must be sufficiently knowledgeable of plant species to enable them to readily distinguish between target trees to be treated, and all non-target desirable low-growing species to be left as undisturbed as possible. Based upon field inspections, the type of vegetation treatment will also be determined in large part by the distribution and abundance of the lower growing species. For instance, when thickets of shrubs, such as viburnums or dogwoods, are present together with only a few target tree stems, the highly selective stem specific application of herbicides would produce the most acceptable results. The extensive use of mowing for example over such a ROW segment containing only a few target species would be quite disruptive to the existing desirable low growing vegetative cover. Such an ecological disturbance would unnecessarily leave the ROW in a much more open and vulnerable condition thereby actually enhancing the ROW site conditions for the eventual re-establishment of undesirable trees as well as significantly reduce its aesthetic and wildlife values.

4. Assessment

Assessment is the process of determining the potential for pest populations (target trees) to reach an intolerable level. For ROW vegetation managers, the most opportune time to eradicate target trees is well before they reach the height of the overhead electrical lines. From an assessment perspective, an effective IPM/IVM strategy needs to: (a) prevent any interruption of electrical service and avoid risk of injury to the public, (b) treat the target species at their optimum height range as they emerge from the lower growing plant cover (at this stage they can be conveniently treated with limited amounts of herbicide so as to achieve the highest degree of control possible), (c) cause the removal of the target tree species before they become tall and dense enough to begin to crowd out and adversely alter the composition, structure and density of the desirable lower growing vegetative cover and (d) minimize any direct disruption by the treatments themselves to the existing desirable ROW plants so they continue to occupy the ROW and function as biological controls.

5. Control Measures

IPM strategy dictates that once a pest population has reached the intolerable level action should be taken. Typically, under an IPM program, chemical pesticides are used as a control measure when no other strategies will bring the pest population back under the economic threshold. In fact, the success of IPM often occurs by waiting until a pest population reaches this threshold and then often hinges on the availability of a pesticide to bring the pest population back under control quickly. For ROW vegetation management the pest population consists of only the target tree species that meet certain critical height[6] characteristics. Only those trees that have emerged from the lower growing plant "canopy" need to be selectively removed; thus many very small tree seedlings may remain untreated, submerged within the low-growing plant community on the ROW. Most of these small tree seedlings, left fully submerged within the dense low growing understory vegetation, will never fully develop into trees as they will succumb to the surrounding competitive pressures of the lower growing desirable vegetation and its associated biotic agents, e.g., animal herbivory. An additional positive attribute of this biological control feature occurs when those few remaining target trees that finally "escape" from the low growing plant communities only do so after a considerably longer time period than would normally

[6] This "critical tree height" is determined "electrically" by the distance between the tip of the tree and the overhead electric line with consideration for the voltage of the transmission facility, at any given point on the ROW. The higher the line voltage the more clearance that is necessary around the conductors which is often referred to as the wire security zone. For instance, a 765 kV line requires a greater wire security zone distance (about 10 feet more) than a 345 kV line needs. Also, as the voltage of the transmission facility increases the minimum wire distance from the ground likewise increases. The minimum conductor sag at mid-span allowed for a 765 kV line is about 50 feet from the ground whereas a 345 kV line only requires a height of around 30 feet from the ground. Finally, the location of the tree on the ROW will determine the distance to the conductors and the resulting allowable maximum tree height that can be tolerated at that particular point. Trees located near the edge of the ROW or close to tall towers can be allowed to grow taller than their compatriots located in the center portions of the ROW near conductor mid-span which is within the area of maximum line sag, i.e., where the line is closest to the ground.

happen under relatively (open) unencumbered circumstances. This helps to extend the duration between ROW vegetation treatments.

The choice of treatment technique as well as the explicit mode of application to ensure adequate control of the target tree species are also important aspects of selective ROW vegetation management that uniquely qualifies IVM as an IPM approach. As part of an IPM/IVM program, herbicides are used only to treat individual tree stems or groups of target trees, and no aerial or indiscriminate ground broadcast (blanket) applications (uniformly spraying the entire ROW) are used in New York State today. Herbicides that are used on ROW are matched to site-specific characteristics and target species, and the products are selected from dozens of commercially available materials based upon various attributes such as efficacy, toxicity, cost, etc. Furthermore, once a specific herbicide(s) is selected for application, its efficacy can be further enhanced (and its environmental impact minimized) by proper timing and selection of the most suitable method(s) of treatment (including integration with mechanical controls) together with choosing the most appropriate formulation and dosage rate.

The option of non-chemical mechanical clearing of the ROW; by hand cutting with chainsaws, mowing with large machines like a hydro-ax or even using massive earth moving equipment in a stump/soil shearing operation, is most always an available alternative. These physical methods of tree species removal are used for those ROW segments occupied by or located close to sensitive land uses or containing special resources that have been determined to be vulnerable to the application of herbicides. These designated ROW locations can be granted this extra protection through the judicious use of "no spray zones" or "set back distances" which are often referred to as "buffer zones" where herbicide use is not allowed. The determination not to use herbicides can be made by the ROW manager on a site-specific basis or through general company policy even when law, regulation, and label conditions allow such herbicide use. The discretion to employ buffer zones as well as the selection of the appropriate set back distances, must be made in a prudent manner since all the mechanical alternatives will inevitably cause an increase in the number and vigor of incompatible tree species on those portions of the ROW so treated. However, the opportunity to employ mechanical clearing of the ROW is an available option for the ROW manager on specifically chosen ROW segments with certain predetermined characteristics that warrant this treatment. Herbicide usage can be restricted in deference to specific notable ROW resources or as a consideration to particularly sensitive land use conditions while still maintaining the overall goals of a sound, long term, and effective IVM program when viewed from a system-wide perspective.

Even in certain ecologically sensitive areas, the selective use of herbicides may be apropos provided the appropriate precautions are taken. For instance, when treating vegetation in or adjacent to designated wetlands, a herbicide with the appropriate characteristics, e.g., an aquatic or wetland label could be selected. However, to assure that virtually no surface water contamination occurs (irrespective of any allowable label statements) buffer zones can be prescribed around streams, lakes, wetlands, and other sensitive water resources. Studies have shown that buffer zones of only 5 to 25 feet can effectively curtail the deposition of airborne spray particles and the movement of the herbicide by runoff into surface water resources. A dense stand of vegetation in the buffer zone will further reduce the linear distance of buffer zone necessary, as will very stem specific treatment techniques. Conversely, sparse vegetation in the buffer zone and high volume treatments will increase the distance of the buffer zone required to insure abatement of any herbicide movement. All established EEANY member system specifications for their buffer zones meet or exceed these threshold conditions.

ROW CONVERSION

One quite unique aspect of IPM, as applied to the management of ROW vegetation, is the relative long-term nature of the desired effects and the timeframe required to assess the consequences of actions taken. Although, mechanical removal of the tall growing trees will physically eliminate the immediate threat to electrical reliability and public safety, this method only serves to perpetuate the long-term tree problem and exacerbate future ROW maintenance requirements. Typically, mechanical tree removal will result in the need for more cutting as frequently as every two or at most about four years. After several mechanical treatments, i.e., over a number of ROW treatment cycles, the collection of tree stems requiring control can readily increase to over 20,000 stems per acre. Similarly, when a new ROW is cleared and all vegetation is allowed to grow back naturally, the target tree densities will likewise increase to very high levels in only a few years after the initial tree removal operations and prior to any herbicide application. In fact the term "ROW Reclamation" is customarily used to describe the extreme actions that must often occur to treat very high tree stem densities that are frequently found on a routinely mechanically treated ROW.

When herbicides are used over several treatment cycles, the period of time between treatments can usually be elongated from three or four to six or seven or even more years and concurrently the number of stems to treat each cycle becomes fewer. Herein lies the truly unique aspect of ROW vegetation management from an IPM/IVM perspective; the treatment of vegetation with herbicides must be viewed over the long term to fully grasp the significance of this system in reducing the target tree population that will also reduce the use of chemicals and concurrently increase the effectiveness of the biological controls, i.e., all the lower growing plants that volunteer to occupy the ROW. For example, when a new ROW (or an older ROW that has received only mechanical treatments) is first treated the amount of herbicide needed for proper coverage of the numerous target trees may be in the order of about two to four gallons of concentrate per acre. The following treatment, in the next cycle, may require about half that amount because the number of target species has been reduced and the lower growing desirable vegetation is beginning to exert it's influence on the ROW vegetation dynamics. Subsequent treatments will continue this downward trend in herbicide usage that produces "nearly" a tree-free ROW requiring a minimum of judiciously applied herbicide to produce the desired effect. At this stage the low growing vegetation is firmly established and offers a relatively stable condition that effectively inhibits the rapid resurgence of trees. However, in order to perpetuate this highly desirable minimum maintenance ROW condition, when new trees begin to emerge (as they most certainly will from the tree seed sources off the ROW) these target trees must still be controlled through the diligent efforts of the ROW vegetation manager to preclude their full development and ultimate dominance over their lower growing associates.

This process of "conversion" from a ROW that is literally filled with trees to one that is dominated by lower growing vegetation with only a few remaining tree stems capable of growing into the overhead electric lines is not a simple one step process, but requires an extended program commitment and adherence to a long range vegetation management plan. Each phase in the ROW conversion process can be quite complex depending in large part upon the target species mix coupled with tree height and density together with the abundance and distribution of the low growing vegetation as well as other site specific characteristics. As the stem density of the target species is reduced with each passing treatment cycle, the type of treatment chosen can then become more selective. Finally, after several treatment cycles when the ROW is occupied by a low density of target trees and the conversion process virtually completed some continuing herbicide use will still be required, but the focus at this stage shifts to selecting techniques which offer the minimum amount of disturbance to the desirable lower growing vegetation, i.e., the biological controls.

GENERAL CONSIDERATIONS

The use of herbicides by the EEANY member systems is subject to regulation under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) administered by the U.S. Environmental Protection Agency (EPA) and Article 33 of the New York Environmental Conservation Law (ECL) administered by the Department of Environmental Conservation (DEC). Pursuant to FIFRA regulations, no herbicide may be marketed, distributed, sold or advertised until the EPA registers it. After many years of product development, advanced toxicology studies and field testing, the pesticide manufacturers submit to EPA thousands of pages of research data that are compiled into a registration application. From this voluminous registration package, the manufacturer develops a proposed product label that identifies the pest or pests that the product will be effective in controlling and provides complete instructions for correct use, handling, and disposal of the product as well as other information required by FIFRA. In New York State, the DEC has the responsibility for establishing regulations and standards for the registration of pesticides, the certification of pesticides applicators, and all other matters pertaining to pesticide use as well as the responsibility for enforcement of all it's regulations and standards.

Other Federal, State and even local laws and their resulting regulations may impinge on the manner in which ROW vegetation management activities will occur. As mentioned previously, wetland protection requirements can have a pronounced effect on the types of vegetation management techniques chosen. Considerations for the protection of endangered or threatened species and their habitats can similarly become a dominant concern on some ROW. For instance, the nurturing of the endangered Karner blue butterfly and its requisite host plant, the blue lupine, has resulted in considerable evaluation of selected ROW herbicide use in the preservation and enhancement of the habitat conditions necessary for the survival of this endangered species of butterfly. Even the State requirements for management of river corridors under the Wild and Scenic Rivers Act provide definitions and requirements for IPM. Local ordinances, zoning mandates, as well as property owner concerns may sometimes play a critical role in the selection of ROW vegetation management techniques, e.g., the control of poisonous plants, invasive weeds, and allergy producing pollinators. In some instances voluntary compliance with provisions of the Federal Noxious Weed Act may require action on the part of utility ROW vegetation managers to prevent the spread of listed deleterious weeds and other alien invasive species. For example, the control of infestations of the introduced weed, purple loosestrife, which threatens the biological integrity of North American wetland ecosystems by displacing native vegetation is a goal shared by the electric utility industry with both state and federal environmental agencies.

Prevention of Non-point Sources of Pollution & Storm Water Discharge Requirements

Another important regulatory program that can directly affect the choice of ROW vegetation management practices available under IPM/IVM is found within the authority of the Clean Water Act as amended by the Water Quality Act of 1987 and involves the control of non-point sources of water pollution along with some aspects of the permit requirements for stormwater discharges for point sources resulting from construction activities. These regulatory programs focus on water quality issues, i.e., the prevention and control of water pollution. In both programs, as they apply to the ROW maintenance situation, the focus is on using management practices to prevent, reduce, minimize or otherwise control the availability, release, or transport of substances that adversely affect surface and ground waters. They both act generally to diminish the generation of potential water pollution emanating from sources on the ROW.

The control of non-point sources of pollution is accomplished through the identification of "best management practices" (BMP's) and their implementation on a site-specific basis using best professional judgment and experience. The control of stormwater discharges which can be considered as point sources due to their collection of runoff into a single outlet, e.g., a culvert or ditch, are similarly treated by the requirement to prepare a "Stormwater Pollution Plan" under the auspices of a SPDES (State Pollutant Discharge Elimination System) General Permit. This plan essentially enumerates the BMP's that will be used to prevent and/or control polluted runoff from occurring. Neither of these programs imposes effluent limits for specific substances, rather they provide for an effective means of reducing or preventing the impact of pollution generated from land management activities. In addition to the ROW managers primary concern of minimizing pesticide related impacts within the context of an IPM strategy, these two somewhat interrelated regulatory programs broaden the environmental concerns arising from IVM to encompass other pollution control objectives. Thus, both of these clean water related programs could directly influence the decision-making process of the ROW vegetation manager and in some cases virtually dictate the menu of treatment choices available.

The most common potential source of pollution arising from a ROW is erosion and the resulting generation of sediment causing siltation in streams and other waterbodies. Sedimentation from all sources is a major water quality degradation issue in New York State. Also, the loss of soil nutrients and their entryway into surface watercourses or groundwater by excessive leaching or as attached to sediment particles is likewise an important water quality concern. Both of these major sources of water pollution can be generated from ROW if bare soils are present or insufficient plant cover occurs. Therefore, in choosing ROW vegetation management techniques, particularly on steep slopes or other areas of high erosive potential, e.g., riparian zones, the ROW vegetation manager must be concerned with their effects on the local hydrology. Vegetative disturbances resulting in bare surfaces or exposed soils and the degree to which vehicular traffic movement occurs causing rutting can become limiting factors in the selection of target tree control methods. For instance, mowing with a hydro-ax on a steep slope or along a streambank could cause erosion by vehicular rutting as well as through denuding the site by excessive removal of vegetation.

The imposition of these regulatory programs to prevent and/or control sources of potential degradation of water resources arising from ROW vegetation management activities results in the following two general precepts: (1) maintain as complete a vegetative cover as possible at all times, and (2) keep exposed soil and any soil disturbance/compaction operations to a minimum especially in critical areas. By keeping these two relatively simple fundamental principles a host of positive attributes can be ascribed to the ROW vegetation management program including: (1) dense low growing vegetation on the ROW will act as filter strips for the surrounding area thereby decreasing overland flow, increasing soil water percolation and removing pollutants, (2) complete vegetative cover on the ROW will stabilize soils and prevent erosion and sediment transfer, (3) minimizing soil compaction by restricting heavy vehicular traffic on the ROW decreases the amount of surface water generated on a given area and thus reduces the volume of stormwater runoff, and (4) avoidance of any soil disturbance on the ROW will reduce or eliminate the need for amelioration activities that would otherwise be required under these clean water programs to restore the disturbed area to its original slope, soil compaction, ground cover, and hydrologic condition.

ROW Management Research

IPM is never a finished or static process. As fresh data become accessible and new knowledge is obtained about the pests in question and the various control treatments available, the specifics and details of the currently acceptable IPM strategies will naturally be altered and thus subject to constant modification. IPM practitioners can aid and abet this dynamic adaptation and improvement process through conducting basic ecological research on the pests in question as well as applied research in new and promising control strategies. Also needed is the constant reappraisal of existing techniques in order to modify them to produce even more efficacious results. The member systems of the EEANY have individually conducted research into IPM related ROW management matters but even more so collectively, through the auspices of the former Empire State Electric Energy Research Corporation (ESEERCO)[7], have collaborated on numerous research projects over a 25 year span of time involving many diverse aspects of ROW vegetation management. These studies were conducted on a wide range of subjects and a host of issues important to utility ROW managers in their execution of ecologically sound and cost effective IPM/IVM programs.

Beginning with a literature review in 1973, this extended ESEERCO ROW management research program has included projects on ROW treatment cost comparisons, long term effectiveness, ROW treatment cycles, herbicide fate and mobility, allelopathy, ROW multiple uses, buffer zones, soil compaction and mitigation, repeated mechanical cutting effects on vegetation and costs and the effects of ROW treatments on wildlife. Two of the more recent multi-year studies have recently been published in the mid 1990's; ROW Vegetation Dynamics conducted by the Institute of Ecosystem Studies and ROW Stability by the State University of New York College of Environmental Science and Forestry. The final ROW research product to come out of ESEERCO program in 2000 involves a risk assessment and environmental evaluation of the use of tree growth regulators. These numerous and diverse research projects have greatly assisted the New York State electric utility industry to focus their ROW Vegetation Management Programs on the most cost effective and least disruptive techniques while also allowing them to tailor the research results to their own individual company circumstances. The latest ROW research efforts currently being undertaken by the electric utility industry are now found within the bailiwick of the Electric Power Research Institute (EPRI). EPRI has picked up where ESEERCO left off and has created a new research target, "ROW Environmental Management & Development" which is currently being subscribed to by 44 electric utilities across the nation.

Summary

The overall goal of a utility ROW vegetation management program is to provide for the safe and reliable transmission of electric power in an economic and environmentally compatible manner. This lofty goal translates "on the ground" into the vegetative conversion of a strip of land, i.e., the ROW, often initially found filled with tree saplings to a ROW corridor that harbors mainly a profusion of lower growing species. This goal is currently being achieved in New York State by the implementation of sound IPM/IVM programs at each of the electric transmission and distribution systems of the EEANY members. To paraphrase applicable IPM terminology; ROW vegetation managers use multiple tactics to prevent pest (tree) buildups that could endanger electric system reliability and public safety by: monitoring pest (tree) populations, assessing the potential for damage (system reliability, public safety, preservation of the biological controls), and making professional management and control decisions, considering that all pesticides (herbicides) should be used judiciously. ROW management decisions depend in large part upon the mix of target species, the height and density of the dominate individual stems, and the abundance and distribution of the low growing desirable species. As the number of different target species is reduced and their stem density decreases with each passing treatment cycle, the type of vegetation treatment performed can become more selective with the attendant benefit of reducing the amount of herbicide needed to maintain the ROW. Thus, after several treatment cycles, when the ROW is occupied by a

[7] ESEERCO ceased to exist in 1999 due to the increased economic pressures of a deregulated competitive electric market.

greatly reduced number of target trees, some minimum herbicide use will still be required but the focus now shifts to selecting techniques with the least amount of disturbance to the lower growing vegetation.

It should be stressed in closing that these ideal ROW conditions of a "minimum maintenance" ROW (composed almost entirely of low growing plants) to be achieved through the attentive implementation of an IPM/IVM program, is simply just that, minimum not zero maintenance. Although the low growing plants will help immensely in precluding the growth of trees, due to the pressures of natural plant community succession that ultimately will occur, (the close proximity to an abundant tree seed sources in the surrounding forest) these voluntary biological controls can never be expected to fully exclude trees alone over long periods of time from invading the ROW and exploiting their well defined ecological niches. Even after many treatment cycles using herbicides, when the ideal ROW condition is seemingly achieved, if the ROW is left untreated or if mechanical methods are resorted to, the ROW will revert rather quickly to a tree dominated landscape and all the attendant benefits of a stable low growing mosaic of desirable ROW vegetation will be lost. These attendant benefits include species diversity in an aesthetically pleasing setting with increased wildlife abundance while protecting soil and water quality values. Thus IVM is truly an ecologically based approach to pest management.

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APPENDIX 3

Study Name: **Vegetation management on utility rights-of-way.**

Study Sponsor: Empire State Electric Energy Research Corporation (ESEERCO)

Project Name/Study Number:

PI's/Contractors: Applied Forestry Research Institute, State University of New York, College of Environmental Science and Forestry, Syracuse, NY

Period: 1975

Cost:

Purpose and description:

The objective of this study was to compile a list of annotated literature references for those interested in or working in utility right-of-way vegetation management and to provide a summary/synopsis of the state-of-the-knowledge on ROW vegetation management. This is the first ESEERCO report and served as the basis for selecting the direction of future experimental research.

Results:

The annotated bibliography contained 279 references and serves as one of the first comprehensive state-of-the-art literature reviews for vegetation management on utility ROWs. Approximately half of the references pertain to the use, effects, or safety of herbicides. The remainder of the references dealt with general ROW issues, vegetation management, methods and procedures of vegetation management, and wildlife benefits.

Cody (1975) concluded: Economic and environmentally acceptable maintenance of transmission line rights-of-way is a matter of great concern for power companies. While everyone agrees that some sort of vegetation management is necessary, there is a wide difference of opinion as to the most economic and environmentally acceptable method. After examining the literature, talking with many right-of-way managers and examining many rights-of-way, the following conclusions were reached:

1. Right-of-way vegetation management should start with initial clearing. Proper initial clearing can greatly reduce future maintenance costs and provide a more environmentally acceptable right-of-way.
2. While initial clearing is important, the greatest job confronting the right-of-way manager is maintenance of existing rights-of-way.
3. A great variety of conditions exists on rights-of-way requiring a variety of treatments to achieve desired results. The need for maintenance should be determined by line examination, and treatment should be prescribed according to species and conditions.
4. While mechanical methods of woody plant control are still needed and are being used, by far the most right-of-way treatment is done using chemical methods.
5. There are two general methods of applying chemicals: broadcast spraying and selective spraying. While more acreage is probably being treated by broadcast methods at present *(1975)*, selective methods are gaining rapidly.
6. Basal spraying is the most selective methods of chemical application, but other methods can also be used selectively; exceptions are helicopters, fixed boom sprayers and mounted mist blowers.
7. Preservation and development of stable low-ground cover is, in the long run, the most economical method of vegetation management. It can be developed and maintained by selective spraying.
8. Where vegetation is dense, initial treatment by broadcast spraying may be the only practical way to reduce density and prepare the way for selective maintenance.
9. In remote areas or extremely rugged terrain, broadcast spraying by helicopter may be the only practical means of vegetation control. It may also be justified in certain other situations such as emergency conditions, shortage of labor, or where all, or nearly all, of the woody vegetation on a

section of right-of-way is of an undesirable species.

10. Right-of-way maintenance success is highly dependent upon the preparation of good vegetation management plans, and reliable resources to carry them to completion.

References:

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Study Name: **Environmental and economic aspects of contemporaneous electric transmission line right-of-way management techniques.**

Study Sponsor: Empire State Electric Energy Research Corporation (ESEERCO)

Project Name/Study Number:

PI's/Contractors: Asplundh Environmental Services, Willow Grove, PA

Period: 1975-1976

Cost:

Purpose and description:

The purpose of this second study was to assess results of the state-of-the-art review as applied to New York by examining the "record in the field". By selecting a range of conditions from 22 ROWs across the state, an attempt was made to impute the cause-effect relationships between the past management techniques used and the observed conditions on the sites. Results could serve to improve ROW managers decisions in selecting and executing safe, economically and environmentally compatible management programs.

Results:

Case histories of 22 rights-of-way managed using commonly accepted methods were carried out in New York State. Study sites were located in all major forest regions of the state. Vegetation management over the previous decades on these ROWs fostered the development a complex of shrub-herb-grass communities. Shrubs found in adjacent forests to the ROW were prominent components of the ROW cover. Tree species continued to invade the ROW even with an established cover of shrubs, herbs, ferns, and grasses. This pressure from invading trees, if left unmanaged, would re-establish forest cover. Characteristic plant communities were developed in relation to habitat and were identified as: blackberry-goldenrod or sumac-goldenrod on mesic habitat areas; blueberry-sweetfern or blueberry-bracken fern on xeric areas; and willow-sensitive fern, red-osier dogwood-sensitive fern, or spirea-sensitive fern on hydric areas. ROW management has improved wildlife food and cover conditions and plant species diversity. Species diversity was consistently higher on the ROWs than in adjacent forests. Impacts of ROW management on erosion and stream water were negligible; construction disturbances were the exception. Generally, there was little change in adjacent land use to the ROWs since ROW construction.

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Study Name: **Cost comparison of right-of-way treatment methods.**

Study Sponsor: Empire State Electric Energy Research Corporation (ESEERCO)

Project Name/Study Number: EP 80-5

PI's/Contractors: K.T. McLoughlin, New York Power Pool/ESEERCO; Environmental Consultants Inc., Fort Washington, Pennsylvania.

Period: 1980-1984

Cost: $1,202,638

Purpose and description:

The objective of the study was to compare effectiveness and cost per acre of seven ROW treatment methods. Treatment methods of hand cutting, mowing, cut stump, dormant basal, summer basal, selective ground foliar, and aerial were applied to 18 ROW segments. 2,4-D+picloram and triclopyr herbicides were utilized. Effects of treatment type on the density of capable species were analyzed. A cost comparison of the seven methods was conducted.

Results:

The effect of seven treatment methods—hand cutting, mowing, cut stump, dormant basal, summer basal, selective ground foliar, and aerial—on capable tree densities varied. In the high density class all treatments decreased density. Medium density class increases were observed in segments treated with hand cutting, mowing, and cut stump methods. Mechanical treatments produced stem reductions of <60% at all densities. Cut stump was most effective at high densities. Dormant basal, summer basal, and aerial treatments exceeded 60% stem reduction at medium and high densities but only summer basal was as effective at low density. Selective ground foliar reductions were 71%, 100% and 59% at high, medium, and low densities, respectively. All treatments produced >60% reduction in mean height on both high and low height sites. Based on a single application of treatments, hand cutting, cut stump, and mowing were less expensive than basal spray treatments ranging from $91-$159, $113-$309, and $162-$193, respectively, depending on stem density. No highly adverse impacts on wildlife habitat were caused by any of the ROW treatments. Cost and effectiveness comparisons of girdling, frilling, basal injection, and stem injection found girdling to be the least desirable method

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Environmental Consultants, Inc. 2001. Integrated Vegetation Management on gas line rights-of-way: Review of the literature. C.A. Nowak and B.D. Ballard (comps.), Gas Technical Institute, Chicago, Illinois, GRI Report No. GRI-01/0096.

Study Name:	**The effects of right-of-way vegetation management on wildlife habitat.**
Study Sponsor:	Empire State Electric Energy Research Corporation (ESEERCO)
Project Name/Study Number:	EP 82-13
PI's/Contractors:	K.T. McLoughlin, New York Power Pool/ESEERCO; Asplundh Environmental Services, Will Grove, Pennsylvania.
Period:	1982-1983
Cost:	$23,759

Purpose and description:

The objective of this project was to summarize the knowledge of the effects of standard ROW vegetation management practices on various wildlife species and their attendant habitats in New York State. The supporting objectives of this project were to: (1) conduct a review of pertinent literature, (2) identify ongoing related research, (3) identify both positive and negative impacts on wildlife habitats, and (4) determine gaps in the knowledge.

This project examined the available data combining it with expert analysis and opinion in order to make predictions about consequences of alternative management actions. This was accomplished by conducting a thorough state-of-the-art literature review including a summary of ongoing research and a survey of unpublished data.

Results:

Initial impacts of ROW vegetation management are usually less favorable to wildlife than the long-term impacts. Treatments performed upon ROWs with high tree densities resulted in an immediate reduction in food and cover available to wildlife, whereas selective treatments on ROWs with a low or medium density of trees resulted in minimum reductions. Successfully managed ROWs that develop relatively stable shrub/herb/grassland plant communities benefit a wide variety of wildlife species. Vegetations management on ROWs encourages a broad spectrum of wildlife species, though the habitat requirements of *all* species cannot be met, thereby discouraging some species.

References:

Asplundh Environmental Services. 1983. The effects of right-of-way vegetation management on wildlife habitat. Empire State Electric Energy Research Corporation, Schenectady, NY. Research Report EP 82-13.

Summary compiled from:

McLoughlin, K. T. 1991. Right-of-way vegetation management in New York State. In: Workshop Proceedings: Herbicides and Right-of-Way Management Regulations, Use, Toxicology, Risks, Impacts, and Alternatives, November, 1991, Albany, New York. Niagara Mohawk Power Corporation, Syracuse, New York.

Study Name:	**ROW multiple uses.**
Study Sponsor:	Empire State Electric Energy Research Corporation (ESEERCO)
Project Name/Study Number:	EP 82-14
PI's/Contractors:	K.T. McLoughlin, New York Power Pool/ESEERCO; Kane & Carruth, P.C., Pleasantville, New York.
Period:	1982-1983
Cost:	$113,374

Purpose and description:

Demands for other uses of electric transmission line rights-of-way (ROWs) have increased as the availability of open land has declined. These ROW lands are attractive to both the underlying fee owner or adjacent property as an extension of their existing preferred land use. Additionally, powerline corridors offer opportunities for recreational pursuits by segments of the general public. Unfortunately these varied and often conflicting uses have resulted in increased maintenance costs, security concerns, and public relation problems for the utility companies. The purpose of this project was to gather all available information on multiple uses of transmission ROWs into a summary report on the management and administration of these multiple uses. This project was conducted by the following sequence of items: review of the literature; a survey (written questionnaire with follow-up interviews) of ESEERCO member system personnel involved with transmission line ROW management; determination of the relative adverse impacts as well as benefits to ROW maintenance costs due to both authorized/desirable uses as well as the unauthorized/undesirable uses; and an examination of the legal implications of ROW multiple use particularly the liability to the utility.

Results:

The final report summarized all available literature on ROW multiple uses and included an annotated bibliography. A summary of survey responses was also presented. Analysis of this information provided summaries on such topics as utility multiple use policies, compatibility of uses, management strategies to control incompatible uses, accommodations of complaints, risk assessment, legal implications, management prerogatives to encourage compatible uses, compatibility criteria, and the current management of multiple use by the ESEERCO member systems as well as regulatory perspectives on these issues.

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Summary compiled from:

McLoughlin, K. T. 1991. Right-of-way vegetation management in New York State. In: Workshop Proceedings: Herbicides and Right-of-Way Management Regulations, Use, Toxicology, Risks, Impacts, and Alternatives, November, 1991, Albany, New York. Niagara Mohawk Power Corporation, Syracuse, New York.

Study Name:	**Long-term right-of-way effectiveness.**
Study Sponsor:	Empire State Electric Energy Research Corporation (ESEERCO)
Project Name/Study Number:	EP 83-15
PI's/Contractors:	K.T. McLoughlin, New York Power Pool/ESEERCO; P.A. Johnston, Environmental Consultants Inc., Fort Washington, Pennsylvania.
Period:	1983-1985
Cost:	$145,000

Purpose and description:

The objective of the study was to compare effectiveness of seven vegetation maintenance treatments. Vegetation maintenance methods—hand cutting, mowing, cut stump, dormant basal, summer basal, aerial, and selective ground foliar—were evaluated on effectiveness to reduce stem density on treatment plots along ROWs. Tordon and Garlon herbicides were utilized.

Results:

Based on three density classes, high, medium, and low, a comparison of effectiveness of seven ROW treatments—hand cutting, mowing, cut stump, dormant basal, summer basal, aerial, and selective ground foliar—on undesirable plants (trees) was performed. Hand cutting was followed by an increase for all density classes. Mowing was followed by 44, 13, and 29% decreases in the three classes, respectively. Cut stump showed 71, 48, and 8% decreases, dormant basal was followed by 75, 57, and 63% reductions for each class, summer basal had 76, 83, and 57% reductions, selective ground foliar showed 81, 67, and 41% density decreases, and aerial treatment was followed by 81,74, and 68% decreases in stem density for the three classes, respectively. A correlation of treatment effectiveness and initial stem density, the relationship of the height of capable trees to the effectiveness of the treatments, and the effectiveness of treatments on common capable tree species is also discussed.

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Environmental Consultants, Inc. 2000. Long-term right-of-way effectiveness: Update 2000. C.A. Nowak, B.D. Ballard, P.M. Charlton (comps.), Electric Power Research Institute, Palo Alto, CA, and Empire State Electric Energy Research Corporation, Schenectady, NY. EPRI Report No. 1000271.

Environmental Consultants Inc. 1985. Long-term right-of-way effectiveness. Empire State Electric Energy Research Corporation, Schenectady, NY. Research Report EP 83-15.

Summary compiled from:

Environmental Consultants, Inc. 2001. Integrated Vegetation Management on gas line rights-of-way: Review of the literature. C.A. Nowak and B.D. Ballard (comps.), Gas Technical Institute, Chicago, Illinois, GRI Report No. GRI-01/0096.

Study Name:	**Right-of-way treatment cycles.**
Study Sponsor:	Empire State Electric Energy Research Corporation (ESEERCO)
Project Name/Study Number:	EP 84-26
PI's/Contractors:	K.T. McLoughlin, New York Power Pool/ESEERCO; P.A. Johnston, Environmental Consultants Inc., Southampton, Pennsylvania.
Period:	1980-1985 (data)
Cost:	$226,597

Purpose and description:

The study objectives included the evaluation of the cost and effectiveness of ROW treatment methods. Seven ROW treatments—hand cutting, mowing, cut stump, dormant basal, summer basal, selective ground foliar, and aerial—were evaluated for cost and effectiveness. The study specifically determined long-term costs, cycle length, density and height of capable trees, changes in desirable non-target vegetation, and the average annual cost among treatment types. This is the third study in a six-year project, which began in 1980 with the collection of baseline data. ROW treatments were applied in 1981, and initial effectiveness data were collected in 1982 (EP 80-5). Longer-term effectiveness was evaluated in 1983 (EP 83-15), and data for this study were collected in 1984 and 1985.

Results:

Fifty-four percent of the study sites treated using seven treatment methods—hand cutting, mowing, cut stump, dormant basal, summer basal, selective ground foliar, and aerial—had a 3 yr treatment cycle, 24% had a 4 yr cycle, 18% had a 5 yr cycle, and 4% had a 6 yr cycle. For sites with a 3 yr cycle, hand cutting showed an increase in stem density by 14%. Summer basal showed the greatest density change with a 76% reduction. At the end of the treatment cycles, ROW sites treated with summer basal had the greatest reduction in density and the lowest density of all the treatment types. All other treatments reduced density except hand cutting, which showed an increase and had the highest average density of all treatment types. The average capable height was effectively the same at the time of retreatment regardless of which treatment was used. Cut stump had the greatest reduction in capable species height while selective ground foliar showed the greatest increase in capable species height. Total shrub cover increased following all treatments, with selective ground foliar and dormant basal showing the best results. Aerial treated sites showed the greatest increase in herbaceous plant cover, while summer basal showed the least.

References:

Environmental Consultants, Inc. 2000. Right-of-way treatment cycles: Update 2000. C.A. Nowak, B.D. Ballard, P.M. Charlton (comps.), Electric Power Research Institute, Palo Alto, CA, and Empire State Electric Energy Research Corporation, Schenectady, NY. EPRI Report No. 1000525.

Environmental Consultants Inc. 1985. Right-of-way treatment cycles. Empire State Electric Energy Research Corporation, Schenectady, NY. Research Report EP 84-26.

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Environmental Consultants, Inc. 2001. Integrated Vegetation Management on gas line rights-of-way: Review of the literature. C.A. Nowak and B.D. Ballard (comps.), Gas Technical Institute, Chicago, Illinois, GRI Report No. GRI-01/0096.

Study Name:	**ROW effects from herbicide residues.**
Study Sponsor:	Empire State Electric Energy Research Corporation (ESEERCO)
Project Name/Study Number:	EP 84-8
PI's/Contractors:	K.T. McLoughlin, New York Power Pool/ESEERCO; D.E. Langseth, A.D. Little, Inc., Cambridge, Massachusetts.
Period:	1984-1988
Cost:	$249,000

Purpose and description:

To develop methods to determine and predict the environmental fate, i.e., migration, distribution and persistence of herbicides as they are applied to electric transmission line ROW's in New York State. The primary emphasis was the characterization of the environmental pathways and rates of degradation of herbicide applications as practiced in NYS. A secondary objective was the establishment of an informative base for responding to public concerns with off site vegetation damage, potential threats to water quality and other perceived adverse effects of herbicide application. The third and final objective was the creation of a future research plan to conduct field and laboratory studies.

The study integrated a literature review with an evaluation of existing applicable fate models. The models selected were then run using parameters typical of NYS conditions. Model results were then compared to measured values cited in the literature. Herbicides reviewed in the literature include dicamba, fosamine ammonium, glyphosate, 2,4-D, picloram, triclopyr, dichlorprop, and AMS. The model was evaluated for 2,4-D, picloram, and triclopyr under two typical NY ROW conditions.

Results:

The primary parameters which characterize potential herbicide behavior in the terrestrial environment are the soil adsorption coefficient, aqueous solubility, vapor pressure, degradation rate in soil, and dissipation rate from leaf surfaces. The simulations/modeling approaches were determined to be suitable for predicting herbicide mobility and residues consistent with observed field studies reported in the literature.

References:

A.D. Little, Inc. 1987. Herbicide residue and mobility study: Existing data and simulation model review. Empire State Electric Energy Research Corporation, Schenectady, NY. Research Report EP 82-13.

Summary compiled from:

McLoughlin, K. T. 1991. Right-of-way vegetation management in New York State. In: Workshop Proceedings: Herbicides and Right-of-Way Management Regulations, Use, Toxicology, Risks, Impacts, and Alternatives, November, 1991, Albany, New York. Niagara Mohawk Power Corporation, Syracuse, New York.

Study Name: **Herbicide mobility study.**

Study Sponsor: Niagara Mohawk Power Corporation

Project Name/Study Number Volney-Marcy research project.

PI's/Contractors: Calocerinos & Spina Consulting Engineers, Liverpool, New York

Period: 1985

Cost:

Purpose and description:

A study was conducted at the Niagara Mohawk Power Corporation's Volney-Marcy transmission line right-of-way to determine the degree of mobility and persistence of herbicides applied to the site. Applications of herbicides were made by basal, foliar, and boom spray techniques. The plots consisted of abandoned agricultural, woodland, and grub sites. Soil and water samples were collected at the site before herbicide application, and at several time intervals afterward. The samples were analyzed for the herbicides which had been applied: triclopyr, picloram, and 2,4 D.

Results:

Overland flow of herbicides in runoff did not occur under normal conditions, but two off ROW soil samples did contain detectable levels of herbicide. In both instances, the herbicide application was immediately followed by rainfall. The linear extent of overland flow was minimal, and when it occurred, the herbicide degraded rapidly. After the initial application, there was no indication that overland migration of herbicide off the site was occurring. Rather, the trend was towards degradation of herbicides to undetectable levels. Entry into streams from overland flow is highly unlikely when appropriate non-treatment buffer zones are established adjacent to water resources, as is entry into wells or groundwater through leaching. Leaching to a depth of 10-15 inches of herbicides on the sprayed sites was rare, occurring only at three locations. The leaching likely occurred under three types of circumstances: (1) rainfall immediately after application, (2) a large amount of rainfall within a day after application, and (3) the basal application of a high concentration of herbicides to a single spot on the site. Herbicide concentrations in seepage from the top 6 inches of soil followed similar trends in mobility and persistence in soil samples. Drift of herbicides off the treated right-of-way did not occur during the study, because non-volatile herbicides were used and were carefully applied using proper techniques.

During the study, the herbicide 2,4-D did not persist past four weeks; Picloram did not persist past ten weeks. Triclopyr applied by the foliar method in a water carrier did not persist past ten weeks. Triclopyr applied by the basal method in an oil carrier persisted up to 18 weeks. This unusual length of persistence likely resulted from the high initial herbicide concentrations in localized spots associated with the application method. Because the herbicides biodegrade rapidly, the possibility of movement of the material into adjacent water resources is greatly diminished, especially when proper buffer zones are established.

Reference:

Calocerinos & Spina Consulting Engineers. 1985. Herbicide mobility study. Niagara Mohawk Power Corporation, Syracuse, NY. NMPC final report.

Study Name:	**Right-of-way chemical treatments—site preparation.**
Study Sponsor:	Empire State Electric Energy Research Corporation (ESEERCO)
Project Name/Study Number:	EP 85-5
PI's/Contractors:	K.T. McLoughlin, New York Power Pool/ESEERCO; C.H. Stevens, Tree Preservation Company, Inc., Briarcliff, New York
Period:	1985-1987
Cost:	$61,224

Purpose and description:

The overall objective of this two-phase study was to determine the effectiveness of 25 different chemical treatments. This first phase of the project was designed to prepare the selected ROW segments, using handcutting, for future application of a variety of herbicide types, formulations and treatment methods to establish a comparative efficacy test. The chosen ROW segments were studied for previous ESEERCO projects (EP 80-5, 83-15, 84-26) and were found to contain the ideal species composition and density characteristics for this study. However, due to the resulting regrowth from having been mechanically cut previously (1981), the wire security zone was in danger of being breached. Therefore, in order to use these sites for the future chemical treatments, additional handcutting was required to reduce the growth to a uniform lower condition. This provided a unique opportunity to gather additional data on the costs of handcutting. In determining handcutting costs the additional cost of slash disposal (hand piling and mechanical raking of the slash) was also determined.

Results:

Site preparation using handcutting resulted in an average treatment time of about 4 hours per acre for all 30 units. The averages of manhours based on vegetation density were: 6.2 (high), 3.1 (medium), 1.8 (low) . For vegetation in the high density category, the average handcutting times based upon topography were 7.4 (steep), 6.5 (sloped), 5.8 (level). The average manhours per acre for all hand disposal units was 5.3. Averages of hand disposal manhours based upon vegetation density were 9.8 (high), 3.9 (medium) and 1.2 (low). The average hand disposal times on high density units based upon topography differences were 13.4 (steep), 9.5 (sloped) and 3.3 (level). The average machine disposal manhours was only 1.8 per acre but significant equipment costs were also incurred for this technique.

References:

Tree Preservation Company, Inc. 1987. Right-of-way chemical treatments—site preparation. Empire State Electric Energy Research Corporation, Schenectady, NY. Research Report EP 85-5.

Summary compiled from:

McLoughlin, K. T. 1991. Right-of-way vegetation management in New York State. *In*: Workshop Proceedings: Herbicides and Right-of-Way Management Regulations, Use, Toxicology, Risks, Impacts, and Alternatives, November, 1991, Albany, New York. Niagara Mohawk Power Corporation, Syracuse, New York.

Project Name:	**ROW vegetation dynamics.**
Study Sponsor:	Empire State Electric Energy Research Corporation (ESEERCO) and Central Hudson Gas & Electric Corporation
Project Name/Study Number:	EP 85-38
PI's/Contractors:	C.D. Canham, Institute of Ecosystem Studies (IES), Cary Arboretum, Millbrook, New York.
Period:	1985-1991
Cost:	$1,462,518 total

Purpose and description:

The purpose of this series of studies was to conduct basic ecological research on vegetation dynamics along rights-of-way, with specific emphasis on understanding the processes that inhibited invasion of communities dominated by shrub or herbaceous species by trees. The objective was to contribute to the body of ecological science that is needed to maximize the effectiveness of ecologically-based management of utility ROWs. Fifteen studies were conducted in the following general categories: patterns and dynamics of ROW vegetation, dynamics of tree seeds and seedlings, competition, and herbivory.

Results:

Summary of fifteen studies compiled from Institute of Ecosystem Studies (1993, p. 341-353):

ROW vegetation is often extremely diverse, and is an important component of overall landscape diversity, particularly in heavily forested landscapes. ROW vegetation is commonly "patchy", producing mosaics of small communities that differ in composition, structure and dynamics. On undisturbed ROWs, shrub cover is increasing, particularly for gray dogwood on moist sites. Gray dogwood appears capable of establishing and maintaining long-term dominance of a site if invading trees are systematically and selectively removed.

Tree invasion is directly proportional to the number of seeds dispersed into a site, and resistance by shrubs does not appear to be density dependent, though seed predation may be. Sapling emergence will vary significantly from year to year and site to site due to pulses in seed production; cohorts of seedlings will emerge 10-40 years after such a pulse. Most new tree invasion along ROWs in the Hudson Valley comes from large-seeded, wind-dispersed species (i.e., maples and ashes), and secondarily from large-seeded, animal dispersed species (i.e., oaks). Light-seeded, widely dispersed, "pioneer" tree species appear to be effectively inhibited by intact ROW vegetation. Dormant tree seeds buried in the soil are not an important source of seedlings for any of the common trees invading ROWs in the Hudson Valley. The adjacent forest community has a significant effect on the species and the rate of trees invading the ROW. On ROWs wider than 30 meters (100 ft.) that are bordered by forests, rates of tree invasion will be highest adjacent to the edges and drop off at distances greater than 15 meters from the forest edge.

Natural mortality reduces tree density throughout the process of invasion—from the time of arrival of seeds to sapling emergence. Tree invasion is not limited to disturbances within ROW vegetation. Tree seedlings exploit natural variability in resource availability within ROW vegetation. However, the heterogeneity *per se* does not appear to be an important determinant of overall rates of invasion (i.e., successful invasion on favorable microsites is offset by poor survival of tree seedlings in unfavorable microsites). Tree seedling density is not necessarily a good predictor of the number of seedlings that will survive to sapling size because the factors that determine seedling establishment often appear to be inversely related to the factors that determine subsequent survival. Rates of tree invasion are highly sensitive to small changes in growth and mortality of older seedlings (i.e., small differences among communities in annual rates of growth and survival of older seedlings have a significant effect on overall rates of invasion).

The net competitive effects of low-growing communities on tree seedling growth and survival are the result of the combination of (1) the effects of low growing communities on the availability of resources essential for seedling growth; and (2) the responses of tree seedlings to variation in resource availability. There are fundamental differences in the degree to which the specific resources (light, moisture and nutrients) required for tree seedling growth can be depleted by low-growing communities. Low-growing communities differ significantly in the amount of shade they cast. There was little evidence that the communities differ in the degree to which they deplete the availability of water. There is considerable variation among the low-growing communities in the supply of nitrogen (from the decomposition of organic matter in the soil). The effects of ROW vegetation on tree seedling growth and survival can be both positive ("facilitation") and negative ("inhibition"); the net effect will depend on the balance over the period from seedling establishment to sapling emergence, but will vary depending on the physiology and ecology of individual tree species (e.g., shade tolerant versus shade intolerant species).

The intensity of competition between ROW vegetation and tree seedlings varies directly with site quality. The net negative effect of ROW vegetation on seedling growth is greatest on productive soils. On physically stressful sites, seedlings grow slowly even in the absence of intact vegetation. As a result, competition and physical stress tend to balance one another, resulting in relatively low growth rates for newly established seedlings, regardless of community type or site quality. One implication of this result is that disturbance to the intact vegetation will be particularly detrimental on productive sites, where seedlings can rapidly exploit any openings. In contrast, poor quality sites may be less sensitive to short-term disturbance because physical stress severely limits early seedling growth and survival of most species even in temporary openings in ROW vegetation. Thus, the duration of competition (i.e. the number of years it takes for a seedling to overtop the ROW vegetation) is more important to tree invasion than the intensity in any given year (e.g., shrub cover can depress seedling growth longer than herbaceous communities). ROW vegetation inhibits tree seedling growth through competition both aboveground (for light) and belowground (for water or nutrients). Most low-growing communities on most sites inhibit tree seedling growth through simultaneous limitation of the availability of both light and soil resources. Aboveground competition will often be the predominant interaction on productive sites, while belowground competition is greatest on more stressful sites. This reinforces the conclusion that productive sites will be the most sensitive to disturbance to the canopy of ROW vegetation.

Seed predation, primarily by white-footed mice, is frequently an important source of mortality for seeds that are dispersed into rights-of-way. Short-term rates of seed predation are higher under shrubs than in herbaceous dominated communities, presumably reflecting the habitat preferences of white-footed mice. Seedling predation (outright mortality of seedlings due to consumption), primarily by meadow voles, is a potential major source of mortality for tree seedlings. Rates of seedling predation are greatest when meadow vole population densities are high; but significant predation occurs even at low vole population densities. Seedling predation by meadow voles may be restricted to herbaceous communities that provide suitable habitat. Therefore, the relative importance of seed predation versus seedling predation may vary significantly as a function of the amount of woody cover within a site. Mammalian browsing on tree seedlings, by both white-tailed deer and eastern cottontail rabbits, significantly reduces the rate of tree invasion in most ROW communities. Deer browsing within rights-of-way is highest in heavily forested landscapes. Browsing rates are highest on seedlings that are not overtopped by adjacent shrubs or herbaceous species. The effects of browsing on seedling growth and mortality depend strongly on the timing and intensity of browsing, and the levels of other stresses experienced by a seedling. Even heavy winter browsing of unshaded seedlings for 2 successive years has little effect on either growth or survival of tree seedlings. Whereas summer browsing has significant effects on seedling growth and survival.

Overall rates of tree invasion in any given community reflect the net results of a large number of processes (i.e. seed dispersal, seedling establishment, first-year seedling survival, etc.) Shrub communities had the highest resistance to tree invasion of the communities examined in our research, though long-term ability of the community to resist tree invasion was not evaluated during the relatively short life of this project. Herbaceous communities on poor soils (specifically, little bluestem meadows) also had high net resistance to tree invasion. The communities with the lowest resistance to invasion were herbaceous communities on productive soils. These herbaceous communities on good soils often represent very early stages of old field succession, and are undergoing rapid colonization by shrubs.

References:

Berkowitz, A. R. and C. D. Canham. 1995. Ecological perspectives on tree invasion in rights-of-way: New competitive effects of intact vegetation. p. 54-58 *In* G.J. Doucet, C. Séguin, and M. Giguère (eds.) Proceedings of the 5th International Symposium on Environmental Concerns in Rights-of-Way Management, September 19-22, 1993, Montreal, Quebec, Canada.

Berkowitz, A.R., C.D. Canham, and V.R. Kelly. 1995. Competition vs. facilitation of tree seedling growth and survival in early successional communities. Ecology 76(4):1156-1168.

Boeken, B. and C. D. Canham. 1995. Biotic and abiotic control of the dynamics of gray dogwood (*Cornus racemosa* Lam.) shrub thickets. Journal of Ecology 83:569-580.

Canham, C. D., J. D. Hill, A. R. Berkowitz, and R. S. Ostfeld. 1995. Ecological perspectives on tree invasion in rights-of-way: quantifying variation among communities in resistance to tree invasion. p. 81-86 *In* G.J. Doucet, C. Séguin, and M. Giguère (eds.) Proceedings of the 5th International Symposium on Environmental Concerns in Rights-of-Way Management, September 19-22, 1993, Montreal, Quebec, Canada.

Dickinson, Matthew B., Francis E. Putz, and Charles D. Canham. 1993. Canopy gap closure of the clonal shrub, *Cornus racemosa*. Bulletin of the Torrey Botanical Club 120(4):439-444.

Hill, J.D., C.D. Canham, and D.M. Wood. 1995. Patterns and causes of resistance to tree invasion in rights-of-way. Ecological Applications 5(2):459-470.

Institute of Ecosystem Studies. 1993. Vegetation dynamics along utility rights-of-way: Factors affecting the ability of shrub and herbaceous communities to resist invasion by trees. C.D. Canham (ed.). Empire State Electric Energy Research Corporation, Altamont, NY. Final technical report EP 85-38.

Putz, F.E. and C.D. Canham. 1992. Mechanisms of arrested succession in shrublands: root and shoot competition between shrubs and tree seedlings. Forest Ecology and Management 49:267-275.

Study Name:	**Tree growth retardants.**
Study Sponsor:	Empire State Electric Energy Research Corporation (ESEERCO)
Project Name/Study Number	EP 88-29
PI's/Contractors:	K.T. McLoughlin, New York Power Pool/ESEERCO; ACRT, Inc.
Period:	1988-1990
Cost:	

Purpose and description:

The objective of this study was to evaluate tree growth regulator (TGR) usage within the utility industry. The project consisted of three parts: (1) an annotated bibliography of tree/plant growth regulator information, (2) a search of unpublished literature and mail-phone surveys, and (3) a workshop to determine future research direction and usage recommendations of TGRs by New York State utilities.

Results:

Six TGRs were identified as the major compounds that have been used in utility situations, including maleic hydrazide (Slow Grow), dikegulac sodium (Atrinal), chlorflurenol (CF125 or Maintain A), paclobutrazol (Clipper), flurprimidol (Cutless), and uniconazole (Prunit). Dikegulac, maleic hydrazide, and chlorflurenol affect cell division and block apical dominance, restricting terminal growth. Paclobutrazol, flurprimidol, and uniconazole are anti-gibberellic in nature; they allow cell division and growth to occur but suppress cell wall and internodal elongation. The advantages and disadvantages and method of application and use of the various TGRs were considered. TGRs, like other vegetation management tools, do not meet all of the vegetation management needs, but can be integrated into a comprehensive vegetation management program.

Reference:

ACRT, Inc. 1990. Tree growth retardants: Literature search synopsis. Empire State Electric Energy Research Corporation, Schenectady, NY. Research report EP 88-29.

Study Name: **ROW herbicide buffer zone efficacy.**

Study Sponsor: Empire State Electric Energy Research Corporation (ESEERCO)

Project Name/Study Number: EP 89-44

PI's/Contractors: K.T. McLoughlin, New York Power Pool/ESEERCO; L.A. Norris, Environmental Consultants Inc., Fort Washington, Pennsylvania.

Period: 1989-1990

Cost:

Purpose and description:

The objective of this project was to test buffer zone effectiveness in protecting stream water quality and evaluate herbicide toxicity to provide a technical basis for establishing water quality protection goals or standards. There were three studies. First was a determination of buffer zone widths needed to achieve water protection goals by comparing herbicide deposition at distances from 0-100 ft from the downwind edge of areas treated by either stem-foliar or basal methods. The second study, a field test, tested buffer zone effectiveness in protecting water quality using high-volume stem-foliar and low-volume basal applications of picloram, triclopyr, 2,4-D, or imazapyr. Water samples were collected and chemical analysis made. The third study evaluated published literature and other information on the toxicity of herbicides used in the study.

Results:

No buffer or 10 ft buffers were sufficient in protecting water quality where medium to low density vegetation was treated with herbicide. Larger buffer zones were needed where high density vegetation was treated; buffers of 25 ft or more achieve stream water quality criteria. Positive water samples contained concentrations of herbicide of 0.001 to 0.002 mg/l with the highest at .006 mg/l, levels not harmful to humans or aquatic life.

References:

Environmental Consultants, Inc. 1991. Determination of the effectiveness of herbicide buffer zones in protecting water quality on New York State powerline rights-of-way. Empire State Electric Energy Research Corporation, Schenectady, New York. Report EP 89-44.

Norris, L.A., and P.M. Charlton. 1995. Determination of the effectiveness of herbicide buffer zones in protecting water quality. p. 147-152 *In* G.J. Doucet, C. Séguin, and M. Giguère (eds.) Proceedings of the 5th International Symposium on Environmental Concerns in Rights-of-Way Management, September 19-22, 1993, Montreal, Quebec, Canada, Hydro-Québec, Quebec, Canada.

Summary compiled from:

Environmental Consultants, Inc. 2001. Integrated Vegetation Management on gas line rights-of-way: Review of the literature. C.A. Nowak and B.D. Ballard (comps.), Gas Technical Institute, Chicago, Illinois, GRI Report No. GRI-01/0096.

Study Name:	**ROW natural growth inhibitors.**
Study Sponsor:	Empire State Electric Energy Research Corporation (ESEERCO) and Consolidated Edison Co. of NY, Inc
Project Name/Study Number:	EP 90-14
PI's/Contractors:	Brooklyn Botanical Garden Research Center, Brooklyn, New York.
Period:	1990
Cost:	$40,000

Purpose and description:

The objective was to identify natural compounds and vegetation that inhibit the growth of trees commonly found on New York State transmission line ROWs. The study included a review of literature pertinent to natural growth inhibitors, emphasizing those natural compounds that affect tree growth, including a broad overview of the subject of allelopathy, microorganisms, and tree pathogens.

Results:

The annotated bibliography highlighted literature pertinent to natural growth inhibitors, including a broad overview of the subject of allelopathy, microorganisms, and tree pathogens. The literature reported approximately 200 phytotoxins from over 100 microbial species, most being produced by fungi. A few of the phytotoxins described in the literature have already been developed as commercial herbicides (e.g., bialaphos and phosphinothricin—the synthetic version is the herbicide Glufosinate). The development of herbicides from microbially produced phytotoxins is a highly promising area for future discovery, which has not been adequately explored. Literature regarding phytotoxins isolated from pathogens of trees is very limited, and those that have been reported were toxic only to the host plant and show little promise as a herbicide/growth regulator for a broad range of trees. Articles pertaining to allelopathic effects of one plant on another were also reviewed. Very few investigations of allelopathy found in the scientific literature stood up to the scrutiny of proof required to "prove" allelopathic effects of one plant on another.

Reference:

Brooklyn Botanical Garden. 1991. Natural growth inhibitors—literature review. Empire State Electric Energy Research Corporation, Schenectady, NY, and Consolidated Edison Company of New York, Inc. Research report EP 90-14.

Study Name:	**Volney-Marcy *Rubus* study.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	Volney-Marcy research project.
PI's/Contractors:	C.A. Nowak. SUNY-ESF
Period:	1982-1991
Cost:	NA

Purpose and description:

The objective of this study was to examine the presence of one desirable genus—*Rubus*—in response to first and second maintenance cycle herbicide treatments, 1 and 4 years after initial clearing on one recently cleared right-of-way (ROW) in Upstate New York. *Rubus* density and cover were compared among plots treated with herbicides using selective and nonselective basal (triclopyr) and stem-foliar (2, 4-D, picloram and triclopyr) treatment schemes.

Results:

Rubus allegheniensis Porter (common blackberry) was the dominant *Rubus* species on a recently cleared ROW in Upstate New York. The presence of *Rubus* was not affected by first maintenance cycle treatments. In response to second maintenance cycle treatments, basal schemes generally had more *Rubus* than stem-foliar treatments. In terms of broad plant community stability on ROWs, the role of *Rubus* is unclear, as are the implications of any differences in *Rubus* cover among treatments with regard to multiple uses of ROWs.

Reference:

Nowak, C.A. 1991. Volney-Marcy *Rubus* study. Niagara Mohawk Power Corporation, Syracuse, NY. NMPC final report.

Project Name:	**Principles and practices of vegetation management on electric power transmission line rights-of-way.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	Volney-Marcy research project.
PI's/Contractors:	Abrahamson, L.P. and C.A. Nowak. SUNY-ESF
Period:	1989-1992
Cost:	$126,649

Purpose and description:

The purpose of this series of studies was to evaluate which application mode and method was most cost-effective in accomplishing vegetation management objectives during early ROW management phases. Treatment plots along ROWs were treated with selective and nonselective basal or cut stump applications of picloram, 2,4-D, and triclopyr and no herbicide treatments in the initial clearing phase, and selective and nonselective basal or stem-foliar applications for the first and second conversion cycles. Effects of treatments on desirable woody stem density, undesirable woody stem density, herbaceous cover, undesirable sprouting, and herbaceous density were evaluated at the end of each conversion cycle.

Results:

During initial ROW clearing the number of desirable plants was reduced with herbicide treatment, undesirable plants were generally the same between herbicide-treated and no herbicide treatment plots, and costs were higher for herbicide treatments as compared with no herbicide treatment. The most cost-effective method for initial clearing was clear or selective cutting with no herbicide treatment. During the first conversion cycle there was equal reduction of undesirable vegetation and maintenance of desirable vegetation. Therefore, cost-effectiveness was based on treatment costs alone. Basal treatment costs were nearly double that of stem-foliar with the nonselective mode being less costly than selective; therefore, the nonselective stem-foliar treatment was the most cost-effective scheme. For the second conversion cycle there were more desirable plants with the selective mode, there was a greater reduction in undesirable plants with stem-foliar schemes, and basal treatment costs were nearly double that of stem-foliar. Therefore, selective stem-foliar was the most cost-effective herbicide scheme.

References:

Abrahamson, L. P., C. A. Nowak, E. F. Neuhauser, C. G. Foreback, H. D. Freed, S. B. Shaheen, and C. H. Stevens. 1991a. Cost-effectiveness of utility rights-of-way vegetation management treatments: I. Initial clearing. Journal of Arboriculture 17(12): 325-327.

Abrahamson, L. P., C. A. Nowak, E. F. Neuhauser, C. G. Foreback, H. D. Freed, S. B. Shaheen, and C. H. Stevens. 1991b. Cost-effectiveness of utility rights-of-way vegetation management treatments: II. First maintenance cycle. Journal of Arboriculture 17(12): 328-330.

Nowak, C. A., L. P. Abrahamson, E. F. Neuhauser, C. G. Foreback, H. D. Freed, S. B. Shaheen, and C. H. Stevens. 1992. Cost-effective vegetation management on a recently cleared electric transmission line right-of-way. Weed Technology 6: 828-837.

Summary compiled from:

Environmental Consultants, Inc. 2001. Integrated Vegetation Management on gas line rights-of-way: Review of the literature. C.A. Nowak and B.D. Ballard (comps.), Gas Technical Institute, Chicago, Illinois, GRI Report No. GRI-01/0096.

Study Name:	**A 15-year appraisal of plant dynamics on electric power rights-of-way in New York State.**
Study Sponsor:	Empire State Electric Energy Research Corporation
Project Name/Study Number	EP 91-16: Rights-of-way stability.
PI's/Contractors:	Abrahamson, L.P., C.A. Nowak, and D.J. Raynal. SUNY-ESF
Period:	1991-1993
Cost:	$147,690

Purpose and description:

The purpose of this 15-year appraisal was to describe long-term changes in tree populations on powerline ROWs across New York with operational vegetation management during the period of 1975-1991.

Results:

Results from the 15-year appraisal indicated that on corridors where trees were periodically, selectively removed using herbicides, tree populations were observed at constant low density. There was a spatial redistribution of trees in 1991 compared to 1975, with fewer trees in the corridor centerline and more in the border areas along corridor edges in 1991. An increase in tree density was observed on corridors that did not receive herbicide treatments to control trees, but had only aboveground portions of trees selectively removed using periodic hand cutting. Species composition generally did not change over the study period. *Acer, Betula, Fraxinus, Populus, Prunus,* and *Quercus* species were commonly present on all sites during 1975 and 1991. Red maple *(Acer rubrum* L.) and white ash *(Fraxinus americana* L.) were ubiquitous. Operational, selective removal of trees on powerline corridors with herbicides, whereby both the above- and below ground portions of the plants are periodically killed and site disturbance minimized, can lead to the creation of relatively stable, compositionally constant, low density tree populations.

References:

Nowak, C. A., L. P. Abrahamson, D. J. Raynal, and D. J. Leopold. 1995. Selective vegetation management on powerline corridors in New York State: Tree density and species composition changes from 1975 to 1991. p. 153-158 *In* G.J. Doucet, C. Séguin, and M. Giguère (eds.) Proceedings of the 5th International Symposium on Environmental Concerns in Rights-of-Way Management, September 19-22, 1993, Montreal, Quebec, Canada.

Summary compiled from:

Environmental Consultants, Inc. 2001. Integrated Vegetation Management on gas line rights-of-way: Review of the literature. C.A. Nowak and B.D. Ballard (comps.), Gas Technical Institute, Chicago, Illinois, GRI Report No. GRI-01/0096.

Study Name:	**Cost effectiveness of herbicide and non-herbicide alternatives for vegetation management on powerline corridors in the northeastern United States: A review.**
Study Sponsor:	Environmental Consultants, Inc.
Project Name/Study Number	NMPC project JC28477AGP.
PI's/Contractors:	L.P. Abrahamson and C.A. Nowak. SUNY-ESF P.M. Charlton and P.G. Snyder, ECI
Period:	1992
Cost:	$34,891

Purpose and description:

The purpose of this series of studies was to assess available information on both herbicide and non-herbicide vegetation management methods for electric utility rights-of-way in the northeastern United States. An extensive search of the literature was conducted, along with mail and phone surveys of utility vegetation managers throughout North America, and on-site visits with several regional utilities. The study had several general goals, including: (1) review existing literature, (2) examine experience of utilities that offer special maintenance agreements to landowners who prefer that non-herbicide methods be employed, and (3) evaluate information from utilities that have experience with long-term no-herbicide-use policies.

Results:

The maintenance of vegetation on electric utility rights-of-way is a dynamic process affected by site conditions, public interest, environmental concerns, and costs. Existing information is insufficient to identify one method or group of methods as optimal in all circumstances. Long-term, cost-effective management of ROW vegetation is dependent upon both herbicide and non-herbicide methods. A prescription-based approach, where different methods are selected for different circumstances, is the most rational strategy. To effectively manage this type of program, it is essential that utilities have well-trained professionals and data to make operational prescriptions in the field.

References:

Abrahamson, L. P., C. A. Nowak, P. M. Charlton, and P. G. Snyder. 1995. Cost effectiveness of herbicide and non-herbicide vegetation management methods for electric utility rights-of-way in the Northeast: state-of-the art review. p. 27-43 *In* G.J. Doucet, C. Séguin, and M. Giguère (eds.) Proceedings of the 5th International Symposium on Environmental Concerns in Rights-of-Way Management, September 19-22, 1993, Montreal, Quebec, Canada.

Environmental Consultants, Inc. 1992. Cost effectiveness of herbicide and non-herbicide vegetation management methods for electric utility rights-of-way in the Northeast: state-of-the art review and annotated bibliography. Abrahamson, L. P., C. A. Nowak, P. M. Charlton, and P. G. Snyder (comps.). Niagara Mohawk Power Corporation, Syracuse, NY. NMPC final project report JC28477AGP.

Summary compiled from:
Environmental Consultants, Inc. 2001. Integrated Vegetation Management on gas line rights-of-way: Review of the literature. C.A. Nowak and B.D. Ballard (comps.), Gas Technical Institute, Chicago, Illinois, GRI Report No. GRI-01/0096.

Study Name:	**Utility right-of-way vegetation management in Karner blue butterfly habitat areas.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	
PI's/Contractors:	D.J. Leopold, P. Smallidge and L.P. Abrahamson. SUNY-ESF
Period:	1994-2002
Cost:	$425,000

Purpose and description:

The study was designed to determine the relationship between short and long-term vegetation management on the abundance of blue lupine *(Lupinus perennis* L.), an herbaceous perennial critical as a food source for the Karner blue butterfly *(Lycaeides melissa samuelis* Nabokov)—a U. S. Fish and Wildlife Service listed endangered species—in its larval stages.

Results:

Increased relative light level was the primary variable associated with increased blue lupine abundance. Percent cover of blue lupine was correlated positively with both the recent and longer-term use of herbicides. Blue lupine clump density was most dependent on relative light intensity, and was negatively associated with the number of years since the last management activity and the recent use of herbicides.

References:

Smallidge, P. J., D. J. Leopold, and C. M. Allen. 1995. Management concerns for the response of blue lupine communities on rights-of-way in east-central New York, USA to environmental factors and vegetation management. p. 330-335 *In* G.J. Doucet, C. Séguin, and M. Giguère (eds.) Proceedings of the 5th International Symposium on Environmental Concerns in Rights-of-Way Management, September 19-22, 1993, Montreal, Quebec, Canada.

Smallidge, P.J., D.J. Leopold, and C.M. Allen. 1996. Community characteristics and vegetation management of Karner blue butterfly (*Lycaides Melissa samuelis*) habitats on rights-of-way in each-central New York, USA. Journal of Applied Ecology 33: 1405-1419.

Summary compiled from:

Environmental Consultants, Inc. 2001. Integrated Vegetation Management on gas line rights-of-way: Review of the literature. C.A. Nowak and B.D. Ballard (comps.), Gas Technical Institute, Chicago, Illinois, GRI Report No. GRI-01/0096.

Project Title:	**Volney-Marcy electric transmission line vegetation management project: Third cycle treatments**
Study Sponsor:	Niagara Mohawk Power Corporation (see individual study descriptions for other partners)
Project Name/Study Number	Study No.s 1 – 11, 15
PI's/Contractors:	C.A. Nowak, L.P. Abrahamson, and L.W. VanDruff. SUNY-ESF.
Period:	1999-2002
Cost:	$486,000 (NMPC) $150,000 (see NYSEG partnership) $10,000 (Dow AgroSciences) $4,500 (DuPont) $25,000 (BASF) ($5,000/year for up to 5 years)
Total:	$675,500

Purpose and description:

This series of studies was designed to evaluate a range of management considerations including:

Long-term effects of non-herbicide treatments and selective and non-selective herbicide treatments on desirable and undesirable woody species dynamics during the second conversion cycle;

Methods of reclaiming a ROW (mowing, low volume hydraulic stem-foliar, and cut stump treatment methods);

Efficacy and effectiveness of contemporary herbicide treatment methods and mixtures (low volume backpack, low volume hydraulic, basal, and cut stump treatments), and quantification of herbicide use and deposition off-target: disturbance from treatments, duration of impact, opportunity for tree seedling establishment;

Ecological considerations: songbird habitat, vascular plant species diversity, competitive ability of low-growing communities: effects on tree growth and development, and a study of gray birch dynamics/ecology.

Results:

See individual study descriptions.

References:

See individual study descriptions.

Study Name:	**Long-term effectiveness of various herbicide and non-herbicide treatment schemes during the second conversion cycle.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 1
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

The objective of this study was to determine the long-term effectiveness of select treatments applied during the second conversion cycle on the Volney-Marcy powerline. Remeasurement of past treatment areas that included selective and non-selective stem-foliar and basal herbicide treatments, brush hog (hydro-axe/mowing), and grub and seed treatments was completed in 1999/2000, 11-12 years post-treatment. Desirable and undesirable stem densities by height/diameter class and percent cover for all species were measured using a series of milacre plots and strip transects.

Results:

Over an 11-year period, stem densities were maintained at low levels using selective chemical treatments in an IVM program on the Volney-Marcy powerline ROW in Upstate New York. Larger trees on the ROW were dominated by gray birch, whereas red maple was the dominant species for smaller seedlings, suggesting that a species shift in undesirable species may be occurring on the Volney-Marcy ROW. Mechanical treatments resulted in higher undesirable densities than chemical treatments. Desirable stem densities have increased or remained constant over time with an IVM approach.

Reference:

Ballard, B.D., C.A. Nowak, L.P. Abrahamson, E.F. Neuhauser, and K.E. Finch. *In press*. Integrated vegetation management on electrical transmission rights-of-way using herbicides: Treatment effects over time. *In*: Proceedings of the 7th International Symposium on Environmental Concerns in Rights-of-Way Management, September 9-13, 2001, Calgary, Alberta, Canada.

Study Name:	**Effectiveness of various selective herbicide treatment schemes to reclaim a ROW.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 2
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

The purpose of this study was to evaluate the effectiveness of selective stem-foliar and cut stump treatments applied to a ROW with tall, low-density undesirable trees. A subset of three stem-foliar and three basal treatment areas from Study No. 1 was selected for retreatment 11 years post-treatment. Stem-foliar treatments were applied corresponding with historic stem-foliar treatment plots. Cut stump treatment methods were applied to historic basal treatment plots.

Results:

Pending.

Reference:

Pending.

Study Name:	**Vascular plant species diversity before and after first maintenance cycle vegetation management.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 3
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

Vegetation management on ROWs is conducted to produce values chiefly associated with the safe and reliable transmission of electricity. Secondary values are produced as well. Communities of rare, early successional plant communities can often be found on ROWs. The objective of this study was to determine the effects of selective and non-selective stem-foliar and basal herbicide treatments on plant species diversity during the second conversion cycle.

Results:

Pending.

Reference:

Pending.

Study Name:	**Competitive hierarchies of desirable plant communities.**
Study Sponsor:	Niagara Mohawk Power Corporation. New York State Electric and Gas Corporation
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 4 (NYSEG Study No. 4)
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

Vegetative communities found on powerline ROWs vary in their ability to inhibit undesirable tree seedling establishment, survival, and growth. The purpose of this study was to evaluate each of these suppression factors for important vegetative communities found on the Volney-Marcy ROW. To better understand the stability of these community types, two approaches were employed in this study: 1) stem analysis and 2) seedling demography of trees growing in each community type.

Results:

Pending.

Reference:

Pending.

Study Name:	**Herbicide deposition patterns for commonly used treatment schemes.**
Study Sponsor:	Niagara Mohawk Power Corporation, New York State Electric and Gas Corporation, Dow AgroSciences, DuPont, BASF.
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 5 (NYSEG Study No. 6)
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

Work on this study corresponds with low volume backpack foliar treatment applications in Study No. 8 and cut stump treatments in Study No. 10. One concern with herbicide is that there are detrimental effects on non-target vegetation (communities) due to overspray. This objective of this study was to quantify the amount of herbicide used to treat varying densities and sizes of trees and to quantify the amount of overspray that results for conventional herbicide methods/application techniques.

Results:

Pending.

Reference:

Pending.

Study Name:	**Site-specific and landscape-level effects of ROW vegetation management on songbird communities.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 6
PI's/Contractors:	L.W. VanDruff. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

Powerline ROWs may serve as suitable habitat for a number of shrub bird species currently in decline because of the loss of agriculture and reversion of old fields back to forest in the northeastern United States. The potential quality of that habitat will largely reflect the vegetation management strategy employed in any given ROW. The objective of the study was to determine what the site-specific effects of vegetation management were on songbird communities. Two of the primary vegetation management strategies are mechanical treatments and selective herbicide treatments. The bird community of a ROW in which both treatments were used on one or the other of two side-by-side powerlines was studied using a combination of spot-mapping, nest searching, and vegetation measurements.

Results:

There was a difference in shrub density on the two powerlines; the older Fitzpatrick-Edic line, with a history of mechanical treatments, had a higher shrub density than the younger Volney-Marcy powerline. There were two times more bird territories and nests in high shrub density areas. Songbirds respond directly to shrub habitat on ROWs; as shrub density increases, shrub nesting birds increase. Once established, the permanence of the plant community produced with selective herbicides may be better for short-lived bird species than the regular destruction of the plant community required in mechanical treatments.

Reference:

Marshall, J.S., L.W. VanDruff, and S.D. Shupe. *In press*. Effects of Power Line Right-of-Way Vegetation Management on Avian Communities. *In*: Proceedings of the 7th International Symposium on Environmental Concerns in Rights-of-Way Management, September 9-13, 2001, Calgary, Alberta, Canada.

Study Name:	**A study of the invasion and growth patterns of *Betula populifolia* Marsh. (gray birch) on a powerline ROW in New York State.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 7
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

Gray birch (*Betula populifolia* Marsh.) is an important tree species on powerline ROWs in the north temperate zone of North America. It is a pioneer species that can proliferate in the early plant succession environment of powerline ROWs. While a short tree at maturity (10- to 15-meters), it is commonly a danger for the transmission of electricity. This study was initiated to determine why gray birch was so prevalent on the Volney-Marcy ROW, 17 years after initial clearing. Stem densities of the gray birch population (trees greater than 1 cm diameter at breast height and approximately 3 m height) averaged 350 ha^{-1} 11 years post-treatment (second treatment cycle). Treatments were basal and stem-foliar herbicides applied using non-selective or selective modes as part of a long-term study. Fifty-four gray birch trees from across a 25 km section of ROW were examined for height-age development patterns. Population density and age structure were measured on 11 treatment plots.

Results:

Gray birch tree heights ranged to over 11 m and tree ages from 4 to 13 years. Most of the trees were established within 3 years after treatment. Young powerline corridors that have mesic to hydric moisture regimes are well-suited to birch invasion, particularly with management-related disturbance. Minimizing site disturbance and promoting the development of a tall shrub community should reduce birch presence on older powerlines.

Reference:

Nowak, C.A., B.D. Ballard, and E. O'Neill. *In press*. Gray Birch Ecology on an Electric Powerline Right-of-way in Upstate New York. *In*: Proceedings of the 7th International Symposium on Environmental Concerns in Rights-of-Way Management, September 9-13, 2001, Calgary, Alberta, Canada.

Study Name:	**Effectiveness of various herbicide treatment schemes on ROWs that were operationally treated during the last treatment cycle.**
Study Sponsor:	Niagara Mohawk Power Corporation, New York State Electric and Gas Corporation, Dow AgroSciences, DuPont, and BASF.
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 8 (also NYSEG Study No. 5)
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

The objective of this study was to compare the effectiveness of low volume backpack foliar, low volume hydraulic stem-foliar, and basal treatments under conditions that are routinely encountered on managed powerline ROWs. Three herbicide mixtures were used for the backpack foliar treatment: Accord/Arsenal, Tordon/Garlon, and Krenite/Arsenal/Escort. Two herbicide mixtures were used for hydraulic foliar: Tordon/Garlon and Accord/Arsenal. A single herbicide mixture was used for basal treatments: Garlon/Arsenal. Sites were selected from operationally treated areas with an area of approximately 1 acre for each of the six treatments and stem densities of 50-200 undesirable stems/acre over 6 feet in height. In addition to quantifying treatment effectiveness, treatment methods in this study will be evaluated for herbicide deposition patterns and the impact on non-target vegetation (Studies 5 and 9).

Results:

Pending

Reference:

Pending

Study Name:	**Herbicide deposition patterns for commonly used treatment schemes: Impacts on community structure and composition in the near- and long-term.**
Study Sponsor:	Niagara Mohawk Power Corporation, New York State Electric and Gas Corporation, Dow AgroSciences, DuPont, and BASF.
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 9 (NYSEG Study No. 6)
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

Work on this study corresponds with the treatment applications in Studies No. 2 and 8. The purpose of this study was to quantify the area affected by the "overspray shadow", and to assess the impacts that the overspray has on the vegetative community soon after treatment and over time. The areas impacted from "overspray" were quantified by delineating and mapping these areas for a total of 30 trees for each treatment method studied.

Results:

Pending

Reference:

Pending

Study Name:	**Expanding the treatment window for cut stump herbicide treatments.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 10
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

The purpose of this study was to evaluate the efficacy and effectiveness of three cut stump herbicide mixtures, Accord/Arsenal, Garlon 4/Stalker, and Pathway, applied at three different times during the year: early spring (April), mid-summer (June), and late fall (November).

Results:

Pending

Reference:

Pending

Study Name:	**Effectiveness of mowing to reclaim a previously mowed ROW.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 11
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	1999-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments.

Purpose and description:

Mowing has often been used on ROWs in New York State. This study evaluated the effectiveness of mowing and mowing with follow-up stem-foliar herbicide treatment(s) to reclaim a ROW that has gone untreated for 11 growing seasons. Ten mowing (hydro-ax) treatment areas were retreated in late June 2000 using a Hydro-Ax 621E skidder with a Rotary Ax mower deck. As of August, 2001, follow-up herbicide treatments have not yet been prescribed.

Results:

Pending

Reference:

Pending

Study Name:	**Demonstration of ROW Vegetation Management Tools on a ROW near Albany, New York.**
Study Sponsor:	Niagara Mohawk Power Corporation
Project Name/Study Number	Volney-Marcy electric transmission line vegetation management project: Study No. 15
PI's/Contractors:	C.A. Nowak and L.P. Abrahamson. SUNY-ESF.
Period:	2000-2002
Cost:	See Volney-Marcy electric transmission line vegetation management project: Third cycle treatments. 2001 *Environmental stewardship of utility rights-of-way conference* cost: $?

Purpose and description:

The purpose of this study area was to provide a showcase of vegetation management tools and strategies that would be readily accessible in the Albany area. The demonstration/research area was established June 2000. Twelve 1-acre areas were delineated on a hillside west of the New Scotland substation off Route 308, approximately 5 miles southwest of Albany. Pre-treatment measurements were completed in each 1-acre area, which included establishing nine milacre plots and six strip transects (six-feet wide x 66-feet long). The area had high shrub presence, including gray dogwood, honeysuckle, and multiflora rose, and had a suitable number of medium to large undesirables ready for treatment. Treatments were applied in mid-June, 2001

Results:

Vegetation management treatments were demonstrated at the site for the *Environmental stewardship of utility rights-of-way conference* held in Albany, NY in June 12-13, 2001. The event was hosted by Niagara Mohawk Power Corporation, Energy Alliance of New York, and the State University of New York College of Environmental Science and Forestry (SUNY-ESF). The workshop participants included professionals from the utility industry, regulatory agencies, environmental analysts, and universities. Presentations were made by the utilities: NMPC, New York Power Authority, and New York State Electric and Gas. The agency perspective was presented by the New York State Department of Environmental Conservation and the Public Service Commission. SUNY-ESF presented a review of current research and a new framework in which to think about Integrated Vegetation Management.

Reference:

NA

Project Title:	**Shrub community dynamics on a powerline corridor in upstate New York.**
Study Sponsor:	Niagara Mohawk Power Corporation, Electric Power Research Institute, and New York State Electric and Gas Corporation.
Project Name/Study Number	Shrub community dynamics on a powerline corridor in upstate New York/Volney-Marcy electric transmission line vegetation management project: Study No.s 12-14
PI's/Contractors:	C.A. Nowak, L.P. Abrahamson, and B.D. Ballard. SUNY-ESF.
Period:	2000-2002
Cost:	$135,095 (also see NYSEG partnership)

Purpose and description:

The purpose of the three studies in this project was to answer three main questions about shrub ecology: 1) What is known about the life histories (reproduction, growth, and longevity) of common ROW shrubs (*Cornus*, *Rubus* and *Viburnum*)? 2) What factors have influenced the distribution and abundance of shrubs on powerline ROWs? and 3) What cultural treatments can increase and maintain the presence of desirable shrub communities (Specifically, mowing or coppicing of arrowwood, *Viburnum dentatum*, and gray dogwood, *Cornus racemosa*)?

Results:

See individual study descriptions.

Reference:

See individual study descriptions.

Study Name:	**Select shrub life histories: An annotated bibliography.**
Study Sponsor:	Niagara Mohawk Power Corporation and Electric Power Research Institute.
Project Name/Study Number:	Shrub community dynamics on a powerline corridor in upstate New York/Volney-Marcy electric transmission line vegetation management project: Study No. 12
PI's/Contractors:	C.A. Nowak, L.P. Abrahamson, and B.D. Ballard. SUNY-ESF.
Period:	2000-2002
Cost:	See Shrub community dynamics on a powerline corridor in upstate New York.

Purpose and description:

The objective of this study was to develop an annotated bibliography that contains references important to the ROW vegetation manager in understanding the life histories (reproduction, growth, and longevity) of common shrubs (*Cornus* spp., *Rubus* spp., and *Viburnum* spp.) in the northeastern United States. A review of the literature was conducted to assess the state-of-knowledge about shrub life histories of common shrub species, focusing on *Cornus racemosa* Lam., *Viburnum dentatum* spp. L., *V. lentago* L., *Rubus idaeus* spp. L., and *R. allegheniensis* T.C. Porter, based on prominence in the region and vegetation management literature. The annotated bibliography includes summaries of 77 articles.

Results:

Synopsis pending.

Reference:

Ballard, B.D., C.A. Nowak, H.L. Whittier, P.J. Donoso, J.C. Deegan, and J.W. Goodrich-Mahoney. Life Histories of Common Shrubs on Utility Rights-of-Way in the Northeastern United States: An Annotated Bibliography. In press (2001). Electric Power Research Institute, Palo Alto, CA, and Niagara Mohawk Power Corporation, Syracuse, NY.

Study Name:	**Factors influencing the distribution and abundance of shrubs on ROWs in New York State: An observational study.**
Study Sponsor:	Niagara Mohawk Power Corporation, Electric Power Research Institute, and New York State Electric and Gas Corporation.
Project Name/Study Number:	Shrub community dynamics on a powerline corridor in upstate New York/Volney-Marcy electric transmission line vegetation management project: Study No. 13 (NYSEG Study No. 2)
PI's/Contractors:	C.A. Nowak, L.P. Abrahamson, and B.D. Ballard. SUNY-ESF.
Period:	2000-2002
Cost:	See Shrub community dynamics on a powerline corridor in upstate New York.

Purpose and description:

Species composition and abundance of shrub communities on various ROWs appear to vary as a function of site quality and land use history. The distribution, composition, and abundance of shrub/herb communities found on ROWs are a function of physiographic (site) conditions, past land use and treatment history, adjacent land use, and age of the ROW. The objective of this study is to explore and determine what factors have the greatest influence on the distribution and abundance of shrubs on powerline ROWs across New York. Management of shrub communities can be adjusted to meet management objectives based on an understanding of the factors that influence shrub dynamics.

Results:

Pending.

Reference:

Pending.

Study Name:	**Assessment of cultural treatments to increase and maintain the presence of desirable shrub communities: A manipulative field experiment.**
Study Sponsor:	Niagara Mohawk Power Corporation, Electric Power Research Institute, and New York State Electric and Gas Corporation.
Project Name/Study Number:	Shrub community dynamics on a powerline corridor in upstate New York/Volney-Marcy electric transmission line vegetation management project: Study No. 14 (NYSEG Study No. 3)
PI's/Contractors:	C.A. Nowak, L.P. Abrahamson, and B.D. Ballard. SUNY-ESF.
Period:	2000-2002
Cost:	See Shrub community dynamics on a powerline corridor in upstate New York.

Purpose and description:

While shrub communities are generally viewed as the most effective desirable plant community at minimizing colonization by undesirable, tall-growing trees, there is much to learn about shrub community dynamics. The objective of this study was to determine what cultural treatments and by what mechanisms can the presence of desirable shrub communities be increased and maintained on ROWs. Both vegetative and sexual reproduction strategies may be necessary for many shrub species to effectively colonize a site. However, there are cultural practices that may promote vegetative reproduction or spread (e.g., via basal sprouting, root suckering, etc.). Higher shrub density and cover have been observed on ROWs that have a history of mowing or handcutting (alone or in combination with cycles of chemical control) than on ROWs that were managed using only selective chemical treatments (herbicides). This study evaluates the impact of mechanical treatments (mowing/handcutting) on shrub dynamics of arrowwood, *Viburnum dentatum*, and gray dogwood, *Cornus racemosa*.

Results:

Pending.

Reference:

Pending.

Study Name:	**Vegetation dynamics on operationally treated powerline corridors across New York state: 25-year re-assessment of Niagara Mohawk lines.**
Study Sponsor:	Niagara Mohawk Power Corporation and New York State Electric and Gas Corporation.
Project Name/Study Number:	Study No. 16 (also NYSEG Study No. 1)
PI's/Contractors:	C.A. Nowak and B.D. Ballard. SUNY-ESF.
Period:	2002-2004
Cost:	$93,857 (also see NYSEG partnership)

Purpose and description:

The purpose of monitoring the long-term effects of operational vegetation management on New York's powerline ROWs is to improve vegetation management and assure stakeholders that treatments are creating desired conditions. New York State utilities have periodically assessed the state-wide condition of ROWs vegetation; in this study a series of permanent vegetation management plots—originally established in 1975 and re-measured in 1991—on ROWs across the state will be re-assessed at the 25-year mark in 2002-2004.

Results:

Pending.

Reference:

Pending.

Project Name:	**Partnerships for powerline vegetation management in New York.**
Study Sponsor:	New York State Electric and Gas Corporation
Project Name/Study Number:	Study No.s 1-6 (also see NMPC's Volney-Marcy electric transmission line vegetation management project)
PI's/Contractors:	C.A. Nowak, L.P. Abrahamson, and B.D. Ballard. SUNY-ESF.
Period:	2000-2003
Cost:	$150,000

Purpose and description:

This partnership supplements and extends the life of many of the studies described in NMPC's Volney-Marcy electric transmission line vegetation management project, including:

Vegetation conditions on operationally treated powerline corridors across New York State: 25-year re-assessment (NMPC Study No. 16/NYSEG Study No. 1)

Shrub ecology on electric transmission line ROWs in New York State—observational field study (NMPC/EPRI Study No. 13/NYSEG Study No. 2)

Shrub ecology on electric transmission line ROWs in New York State—manipulative field experiment (NMPC/EPRI Study No. 14/NYSEG Study No. 3)

Competitive hierarchies of desirable plant communities (NMPC Study No. 4/NYSEG Study No. 4)

Effectiveness of contemporary herbicide treatment schemes (NMPC Study No. 8/NYSEG Study No. 5)

Herbicide deposition patterns for commonly used treatment schemes. (NMPC Study No.s 5 & 9/NYSEG Study No. 6)

Results:

Pending.

Reference:

Pending.

Study Name: **Vegetation management on utility rights-of-way.**

Results:

The annotated bibliography contained 279 references and serves as one of the first comprehensive state-of-the-art literature reviews for vegetation management on utility ROWs. Approximately half of the references pertain to the use, effects, or safety of herbicides. The remainder of the references dealt with general ROW issues, vegetation management, methods and procedures of vegetation management, and wildlife benefits.

Cody (1975) concluded: Economic and environmentally acceptable maintenance of transmission line rights-of-way is a matter of great concern for power companies. While everyone agrees that some sort of vegetation management is necessary, there is a wide difference of opinion as to the most economic and environmentally acceptable method. After examining the literature, talking with many right-of-way managers and examining many rights-of-way, the following conclusions were reached:

1. Right-of-way vegetation management should start with initial clearing. Proper initial clearing can greatly reduce future maintenance costs and provide a more environmentally acceptable right-of-way.
2. While initial clearing is important, the greatest job confronting the right-of-way manager is maintenance of existing rights-of-way.
3. A great variety of conditions exists on rights-of-way requiring a variety of treatments to achieve desired results. The need for maintenance should be determined by line examination, and treatment should be prescribed according to species and conditions.
4. While mechanical methods of woody plant control are still needed and are being used, by far the most right-of-way treatment is done using chemical methods.
5. There are two general methods of applying chemicals: broadcast spraying and selective spraying. While more acreage is probably being treated by broadcast methods at present *(1975)*, selective methods are gaining rapidly.
6. Basal spraying is the most selective methods of chemical application, but other methods can also be used selectively; exceptions are helicopters, fixed boom sprayers and mounted mist blowers.
7. Preservation and development of stable low-ground cover is, in the long run, the most economical method of vegetation management. It can be developed and maintained by selective spraying.
8. Where vegetation is dense, initial treatment by broadcast spraying may be the only practical way to reduce density and prepare the way for selective maintenance.
9. In remote areas or extremely rugged terrain, broadcast spraying by helicopter may be the only practical means of vegetation control. It may also be justified in certain other situations such as emergency conditions, shortage of labor, or where all, or nearly all, of the woody vegetation on a section of right-of-way is of an undesirable species.
10. Right-of-way maintenance success is highly dependent upon the preparation of good vegetation management plans, and reliable resources to carry them to completion.

Study Name: **Environmental and economic aspects of contemporaneous electric transmission line right-of-way management techniques.**

Results:

Case histories of 22 rights-of-way managed using commonly accepted methods were carried out in New York State. Study sites were located in all major forest regions of the state. Vegetation management over the previous decades on these ROWs fostered the development a complex of shrub-herb-grass communities. Shrubs found in adjacent forests to the ROW were prominent components of the ROW cover. Tree species continued to invade the ROW even with an established cover of shrubs, herbs, ferns, and grasses. This pressure from invading trees, if left unmanaged, would re-establish forest cover. Characteristic plant communities were developed in relation to habitat and were identified as: blackberry-goldenrod or sumac-goldenrod on mesic habitat areas; blueberry-sweetfern or blueberry-bracken fern on xeric areas; and willow-sensitive fern, red-osier dogwood-sensitive fern, or spirea-sensitive fern on hydric areas. ROW management has improved wildlife food and cover conditions and plant species diversity. Species diversity was consistently higher on the ROWs than in adjacent forests. Impacts of ROW management on erosion and stream water were negligible; construction disturbances were the exception. Generally, there was little change in adjacent land use to the ROWs since ROW construction.

Study Name: **Cost comparison of right-of-way treatment methods.**

Results:

The effect of seven treatment methods—hand cutting, mowing, cut stump, dormant basal, summer basal, selective ground foliar, and aerial—on capable tree densities varied. In the high density class all treatments decreased density. Medium density class increases were observed in segments treated with hand cutting, mowing, and cut stump methods. Mechanical treatments produced stem reductions of <60% at all densities. Cut stump was most effective at high densities. Dormant basal, summer basal, and aerial treatments exceeded 60% stem reduction at medium and high densities but only summer basal was as effective at low density. Selective ground foliar reductions were 71%, 100% and 59% at high, medium, and low densities, respectively. All treatments produced >60% reduction in mean height on both high and low height sites. Based on a single application of treatments, hand cutting, cut stump, and mowing were less expensive than basal spray treatments ranging from $91-$159, $113-$309, and $162-$193, respectively, depending on stem density. No highly adverse impacts on wildlife habitat were caused by any of the ROW treatments. Cost and effectiveness comparisons of girdling, frilling, basal injection, and stem injection found girdling to be the least desirable method

Study Name: **The effects of right-of-way vegetation management on wildlife habitat.**

The objective of this project was to summarize the knowledge of the effects of standard ROW vegetation management practices on various wildlife species and their attendant habitats in New York State. The supporting objectives of this project were to: (1) conduct a review of pertinent literature, (2) identify ongoing related research, (3) identify both positive and negative impacts on wildlife habitats, and (4) determine gaps in the knowledge.

This project examined the available data combining it with expert analysis and opinion in order to make predictions about consequences of alternative management actions. This was accomplished by conducting a thorough state-of-the-art literature review including a summary of ongoing research and a survey of unpublished data.

Results:

Initial impacts of ROW vegetation management are usually less favorable to wildlife than the long-term impacts. Treatments performed upon ROWs with high tree densities resulted in an immediate reduction in food and cover available to wildlife, whereas selective treatments on ROWs with a low or medium density of trees resulted in minimum reductions. Successfully managed ROWs that develop relatively stable shrub/herb/grassland plant communities benefit a wide variety of wildlife species. Vegetations management on ROWs encourages a broad spectrum of wildlife species, though the habitat requirements of *all* species cannot be met, thereby discouraging some species.

Study Name: **ROW multiple uses.**

Results:

The final report summarized all available literature on ROW multiple uses and included an annotated bibliography. A summary of survey responses was also presented. Analysis of this information provided summaries on such topics as utility multiple use policies, compatibility of uses, management strategies to control incompatible uses, accommodations of complaints, risk assessment, legal implications, management prerogatives to encourage compatible uses, compatibility criteria, and the current management of multiple use by the ESEERCO member systems as well as regulatory perspectives on these issues.

Study Name: **Long-term right-of-way effectiveness.**

Results:

Based on three density classes, high, medium, and low, a comparison of effectiveness of seven ROW treatments—hand cutting, mowing, cut stump, dormant basal, summer basal, aerial, and selective ground foliar—on undesirable plants (trees) was performed. Hand cutting was followed by an increase for all density classes. Mowing was followed by 44, 13, and 29% decreases in the three classes, respectively. Cut stump showed 71, 48, and 8% decreases, dormant basal was followed by 75, 57, and 63% reductions for each class, summer basal had 76, 83, and 57% reductions, selective ground foliar showed 81, 67, and 41% density decreases, and aerial treatment was followed by 81,74, and 68% decreases in stem density for the three classes, respectively. A correlation of treatment effectiveness and initial stem density, the relationship of the height of capable trees to the effectiveness of the treatments, and the effectiveness of treatments on common capable tree species is also discussed.

Study Name: **Right-of-way treatment cycles.**

Results:

Fifty-four percent of the study sites treated using seven treatment methods—hand cutting, mowing, cut stump, dormant basal, summer basal, selective ground foliar, and aerial—had a 3 yr treatment cycle, 24% had a 4 yr cycle, 18% had a 5 yr cycle, and 4% had a 6 yr cycle. For sites with a 3 yr cycle, hand cutting showed an increase in stem density by 14%. Summer basal showed the greatest density change with a 76% reduction. At the end of the treatment cycles, ROW sites treated with summer basal had the greatest reduction in density and the lowest density of all the treatment types. All other treatments reduced density except hand cutting, which showed an increase and had the highest average density of all treatment types. The average capable height was effectively the same at the time of retreatment regardless of which treatment was used. Cut stump had the greatest reduction in capable species height while selective ground foliar showed the greatest increase in capable species height. Total shrub cover increased following all treatments, with selective ground foliar and dormant basal showing the best results. Aerial treated sites showed the greatest increase in herbaceous plant cover, while summer basal showed the least.

Study Name: **ROW effects from herbicide residues.**

Results:

The primary parameters which characterize potential herbicide behavior in the terrestrial environment are the soil adsorption coefficient, aqueous solubility, vapor pressure, degradation rate in soil, and dissipation rate from leaf surfaces. The simulations/modeling approaches were determined to be suitable for predicting herbicide mobility and residues consistent with observed field studies reported in the literature.

Study Name: **Herbicide mobility study.**

Results:

Overland flow of herbicides in runoff did not occur under normal conditions, but two off ROW soil samples did contain detectable levels of herbicide. In both instances, the herbicide application was immediately followed by rainfall. The linear extent of overland flow was minimal, and when it occurred, the herbicide degraded rapidly. After the initial application, there was no indication that overland migration of herbicide off the site was occurring. Rather, the trend was towards degradation of herbicides to undetectable levels. Entry into streams from overland flow is highly unlikely when appropriate non-treatment buffer zones are established adjacent to water resources, as is entry into wells or groundwater through leaching. Leaching to a depth of 10-15 inches of herbicides on the sprayed sites was rare, occurring only at three locations. The leaching likely occurred under three types of circumstances: (1) rainfall immediately after application, (2) a large amount of rainfall within a day after application, and (3) the basal application of a high concentration of herbicides to a single spot on the site. Herbicide concentrations in seepage from the top 6 inches of soil followed similar trends in mobility and persistence in soil samples. Drift of herbicides off the treated right-of-way did not occur during the study, because non-volatile herbicides were used and were carefully applied using proper techniques.

During the study, the herbicide 2,4-D did not persist past four weeks; Picloram did not persist past ten weeks. Triclopyr applied by the foliar method in a water carrier did not persist past ten weeks. Triclopyr applied by the basal method in an oil carrier persisted up to 18 weeks. This unusual length of persistence likely resulted from the high initial herbicide concentrations in localized spots associated with the application method. Because the herbicides biodegrade rapidly, the possibility of movement of the material into adjacent water resources is greatly diminished, especially when proper buffer zones are established.

Study Name: **Right-of-way chemical treatments—site preparation.**

Results:

Site preparation using handcutting resulted in an average treatment time of about 4 hours per acre for all 30 units. The averages of manhours based on vegetation density were: 6.2 (high), 3.1 (medium), 1.8 (low) . For vegetation in the high density category, the average handcutting times based upon topography were 7.4 (steep), 6.5 (sloped), 5.8 (level). The average manhours per acre for all hand disposal units was 5.3. Averages of hand disposal manhours based upon vegetation density were 9.8 (high), 3.9 (medium) and 1.2 (low). The average hand disposal times on high density units based upon topography differences were 13.4 (steep), 9.5 (sloped) and 3.3 (level). The average machine disposal manhours was only 1.8 per acre but significant equipment costs were also incurred for this technique.

Project Name: **ROW vegetation dynamics.**

Results:

Summary of fifteen studies compiled from Institute of Ecosystem Studies (1993, p. 341-353):

ROW vegetation is often extremely diverse, and is an important component of overall landscape diversity, particularly in heavily forested landscapes. ROW vegetation is commonly "patchy", producing mosaics of small communities that differ in composition, structure and dynamics. On undisturbed ROWs, shrub cover is increasing, particularly for gray dogwood on moist sites. Gray dogwood appears capable of establishing and maintaining long-term dominance of a site if invading trees are systematically and selectively removed.

Tree invasion is directly proportional to the number of seeds dispersed into a site, and resistance by shrubs does not appear to be density dependent, though seed predation may be. Sapling emergence will vary significantly from year to year and site to site due to pulses in seed production; cohorts of seedlings will emerge 10-40 years after such a pulse. Most new tree invasion along ROWs in the Hudson Valley comes from large-seeded, wind-dispersed species (i.e., maples and ashes), and secondarily from large-seeded, animal dispersed species (i.e., oaks). Light-seeded, widely dispersed, "pioneer" tree species appear to be effectively inhibited by intact ROW vegetation. Dormant tree seeds buried in the soil are not an important source of seedlings for any of the common trees invading ROWs in the Hudson Valley. The adjacent forest community has a significant effect on the species and the rate of trees invading the ROW. On ROWs wider than 30 meters (100 ft.) that are bordered by forests, rates of tree invasion will be highest adjacent to the edges and drop off at distances greater than 15 meters from the forest edge.

Natural mortality reduces tree density throughout the process of invasion—from the time of arrival of seeds to sapling emergence. Tree invasion is not limited to disturbances within ROW vegetation. Tree seedlings exploit natural variability in resource availability within ROW vegetation. However, the heterogeneity *per se* does not appear to be an important determinant of overall rates of invasion (i.e., successful invasion on favorable microsites is offset by poor survival of tree seedlings in unfavorable microsites). Tree seedling density is not necessarily a good predictor of the number of seedlings that will survive to sapling size because the factors that determine seedling establishment often appear to be inversely related to the factors that determine subsequent survival. Rates of tree invasion are highly sensitive to small changes in growth and mortality of older seedlings (i.e., small differences among communities in annual rates of growth and survival of older seedlings have a significant effect on overall rates of invasion).

The net competitive effects of low-growing communities on tree seedling growth and survival are the result of the combination of (1) the effects of low growing communities on the availability of resources essential for seedling growth; and (2) the responses of tree seedlings to variation in resource availability. There are fundamental differences in the degree to which the specific resources (light, moisture and nutrients) required for tree seedling growth can be depleted by low-growing communities. Low-growing communities differ significantly in the amount of shade they cast. There was little evidence that the communities differ in the degree to which they deplete the availability of water. There is considerable variation among the low-growing communities in the supply of nitrogen (from the decomposition of organic matter in the soil). The effects of ROW vegetation on tree seedling growth and survival can be both positive ("facilitation") and negative ("inhibition"); the net effect will depend on the balance over the period from seedling establishment to sapling emergence, but will vary depending on the physiology and ecology of individual tree species (e.g., shade tolerant versus shade intolerant species).

The intensity of competition between ROW vegetation and tree seedlings varies directly with site quality. The net negative effect of ROW vegetation on seedling growth is greatest on productive soils. On physically stressful sites, seedlings grow slowly even in the absence of intact vegetation. As a result, competition and physical stress tend to balance one another, resulting in relatively low growth rates for newly established seedlings, regardless of community type or site quality. One implication of this result is that disturbance to the intact vegetation will be particularly detrimental on productive sites, where seedlings can rapidly exploit any openings. In contrast, poor quality sites may be less sensitive to short-term disturbance because physical stress severely limits early seedling growth and survival of most species even in temporary openings in ROW vegetation. Thus, the duration of competition (i.e. the number of years it takes for a seedling to overtop the ROW vegetation) is more important to tree invasion than the intensity in any given year (e.g., shrub cover can depress seedling growth longer than herbaceous communities). ROW vegetation inhibits tree seedling growth through competition both aboveground (for light) and belowground (for water or nutrients). Most low-growing communities on most sites inhibit tree seedling growth through simultaneous limitation of the availability of both light and soil resources. Aboveground competition will often be the predominant interaction on productive sites, while belowground competition is greatest on more stressful sites. This reinforces the conclusion that productive sites will be the most sensitive to disturbance to the canopy of ROW vegetation.

Seed predation, primarily by white-footed mice, is frequently an important source of mortality for seeds that are dispersed into rights-of-way. Short-term rates of seed predation are higher under shrubs than in herbaceous dominated communities, presumably reflecting the habitat preferences of white-footed mice. Seedling predation (outright mortality of seedlings due to consumption), primarily by meadow voles, is a potential major source of mortality for tree seedlings. Rates of seedling predation are greatest when meadow vole population densities are high; but significant predation occurs even at low vole population densities. Seedling predation by meadow voles may be restricted to herbaceous communities that provide suitable habitat. Therefore, the relative importance of seed predation versus seedling predation may vary significantly as a function of the amount of woody cover within a site. Mammalian browsing on tree seedlings, by both white-tailed deer and eastern cottontail rabbits, significantly reduces the rate of tree invasion in most ROW communities. Deer browsing within rights-of-way is highest in heavily forested landscapes. Browsing rates are highest on seedlings that are not overtopped by adjacent shrubs or herbaceous species. The effects of browsing on seedling growth and mortality depend strongly on the timing and intensity of browsing, and the levels of other stresses experienced by a seedling. Even heavy winter browsing of unshaded seedlings for 2 successive years has little effect on either growth or survival of tree seedlings. Whereas summer browsing has significant effects on seedling growth and survival.

Overall rates of tree invasion in any given community reflect the net results of a large number of processes (i.e. seed dispersal, seedling establishment, first-year seedling survival, etc.) Shrub communities had the highest resistance to tree invasion of the communities examined in our research, though long-term ability of the community to resist tree invasion was not evaluated during the relatively short life of this project. Herbaceous communities on poor soils (specifically, little bluestem meadows) also had high net resistance to tree invasion. The communities with the lowest resistance to invasion were herbaceous communities on productive soils. These herbaceous communities on good soils often represent very early stages of old field succession, and are undergoing rapid colonization by shrubs.

Study Name: **Tree growth retardants.**

Results:

Six TGRs were identified as the major compounds that have been used in utility situations, including maleic hydrazide (Slow Grow), dikegulac sodium (Atrinal), chlorflurenol (CF125 or Maintain A), paclobutrazol (Clipper), flurprimidol (Cutless), and uniconazole (Prunit). Dikegulac, maleic hydrazide, and chlorflurenol affect cell division and block apical dominance, restricting terminal growth. Paclobutrazol, flurprimidol, and uniconazole are anti-gibberellic in nature; they allow cell division and growth to occur but suppress cell wall and internodal elongation. The advantages and disadvantages and method of application and use of the various TGRs were considered. TGRs, like other vegetation management tools, do not meet all of the vegetation management needs, but can be integrated into a comprehensive vegetation management program.

Study Name: **ROW herbicide buffer zone efficacy.**

Results:

No buffer or 10 ft buffers were sufficient in protecting water quality where medium to low density vegetation was treated with herbicide. Larger buffer zones were needed where high density vegetation was treated; buffers of 25 ft or more achieve stream water quality criteria. Positive water samples contained concentrations of herbicide of 0.001 to 0.002 mg/l with the highest at .006 mg/l, levels not harmful to humans or aquatic life.

Study Name: **ROW natural growth inhibitors.**

Results:

The annotated bibliography highlighted literature pertinent to natural growth inhibitors, including a broad overview of the subject of allelopathy, microorganisms, and tree pathogens. The literature reported approximately 200 phytotoxins from over 100 microbial species, most being produced by fungi. A few of the phytotoxins described in the literature have already been developed as commercial herbicides (e.g., bialaphos and phosphinothricin—the synthetic version is the herbicide Glufosinate). The development of herbicides from microbially produced phytotoxins is a highly promising area for future discovery, which has not been adequately explored. Literature regarding phytotoxins isolated from pathogens of trees is very limited, and those that have been reported were toxic only to the host plant and show little promise as a herbicide/growth regulator for a broad range of trees. Articles pertaining to allelopathic effects of one plant on another were also reviewed. Very few investigations of allelopathy found in the scientific literature stood up to the scrutiny of proof required to "prove" allelopathic effects of one plant on another.

Study Name: **Volney-Marcy *Rubus* study.**

Results:

Rubus allegheniensis Porter (common blackberry) was the dominant *Rubus* species on a recently cleared ROW in Upstate New York. The presence of *Rubus* was not affected by first maintenance cycle treatments. In response to second maintenance cycle treatments, basal schemes generally had more *Rubus* than stem-foliar treatments. In terms of broad plant community stability on ROWs, the role of *Rubus* is unclear, as are the implications of any differences in *Rubus* cover among treatments with regard to multiple uses of ROWs.

Project Name: **Principles and practices of vegetation management on electric power transmission line rights-of-way.**

Results:

During initial ROW clearing the number of desirable plants was reduced with herbicide treatment, undesirable plants were generally the same between herbicide-treated and no herbicide treatment plots, and costs were higher for herbicide treatments as compared with no herbicide treatment. The most cost-effective method for initial clearing was clear or selective cutting with no herbicide treatment. During the first conversion cycle there was equal reduction of undesirable vegetation and maintenance of desirable vegetation. Therefore, cost-effectiveness was based on treatment costs alone. Basal treatment costs were nearly double that of stem-foliar with the nonselective mode being less costly than selective; therefore, the nonselective stem-foliar treatment was the most cost-effective scheme. For the second conversion cycle there were more desirable plants with the selective mode, there was a greater reduction in undesirable plants with stem-foliar schemes, and basal treatment costs were nearly double that of stem-foliar. Therefore, selective stem-foliar was the most cost-effective herbicide scheme.

Study Name: **A 15-year appraisal of plant dynamics on electric power rights-of-way in New York State.**

Results:

Results from the 15-year appraisal indicated that on corridors where trees were periodically, selectively removed using herbicides, tree populations were observed at constant low density. There was a spatial redistribution of trees in 1991 compared to 1975, with fewer trees in the corridor centerline and more in the border areas along corridor edges in 1991. An increase in tree density was observed on corridors that did not receive herbicide treatments to control trees, but had only aboveground portions of trees selectively removed using periodic hand cutting. Species composition generally did not change over the study period. *Acer, Betula, Fraxinus, Populus, Prunus,* and *Quercus* species were commonly present on all sites during 1975 and 1991. Red maple *(Acer rubrum* L.) and white ash *(Fraxinus americana* L.) were ubiquitous. Operational, selective removal of trees on powerline corridors with herbicides, whereby both the above- and below ground portions of the plants are periodically killed and site disturbance minimized, can lead to the creation of relatively stable, compositionally constant, low density tree populations.

Study Name: **Cost effectiveness of herbicide and non-herbicide alternatives for vegetation management on powerline corridors in the northeastern United States: A review.**

Results:

The maintenance of vegetation on electric utility rights-of-way is a dynamic process affected by site conditions, public interest, environmental concerns, and costs. Existing information is insufficient to identify one method or group of methods as optimal in all circumstances. Long-term, cost-effective management of ROW vegetation is dependent upon both herbicide and non-herbicide methods. A prescription-based approach, where different methods are selected for different circumstances, is the most rational strategy. To effectively manage this type of program, it is essential that utilities have well-trained professionals and data to make operational prescriptions in the field.

Study Name: **Utility right-of-way vegetation management in Karner blue butterfly habitat areas.**

Results:

Increased relative light level was the primary variable associated with increased blue lupine abundance. Percent cover of blue lupine was correlated positively with both the recent and longer-term use of herbicides. Blue lupine clump density was most dependent on relative light intensity, and was negatively associated with the number of years since the last management activity and the recent use of herbicides.

Project Title: **Volney-Marcy electric transmission line vegetation management project: Third cycle treatments**

Results:

See individual study descriptions.

References:

See individual study descriptions.

Study Name: **Long-term effectiveness of various herbicide and non-herbicide treatment schemes during the second conversion cycle.**

Results:

Over an 11-year period, stem densities were maintained at low levels using selective chemical treatments in an IVM program on the Volney-Marcy powerline ROW in Upstate New York. Larger trees on the ROW were dominated by gray birch, whereas red maple was the dominant species for smaller seedlings, suggesting that a species shift in undesirable species may be occurring on the Volney-Marcy ROW. Mechanical treatments resulted in higher undesirable densities than chemical treatments. Desirable stem densities have increased or remained constant over time with an IVM approach.

Study Name: **Effectiveness of various selective herbicide treatment schemes to reclaim a ROW.**

Results:

Pending.

Study Name: **Vascular plant species diversity before and after first maintenance cycle vegetation management.**

Results:

Pending.

Study Name: **Competitive hierarchies of desirable plant communities.**

Results:

Pending.

Study Name: **Herbicide deposition patterns for commonly used treatment schemes.**

Results:

Pending.

Study Name: **Site-specific and landscape-level effects of ROW vegetation management on songbird communities.**

Results:

There was a difference in shrub density on the two powerlines; the older Fitzpatrick-Edic line, with a history of mechanical treatments, had a higher shrub density than the younger Volney-Marcy powerline. There were two times more bird territories and nests in high shrub density areas. Songbirds respond directly to shrub habitat on ROWs; as shrub density increases, shrub nesting birds increase. Once established, the permanence of the plant community produced with selective herbicides may be better for short-lived bird species than the regular destruction of the plant community required in mechanical treatments.

Study Name: **A study of the invasion and growth patterns of *Betula populifolia* Marsh. (gray birch) on a powerline ROW in New York State.**

Results:

Gray birch tree heights ranged to over 11 m and tree ages from 4 to 13 years. Most of the trees were established within 3 years after treatment. Young powerline corridors that have mesic to hydric moisture regimes are well-suited to birch invasion, particularly with management-related disturbance. Minimizing site disturbance and promoting the development of a tall shrub community should reduce birch presence on older powerlines.

Study Name: **Effectiveness of various herbicide treatment schemes on ROWs that were operationally treated during the last treatment cycle.**

Results:

Pending

Study Name: **Herbicide deposition patterns for commonly used treatment schemes: Impacts on community structure and composition in the near- and long-term.**

Results:

Pending

Study Name: **Expanding the treatment window for cut stump herbicide treatments.**

Results:

Pending

Study Name: **Effectiveness of mowing to reclaim a previously mowed ROW.**

Results:

Pending

Study Name: **Demonstration of ROW Vegetation Management Tools on a ROW near Albany, New York.**

Results:

Vegetation management treatments were demonstrated at the site for the *Environmental stewardship of utility rights-of-way conference* held in Albany, NY in June 12-13, 2001. The event was hosted by Niagara Mohawk Power Corporation, Energy Alliance of New York, and the State University of New York College of Environmental Science and Forestry (SUNY-ESF). The workshop participants included professionals from the utility industry, regulatory agencies, environmental analysts, and universities. Presentations were made by the utilities: NMPC, New York Power Authority, and New York State Electric and Gas. The agency perspective was presented by the New York State Department of Environmental Conservation and the Public Service Commission. SUNY-ESF presented a review of current research and a new framework in which to think about Integrated Vegetation Management.

Project Title: **Shrub community dynamics on a powerline corridor in upstate New York.**

Results:

See individual study descriptions.

Study Name: **Select shrub life histories: An annotated bibliography.**

Results:

Synopsis pending.

Study Name: **Factors influencing the distribution and abundance of shrubs on ROWs in New York State: An observational study.**

Results:

Pending.

Study Name: **Assessment of cultural treatments to increase and maintain the presence of desirable shrub communities: A manipulative field experiment.**

Results:

Pending.

Study Name: **Vegetation dynamics on operationally treated powerline corridors across New York state: 25-year re-assessment of Niagara Mohawk lines.**

Results:

Pending.

Project Name: **Partnerships for powerline vegetation management in New York.**

Results:

Pending.

nationalgrid

APPENDIX 4

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EDISON ELECTRIC INSTITUTE

ENVIRONMENTAL STEWARDSHIP STRATEGY FOR ELECTRIC UTILITY RIGHTS-OF-WAY

FORWARD

This strategy was approved by the Edision Electric Institute's Vegetation Management Task Force (VMTF) on August 12, 1996. The VMTF prepared this strategy in accordance with its commitment to the *Pesticide Environmental Stewardship Program* (*PESP*). *PESP* is a voluntary partnership between pesticide users and three Federal agencies: the Environmental Protection Agency, the Department of Agriculture and the Food and Drug Administration. The goal of *PESP* is to reduce pesticide risk and to promote Integrated Pest Management programs.

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VEGETATION MANAGEMENT ON RIGHTS-OF-WAY

Electric utilities are charged by state and federal regulatory agencies with the responsibility for providing safe, reliable electric service to their customers. Customers may include homeowners, businesses, municipalities and other utilities. Electricity is a product which is needed on demand and cannot be stored in large quantities. Because it is essential for domestic use, economic growth and providing vital services, the pathways for the flow of electricity must be kept open at all times.

Trees and other vegetation can cause interruptions of service by growing into, or falling through power lines. These interruptions are a major concern of electric utilities because service is not being provided to customers when needed. A loss of service is not only costly and inconvenient to customers - it can also be life-threatening to people on life support systems. For many utilities, tree related outages rank among the leading causes of interruptions of electric service during both normal operating conditions and during major storm events.

Properly maintained rights-of-way are essential to provide safety for customers and workers, minimize tree-related outages, provide access for inspection and maintenance of facilities and for timely restoration of service during emergency conditions.

The goal of right-of-way vegetation management programs is to provide safe transmission and distribution service and to minimize interruptions caused by trees and other vegetation while maintaining a harmonious relationship with varied land uses and the environment.

Most electric utilities employ a combination of control methods for right-of-way vegetation management in a process known as "Integrated Pest [1] Management" (IPM). Integrated pest management is a system of controlling pests (weeds, diseases, insects or others) in which pests are identified, action thresholds are considered, all possible control options are evaluated and selected control(s) are implemented. Control options - which include biological, chemical, cultural, manual and mechanical methods - are used to prevent or remedy unacceptable pest activity or damage. Choice of control option(s) is based on effectiveness, environmental impact, site characteristics, worker/public health and safety and economics. The goal of an IPM system is to manage pests and the environment to balance benefits of control, costs, public health and environmental quality.

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[1] In vegetation management, "pest" refers to trees and other vegetation which are capable of endangering the safety of the public and workers and the reliability of service of the lines.

As part of their IPM Program, nearly all utilities utilize some mechanical vegetation control. However, cutting or mowing vegetation perpetuates the growth of incompatible (tall growth) vegetation because of the biological response of sprouting. When a single stem is cut, multiple sprouts can grow from the severed stump or the root system (so-called "root suckering"). These sprouts are fast-growing because they are fed from the root system which is already well established. A repetitive cycle of cutting and sprouting results in an increasing density of tall growth species.

It is a common public belief that mechanical/manual methods (power saws and mowing) are safer and have less environmental impact than herbicide methods. Often overlooked are environmental and safety concerns associated with repeated cutting of vegetation such as: soil compaction from heavy equipment, damaging sensitive wetland areas, worker and environmental exposure to petroleum products (which are more toxic than many herbicides used for R/W maintenance), the potential for physical injury from sharp tools and equipment and the repeated, significant alteration of potential wildlife habitat.

In many instances, herbicides are preferred because they control the entire plant and greatly inhibit re-sprouting, thereby reducing the need for repetitive cutting. Even though most herbicides used for vegetation control have low human and animal toxicity, some utilities minimize herbicide use because they fear adverse public reaction from the use of synthetic herbicides. Improved environmental safety of available products and technology and the potential for increased competition in the utility industry may result in increased herbicide usage.

The long-term goal of a vegetation management program is to provide for public and worker safety and to provide reliability of service by converting right-of-way plant communities from predominately tall growing plant species to communities dominated by low growth plant species. This can be accomplished by selectively controlling tall growing plant species, while preserving low growing grasses, herbs and woody shrubs over a period of many years. With proper management, the low growing vegetation can eventually dominate the right-of-way and retard the growth of the tall growing vegetation, providing control of incompatible vegetation and reducing the need for future treatments.

PESTICIDE USE AND RISK REDUCTION

Most industrial herbicides used for vegetation control in rights-of-way are very low in toxicity; in fact, much lower than the petroleum products necessary to power the equipment used for cutting brush. Therefore, the use/risk reduction strategy for electric utilities is aimed at minimizing the amount of active ingredient of a particular product (or products) **per acre** rather than reducing the **total** volume of products used. Lower use per acre is both environmentally responsible and economical: by utilizing only the amount necessary to control vegetation, risks are minimized and material costs are reduced.

Most initial right-of-way vegetation applications are made using non-selective techniques. Non-selective applications are also utilized for maintenance where brush heights and/or densities are high. Mechanized applicators are frequently used for these applications.

In subsequent applications or in applications where brush heights and densities are low to moderate, low volume foliage or basal applications are generally utilized. Carriers for low volume applications are normally water for foliage treatments while synthetic or natural penetrants are used for basal treatments. These applications are referred to as "low volume" because of the lower quantities of water or penetrants used to dilute and carry the chemicals to the plant. Low volume techniques employ garden-type hand-pump or motorized applicators to apply the herbicide mixture at very low rates and pressures.

The key to reducing the amount of herbicide applied per acre is the use of selective applications; i.e., treating only those plants that are capable of growing tall enough to threaten power lines and to leave low growth plants (shrubs, herbs, grasses) untreated. This can be accomplished with any ground application method, but the selective nature of the treatment remains the same. As a result, active ingredients of herbicide applied per acre are minimized and risks are reduced.

Selective applications can also result in reduced herbicide usage as a result of species composition changes from incompatible plant species to compatible plant species. Future herbicide treatments to the same areas will require lesser amounts of herbicides due to the selective nature of the application combined with fewer target stems.

The use of non-active adjuvants can also contribute to reduced volume and, therefore, risk. Adjuvants can improve efficacy and adherence to the target plants resulting in less material being required for control, less runoff from the plant leaf surface and reduced potential for volatilization.

During applications the potential for exposure is only to the diluted herbicide mixture and that exposure is brief since workers apply the solution and then leave the area. After the herbicide is absorbed by the plant, direct exposure is virtually negligible. Any herbicide not absorbed by the plant is rapidly biodegraded by micro-organisms or light. Considering the low toxicity, rapid uptake and rapid biodegradation of most modern herbicides, re-entry times are not significant for these types of application.

CURRENT RESEARCH

The electric utility industry cooperates with manufacturers, applicators, regulators and educational institutions to field test and develop safe and effective herbicide products and application equipment. Research into improved technology is an on-going process. Included in this research are efforts to reduce worker exposure to herbicide concentrates during mixing and to reduce environmental risks associated with the disposal of containers.

Biological controls are being researched to strengthen this phase of Integrated Pest Management methods. For example, researchers have identified vegetative cover that impedes the invasion of incompatible tree species through allelopathy. Such research could lead to the development of biopesticides for use in R/W maintenance programs.

Also being studied are the application techniques and materials that are most effective in producing compatible cover types that are capable of competing for growing space in rights-of-way. Promoting similar cover types on the rights-of-way through selective herbicide applications can reduce the need for maintenance, thus reducing risk and use in the long term.

The electric utility industry will continue to support research that is based on scientifically sound risk reduction principles which benefits the environment, their customers and their employees.

BARRIERS TO ADOPTION

There are both internal and external barriers to the adoption of a use and risk reduction strategy. For example, internally, few educational pesticide stewardship programs that are specifically geared to R/W maintenance have been developed. External barriers exist because much of the public is unfamiliar with herbicides and, therefore, may not understand their use. They may be unaware of the rigorous toxicological and environmental testing that is required by the U. S. Environmental Protection Agency (USEPA) prior to registration of herbicide products. In addition, many people are unaware of the safety and environmental risks involved in other right-of-way maintenance activities; therefore, it is difficult for them to make a knowledgeable comparison of the various options available. This lack of understanding creates a knowledge barrier for the public.

STEPS TO AID IN ADOPTION OF STRATEGY

As a result of the internal and external barriers, some utilities may be reluctant to adopt new technology or follow industry standards. One effective method to induce utilities to adopt these technologies would be to produce a training video promoting pesticide stewardship that has received the endorsement of both the electric utility industry and the USEPA. The video could be shown at regional association meetings. On a national basis, the Edison Electric Institute has the potential to reach much of the electric utility industry through meetings and seminars.

As part of a policy statement regarding IPM Programs, the USEPA and state regulatory agencies should support risk reduction through the use of improved materials and technologies which are based on scientifically verified information. The utilities who utilize these materials and technologies could then be recognized by regulatory agencies for their efforts. This would encourage other utilities and would reassure the public about electric utilities' vegetation management programs.

An outreach program should be produced to educate the general public regarding utility safety and reliability concerns. The program should also address the IPM approach to R/W maintenance and the Best Management Practices that are a part of this strategy.

RIGHT-OF-WAY VEGETATION MANAGEMENT STRATEGY

The purpose of this strategy is to provide principles for current and future vegetation managers that will minimize overall risk to people and the environment while providing safe and reliable electric service. The strategy is designed to protect wildlife, groundwater, surface water, soils, utility customers, utility workers and the general public. The objectives of this strategy are:

* That program prescriptions will be selected which balance environmental concerns, public needs, safety and cost effectiveness.

* That utilities will use Integrated Pest Management methods that are supported through scientific research as minimizing risk and increasing effectiveness for use in right-of-way vegetation management programs.

* That utilities will adopt Best Management Practices (BMPs) for herbicide applications. These practices will be based on the latest scientific research among utilities, manufacturers, applicators, regulators and universities.

* That utilities will set as a long term goal of vegetation management programs the reduction of the level of active ingredient per unit of land area. This is to be accomplished through the proper selection and use of application methods, equipment and technology which will promote and facilitate minimal application rates. Use records for each utility can be used to track application rates.

* That utilities will support research and development initiatives for reduced risk pesticides and for improved herbicide handling (storage, transport, mixing and application) that leads to improved worker protection. The utilities will, where available, adopt those developments that are proven to reduce risk and are cost effective.

* That utilities will encourage the accelerated approval of any risk reduction recommendations to be included on the labels of herbicides used for vegetation control. Utilities will encourage the streamlining of the regulatory process in order to minimize the manufacturer's costs of relabeling.

BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) are included in this strategy to assist in the planning and implementation of ground application programs. They are intended to supplement and not replace the herbicide labels. The practices should be used when the Integrated Pest Management control option indicates that herbicide applications are appropriate. The BMPs will ensure that practical measures are being taken to reduce pesticide use and risk in order to meet the objectives of the pesticide stewardship strategy.

1. The following factors should be considered in the planning of any herbicide application:
   - Target species
   - Height and density of vegetation
   - Land use: within and adjacent to the right-of-way
   - Label restrictions
   - Natural and man-made restrictions

2. Follow herbicide label directions and any other supplemental label information provided by the manufacturer. Material Safety and Data Sheets should also be reviewed.

3. Only herbicides registered by the U. S. Environmental Protection Agency and the designated responsible state agency shall be used.

4. All herbicide applications shall be performed by applicators who are qualified in accordance with the laws and regulations of appropriate regulatory agencies.

5. Selective application techniques should be used wherever practical so that compatible vegetation is not treated.

6. Where practical, herbicides should be measured and mixed with diluent prior to transfer to application site.

7. Herbicide containers must be reused, recycled or otherwise disposed of in a proper manner.

8. Where practical, transfer of herbicide mixtures should be made directly from shipping containers to holding tank and/or application equipment through closed transfer systems, where possible.

9. Appropriate techniques should be used to avoid significant off-target drift.

10. These special precautions should be observed during periods of inclement weather:

- Applications should not be made in, immediately prior to, or immediately following rain when runoff could be expected.

- Applications should not be made when wind and/or fog conditions have the potential to cause drift.

- Basal bark applications should not be made when stems are wet with rain, snow or ice.

11. When making applications near water, crops, and/or other restrictions, application personnel should put their backs to the restricted area with the treatment being directed away from the restricted area.

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APPENDIX 5

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National Grid USA
Transmission Rights-Of-Way (ROW)
NEW YORK INVENTORY REPORT

ROW #: 011008 NAME : Oswego - Lafayette

STATE : NY ROW WIDTH : 330.00 COMPANY : NIMO DIVISION : TLS

ACRES : 2,279.95 ARTICLE 7 : N REGION : NYCE CONTRACTOR :

KV : 345 LINE NUMBER : 17 LINE MILES : 48.50

MANAGEMENT DIVISION : CE

FORESTER : KLK ROW # : 011008

SITE # / TAP #	SPECIAL CONSIDERATIONS	FROM	TO	ACRES	LAND USE	TREATMENT TYPE	COMM	SKIDDER	SENSITIVE	ACCESS RD WORK	URGENT	CHEMICAL DATE	CHEMICAL HERB CD	CHEMICAL GALS
1.00	COM/OSW-VOL/125 FT ROW	SUB	47.00	90.20	8000	Other- no treatment	Yes	No	No	No Work Required	No			
2.00	115KV LINES INC. ST TALL APPLE/LSF SMSTM	47.00	47.75	3.61	9322	Cut and stump treat	No	No	No	No Work Required	No			
4.00	Axed midspan	47.25	49.00	7.21	7221	Cut and stump treat	No	No	No	No Work Required	No			
5.00	ACCESS FOR EQUIP DIFF	49.00	50.00	5.30	9222	Backpack low volume foliar	No	No	No	No Work Required	No			
6.00	ST LOGRO 2MIDSPAN/LSF SMSTEMS	50.00	51.00	5.35	2323	Cut and stump treat	No	No	No	No Work Required	No			
7.00		51.00	53.25	13.42	8222	Cut and stump treat	No	No	No	No Work Required	No			
8.00	CUNNINGHAM ROAD TRIM&CHIP PINES&BCH YARD/axed in 08	53.25	54.00	3.16	3321	Cut and stump treat	No	No	Yes	No Work Required	No			
9.00	SEPTIC OUTLET	54.00	54.25	1.55	8332	Cut and stump treat	No	No	No	No Work Required	No			
10.00	CUT ON EDGE NEAR HOMES	54.25	55.75	9.49	8221	Backpack low volume foliar	No	No	No	No Work Required	No			
11.00	SM.STREAM WIDEN ONE SIDE/CUT NEAR HOMES	55.75	56.75	5.40	1323	Cut and stump treat	No	No	No	No Work Required	No			
12.00	NO CHEM BY WELL @ 56.75 DEL 520-GAR 4E/345 axed at 56-58	56.75	57.75	5.09	8322	Cut and stump treat	No	No	No	No Work Required	No			
13.00		57.75	58.25	2.73	5000	Open field	No	No	No	No Work Required	No			

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APPENDIX 6

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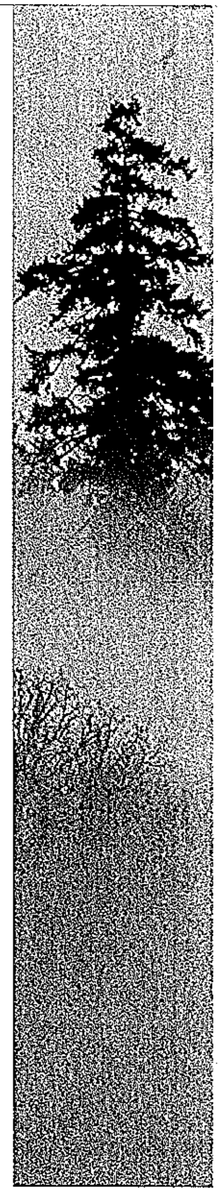

Important Information for Homeowners along Transmission Rights-of-Way

Our Vegetation Management Department will soon carry out selective side trimming and/or "danger tree" removal along the electric transmission right-of-way on or adjacent to your property. Our goal is to ensure safe and reliable delivery of electricity. The work will be completed by licensed and experienced contract tree crews.

Side trimming procedures consist of tree crown reduction and/or selective trimming of branches from trees growing along the right-of-way corridor posing an immediate or potential threat to the lines. In such cases, trimming is performed by removing treetops and upper limbs to produce a "rolled back" effect, directing tree growth away from the line.

Danger trees are defined as trees that due to their species, location and physical condition pose a significant risk of contacting the lines. When danger tree removal occurs, a tree (or trees) growing within or beyond the width of the right-of-way are completely removed. While we aim to selectively trim rather than remove trees, removal may be necessary when a danger tree poses a direct threat.

As the work is carried out, crews attempt to reduce visual impacts as much as possible. Cut tree branches are diced close to the ground and left to decompose. Stumps are left as low as possible. Logs are cut and piled along the right-of-way edge following danger tree removal. As a result, aesthetic quality is maintained to the greatest extent possible.

In instances where trees off the right-of-way corridor need to be removed, our contractors will contact the property owner prior to carrying out the work.

The contractor doing the work in your area is:

____

The contractor's representative is:

____

and may be contacted at:

____

The electric company identification for the right-of-way is:

____

☐ If this box is checked, our contractor has determined that we need to discuss side trimming and or danger tree removal on your property. Please contact the person listed above.

EP2313 1/06

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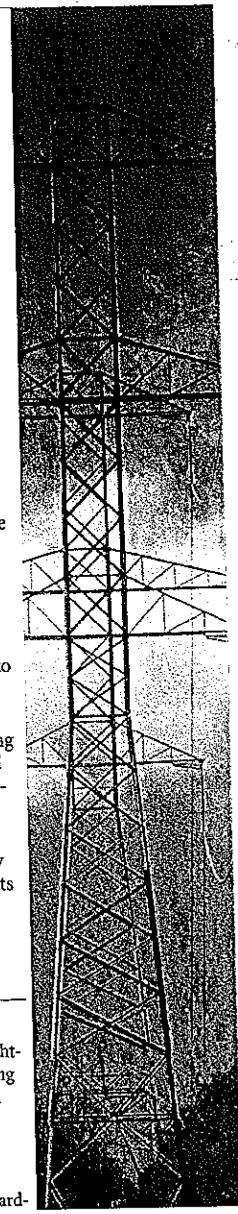
Important Information for Homeowners along Transmission Rights-of-Way



Our Vegetation Management Department will soon carry out routine maintenance on the electricity transmission right-of-way on or adjacent to your property. A variety of **Integrated Vegetation Management** (IVM) methods will be used, including hand cutting, mowing, and selective herbicide application, and will be implemented by our licensed and experienced contractors.

IVM is essential to provide safe and reliable delivery of electricity. It prevents tall-growing vegetation from growing into the overhead lines. In addition, we manage vegetation to allow access to the lines for routine maintenance and for restoration of electric service following major storms.

By implementing IVM methods, we create stable, low-growing plant communities that require minimal maintenance and disruption of the environment. These plant communities provide a healthy wildlife habitat, especially for those animals requiring open fields, meadows, and shrubs.

Use of herbicides within our IVM approach is regulated by federal and state statutes and regulations. These requirements protect sensitive areas such as:

- surface water supplies
- public and private wells
- wetlands
- visually sensitive sites near roads and residences

The work takes place in up to four phases:

- Crews hand cut tall hardwood and conifer trees within the right-of-way, and identify and mark appropriate buffers surrounding public water supplies, private wells, streams, ponds, lakes, and residences.
- Crews treat the stumps of cut hardwood trees with herbicide to prevent re-sprouting.
- Selective foliar (leaf) application of herbicides, primarily to hardwood trees, takes place in summer.
- Follow-up work at roads and yards is carried out in autumn.

If you have a private water supply well that is within 100 feet of the right-of-way, please call the contractor designated below.

The contractor doing the work in your area is:

____

The contractor's representative is:

____

and may be contacted at:

____

The electric company identification for the right-of-way is:

____

We at National Grid believe our IVM approach to right-of-way vegetation management is the most environmentally friendly and customer-friendly way to accomplish this necessary task. We would be happy to answer any questions you may have as the work is carried out.

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APPENDIX 7

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March 27,2009

Hon. Jaclyn A. Brilling
NYS Department of Public Service
3 Empire State Plaza
Agency Building three
Albany, NY 12223-1350

Dear Jaclyn:

Attached please find the following submittals relating to our transmission right-of-way management program:

1. 2008 New York Transmission Right-of-way System Herbicide Use Report.
2. 2008 New York – Herbicide Code Sheet.
3. 2008 New York Transmission Right-of-way Management – Cost of Integrated Vegetation Management Treatments.
4. 2008 New York Transmission Right-of-Way Management – Integrated Vegetation Management Completions.
5. 2008 New York Transmission and Sub-Transmission Off Right-of-Way Tree Work Completions.
6. 2008 New York Transmission Right-of-Way Management – Acres by Technique for Work Performed in The Adirondack Park.
7. New York Transmission Right-of-Way 2009 Integrated Vegetation Management Schedules.
8. 2008 Progress Report on Vegetative buffer Assessment
9. 2008 Progress Report on Plan For Identifying Deficiencies in Vegetation Maintenance Rights on Existing Transmission Rights-of-Way.
10. The 2008 Transmission Tree Caused Outage Summary

We are currently sending our annual transmission right-of-way vegetation management program notifications to the NYS Department of Environmental Conservation (DEC) and NYS Department of Health - County Offices. In addition, we continue to provide notification to the DEC for compliance with our multi-year wetland permit.

Sincerely,

Kenneth Kirkman
Senior Transmission Forester
Attachments
Cc: W. J. Balestra, D. Travalini, D. Morrell (DPS Staff)

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2008 New York System Right-of-Way Herbicide Use Report

Technique	Code - Chemical	Mixture Gallons	Concent. Gallons	Acres	Con.Gals Acre
Cut / Stumptreat	A - Pathway RTU	533	533.0	1926.3	0.28
	B - AccordC/Arsenal (40%/ 3%)	1	0.4	2.4	0.18
	C - AccordC (40%)	248	99.2	781.2	0.13
	E - Garlon/Stalker (20% / 1%)	29	6.1	104.3	0.06
	Total	811	639	2,814.2	**0.23**
Hydraulic High Volume	F - Tordonk/Garlon4 (.25%/.5%)	7110	53.3	135	**0.40**
Hydraulic Low Volume	G - TordonK/Garlon4 (.5%T/.75%G)	3,280	41.0	95	**0.43**
	N - AccordC/Arsenal (1.125%/.125%)	29,895	373.7	713	0.52
	P - Krenite/Arsenal/Escort (2%/.25%)	14,027	315.6	1283	0.25
	H - AccordC (2%)	3,700	74.0	109.7	0.67
		47,202	804	2,201	**0.37**
Backpack Low-Volume Foliar	L - AccordC/Arsenal (3.75%/.125%)	4573	177.2	1223.1	0.14
	W - Krenite/Arsenal/Escort (5%/.25%)	3972	208.5	635.6	0.33
	X - Accord C (5%)	424	21.2	103.8	0.20
		8,545	407	1,963	**0.21**

Total Concentrate		Gallons
AccordC		702
Arsenal		89
Tordon K		34
Garlon 4		66
Pathway		533
Krenite		478
Stalker		1
Escort: lbs	27	
	Total Gallons	**1903**

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New York - HERBICIDE CODES – YEAR 2008

Code	Trade Name	EPA #	Percent Active	Mixture	Treatment
A#	Pathway	62719-31	5.4% Picloram 20.9% 2,4-D	Premixed, Ready-to-use	Stump
B	Accord C	524-343	53.8% Glypho.	50% Accord C / 50% Water	Stump
D	Pathfinder II	62719-176	13.6% Triclopyr	Premixed, Ready-to-use	Basal
E#	Garlon 4/Stalker	62719-40 241-398	61.6% Triclopyr 27.6% Imazapyr	20% / 3% in Hi-Grade Oil	Basal
F#	Tordon K/Garlon 4 Hydraulic High Volume	62719-17 62179-40	24.4% Picloram 61.6% Triclopyr	1 qts / 2 qts. in 100 gals. Water (0.25% Tordon K / 0.50% Garlon4)	Selective Foliar (SF)
G#	Tordon K/Garlon 4 Hydraulic Low Volume (Modified High Volume)	62719-17 62719-40	24.4% Picloram 61.6% Triclopyr	1 qts./ 3 qts. in 100 gals. Water (0.5% Tordon K / 0.75% Garlon 4)	Selective Foliar (SF)
N	Accord C /Arsenal Hydraulic Low Volume	524-343 241-346	53.8% Glypho. 28.7% Imazapyr	4.5 qts / 1 pt. in 100 gals Water (1.125% AccordC / 0.125% Arsenal)	Selective Foliar (SF)
P	Krenite/Escort Hydraulic Low Volume	352-395 352-439	41.5% Fosamine 60.0% Metsulfuron	5 gals./ 2 oz. in 100 gals. Water (5% Krenite / Escort)	Selective Foliar (SF)
T	Accord C Hydraulic Low Volume	524-343	53.8% Glypho.	2 gals. / 2 oz.. in 100 gals. Water (2% Accord C)	Selective Foliar (SF)
L#	Accord C/Arsenal Backpack Low Volume	524-343 241-346	53.8% Glypho. 28.7% Imazapyr	3.75 gals / 1 pt in 100 gals Water (3.75% AccordC / 0.125% Arsenal)	Selective Foliar (LSF)
R	Krenite/Arsenal Backpack Low Volume	352-395 241-346	41.5% Fosamine 28.7% Imazapyr	5 gals./ 1 qts. in 100 gals. Water (5% Krenite / 0.25% Arsenal)	Selective Foliar (LSF)
W	Krenite/Escort Backpack Low Volume	352-395 352-439	41.5% Fosamine 60.0% Metsulfuron	5 gals / 4 oz. in 100 gals. Water (5% Krenite /Escort)	Selective Foliar (LSF)
X	Accord C Backpack Low Volume	524-343	53.8% Glypho.	5 gals. in 100 gals. Water (5% AccordC)	Selective Foliar (LSF)
Z	Test Plots				

NOTES:

Primary herbicide mix

2007 Soil Sterilant

1 oz Telar /3 ozs. Oust (Landmark II MP) per 100 gals Water per acre
3 pts. Arsenal /4 ozs. Oust per 100 gals. Water per acre
2.5 lbs. Predict / 3 ozs. Oust per 100 gals. Water per acre #
Note: add Round-up or Glypro – 1 gal Per 100 gals. Water per acre where green vegetation is present

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New York Transmission Right-of-Way
2008 Cost of Integrated Vegetation Management Treatments

Work type	Expenditure	Acres	Dollars/Acre
Selective Herbicide Treatments	$2,151,972	7367.9	$292
Mechanical Prune	$638,336	397.3	$1607
Mechanical Mow	$48,130	131.8	$365
Grass Mow	$106,481	626	$170
Mid span Mow	$546,998	-	
Access/Gates	$23,533	-	
Off Cycle	$295,941	-	

The Off cycle costs represent 4% of total year end IVM, mechanical, mowing and danger tree expenditures. Grass mowing cost per acre includes two cuts per year.

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CAPITAL REGION 2008 IVM SCHEDULE

NAME	ROW #	ACRES SCH	COMP
Edic-New Scotland	012002	870.99	1015.1
Porter-Rotterdam	012012	182.91	231.5
Churchtown-Pleasant Valley	012020	366.90	396.5
Maplewood-Menands	012034	55.07	56.2
Cresent-School Street	012262	8.48	9.1
Delaware-Bethlehem	012264	23.42	29.4
Greenbush-Hudson	012268	172.99	178.1
Rensselear-Greenbush	012300	12.67	16.8
Vischer-Woodlawn	012318	21.21	27.7
Woodlawn-Karner	012320	23.96	19.4
Total IVM Unit Acres		**1,738.60**	**1,979.80**

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NORTHEAST REGION 2008 IVM SCHEDULE

NAME	ROW #	ACRES SCH	ACRES COMP
Edic-New Scotland	012500	759.40	817.9
Porter-Rotterdam	012502	397.92	519.5
Canajoharie-Marshville	012506	3.29	2.8
Inghams-St. Johnsville	012510	42.16	35.7
Charlston-Balston	012708	6.96	35.4
Chestertown-Schroon Lake	012710	121.90	123.4
Ft Gage-Warrensburg;Bolton Tap	012712	47.87	104.7
Henry Street-GlensFalls	012720	5.06	2.4
Queensbury-Ft Gage	012738	46.44	44.1
Total IVM Unit Acres		**1,431.00**	**1,685.90**

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MOHAWK VALLEY REGION 2008 IVM SCHEDULE

NAME	ROWNUM	ACRES SCH	ACRES COMP
Boonville-Porter	011310	194.65	210.6
Porter-Terminal	011328	20.97	37.9
Terminal-Schuyler	011336	39.86	36
Dolgeville-Schuyler	011408	11.96	6.8
New Hartford-Schuyler	011410	58.90	58.9
Old Forge-Raquette Lake	011412	101.07	101.4
Pleasant-Schuyler	011414	6.41	4.8
Schuyler-Valley	011416	84.04	90
Trenton-Deerfield	011418	47.73	37.3
Trenton-Prospect	011422	14.48	10
Whitesboro-New Hartford	011428	10.65	10.1
Yahnandasis-New Hartford	011432	14.57	5.3
Yahnandasis-Pleasant	011434	11.02	9.5
Total IVM Unit Acres		**616.31**	**618.6**

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CENTRAL REGION 2008 IVM SCHEDULE

NAME	ROWNUM	ACRES SCH	ACRES COMP
Oswego - Varrick	011148	0.80	0.75
Teall #25 Loop	011154	9.40	9.4
Teall #26 Loop	011156	17.90	17.9
Woodard - Ash	011170	9.30	9.3
Clay - Teall #11	011018	138.40	141.5
Oneida - Cortland	011038	179.90	193.79
Miller & Owens IllinoisTap	011040		
Sealright Tap	011040		
Nestle Tap	011040		
Oswego - Clay	011040	195.80	215.96
Headson - Minoa	011126	27.00	27
Total IVM Unit Acres		**578.50**	**615.6**

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NORTHERN REGION 2008 IVM SCHEDULE

		ACRES	
NAME	ROWNUM	SCH	COMP
Adirondack - Porter	011500	860.9	841.5
MEP Alcoa Tap	011546	18.2	18.6
Raymondville - Norfolk	011550	15.5	17.3
Norfolk - Norwood	011742	28.8	30.9
E Norfolk Tap	011742		
Spencers Crns - Malone	011670	45.3	45.8
Frankiln St Tap	011670	0	0
Ft Covington - Spencers Crns	011662	29.6	34.2
Nicholville - Brasher	011666	65.4	69.2
Taylorville - Belfort	011764	0	
Total IVM Unit Acres		**1,063.70**	**1057.5**

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GENESEE REGION 2008 IVM SCHEDULE

		ACRES	
NAME	ROWNUM	SCH	COMP
Batavia-Golah	10202	250.80	287
Total IVM Unit Bid Acres		**250.80**	**287**

FRONTIER REG. 2008 IVM SCHEDULE

		ACRES	
NAME	ROWNUM	SCH	COMP
Tonawanda lines	10174	6.54	8.9
Gardenville-Dunkirk	10004	251.00	267.7
Packard-Huntley	10040	82.80	96.1
Packard-Union Carbide	10042	23.90	21.7
Total IVM Unit Bid Acres		**364.24**	**394.4**

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SOUTHWEST REGION 2008 IVM SCHEDULE

		ACRES	
NAME	ROWNUM	SCH	COMP
Ashville-S.Dow	10500	44.70	**56.6**
Dake Hill-Machias	10506	50.80	**83.5**
Delevan-Machias	10510	16.10	**43.4**
Dunkirk-W.Portland	10512	49.00	**59.6**
Hartfield-Ashville	10518	18.00	**17.50**
Hartfield-Sherman	10522	17.50	**74.8**
N.Ashford-Nuclear Fuels	10534	11.70	**9.1**
Homer Hill-W.Salamanca	10540	112.20	**139.2**
W.Portland-Hartfield	10546	27.10	**41.2**
W.Portland-Sherman	10548	62.30	**64.2**
Valley-Ischua	10402	96.2	**140**
Total IVM Unit Acres		**505.60**	**729.1**

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2008 New York Transmission Off Right-of-Way Tree Work Completions

ROW Name/Number	Voltage	IVM Cycle Year FY	Miles in Region	Complete Miles	Work Description	Expended Dollars (k)
CAPITAL						
New Scotland - Leeds 93 & 94	345	2007	26	1.5	DT-Stormproofing	17
Leeds-Pleasant Valley 91 & 92	345	2008	39	9	DT-Stormproofing	16
New Scotland Alps 2	345	2010	30.8	2.8	Spot work	5
Rotterdam-Bear Swamp 205	230	2010	43.9	2	DT-TROW (spot)	21
Stoner-Rotterdam 12	115	2012	6.9	1	DT	30
Unionville - Atlantic Cem 6&7	115	2007	9.1	2	DT-TROW	85
Woodlawn-Menands	115	2008	12.8	5.8	DT-TROW	58
TOTALS				24.1		
NORTHEAST						
Porter-Rotterdam 30 &31	230	2009	41	2	DT/WIDEN	22
Spier-Queensury	115	2009	9.1	3	DT/WIDEN	130
Spier-EJ West; Warrensburg Tap	115	2010	26.3	4	DT/WIDEN	150
TOTALS				9		
MOHAWK VALLEY						
Porter-Rotterdam 30 &31	230	2010	24	1	DT/WIDEN	12
TOTALS				1		
CENTRAL						
Oswego - Volney	345	2007	13	4.6	DT/WIDEN	32
Nine Mile - Clay	345	2006	27	3.3	DT/WIDEN	22
Elbridge - Longbranch	115	2007	8	1.5	DT	11
Black River - LightHousehill	115	2007	12	6.3	DT/WIDEN	61
Lighthousehill - Clay	115	2007	25	8	DT-TROW	15
Budwieser Tap	115	2005	3.6	3.6	DT-TROW	7
Sleight Road - Auburn	115	2006	15	3	DT	19
Oneida - Cortland	115	2008	25	4.8	DT	30
TOTALS				35.1		
NORTHERN						
Adirondak - Porter	230	2009	29	7	WIDEN	138
Colton - Browns Falls	115	2006	30	4	WIDEN	14
McIntyre - Colton	115	2003	32	14	DT/WIDEN	152
Little River Tap (included)	115	2003	3.4	3.4	DT/WIDEN	0
				28.4		
SOUTHWEST						
Homer City-Stolle Rd. #37	345	2010	37	2	Excavator	56
Gardenville-Dunkirk #73/#74	230	2011	36	2	Spot work	17
Dunkirk-Falconer #161/#162	115	2011	35	4	Excavator	113
Falconer-Homer Hill #153/#154	115	2013	42	1	climbing	21
Ischua switch-Valley #158	115	2009	9	3.25	Excavator	73
				12.25		
GENESEE						
Mortimer-Quaker #23	115	2011	19	3	skidderbucket	15
Mortimer-Golah #110	115	2011	10	2	skidderbucket	24
Lockport-Mortimer #111/113 Hamlin Taps	115	2010	7.5	6.5	skidderbucket	47
				11.5		
FRONTIER						
Gardenville-Seneca #81/#82	115	2011	2	2	skidder bucket/bucket truck	23
Packard-Huntley #77/#78	230	2010	12	5.0	excavator	22
Gardenville-Kensington #44/#45	115	2011	6	1.0	skidder bucket/bucket truck	14
				8		
			total	129.35		1,474

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2008 New York Sub Transmision Off Right-of-Way Tree Work Completions

ROW Name/Number	Voltage	IVM Cycle Year FY	Miles in Region	Miles Complete	Work Description	Expended dollars (k)
CAPITAL						
PATROON - KRUMKILL 3	34.5	2009	4.1	4	Widen	$48
Bethlehem-Voorheesville	34.5	2010	10.5	10.5	Widen	$168
Bethlehem-Selkirk	34.5	2013	5.6	5	Widen	$182
Lynn-Woodlawn	34.5	2010	6.8	5	Widen	$16
NASSAU - HUDSON 9	34.5	2012	22.1	4	Widen	$13
Ballston-Charlton #9 - Milton Atomic Plant	34.5	2013	5.2	5.2	Widen	$75
		Region	49.0	33.7		$502
NORTHEAST						
Cambridge-Hoosick 3	34.5	2010	2.2	1	Widen	$24
Barton Mines Taps 1,2,3 and Gore Mnt	34.5	2013	8.5	6	Widen	$176
WELLS - GILMANTOWN RD 2	23	2012	11.4	2	Widen	$70
NORTHVILLE - WELLS 1	23	2012	15.0	0.5	Widen	$14
SCHENEVUS - SUMMIT 3	23	2012	17.3	1	Widen	$12
WARRENSBURG - FORT GAGE 8	34.5	2012	7.5	0.5	Widen	$33
FORT GAGE - QUEENSBURY 2	34.5	2009	6.4	5	Widen	$29
		Region	68.3	16		$358
CENTRAL						
Headson-Minoa, Fayetteville Taps	34.5	2008	5.5	4.2	Widening	$34
Tilden - Tully #24	34.5	2011	19.0	4.4	Widening	$90
Jewitt - Solvay	34.5	2012	5.5	5.5	Widening	$42
Harris road - Tilden #21 &33	34.5	2010	4.8	4.8	Widening	$117
Glenwood Tap (included)	34.5	2010	2.8	2.8	Widening	$0
Fabius tap 34.5 kV	34.5	2010	5.0	3	HZTR REMOVAL	$14
Teall - Headson #31	34.5	2010	3.0	3	HZTR REMOVAL	$7
Teall Industrial Loop #23	34.5	2010	2.0	2	HZTR REMOVAL	$7
LighthouseHill - Mallory	34.5	2012	45.0	45	HZTR REMOVAL	$36
		Region	92.6	74.7		$347
NORTHERN						
Union - Ausable Forks #36	46	2005	10.0	1.7	Widening	$27
Spencers Corners - Malone	34.5	2008	7.0	7	Widening	$95
Lake Clear - Lake Colby #30	46	2009	5.0	5	HZTR	$32
Coffeen - Brownville	23	2010	2.7	2.7	HZTR	$23
Brownville - Dexter (included)	23	2010	3.3	3.3	HZTR	$0
Coffeen - Mill St. #26	23	2010	2.4	2.4	Widening	$7
Black River Kalmargo #25	23	2013	1.2	1.2	Widening	$9
Nicholville - Franklin St. #21	34.5	2011	30.0	2.5	Widening	$10
		Region	61.6	25.8		$203
FRONTIER						
Philips -Telegraph #304	34.5		10.0	2	widen	$18
		Region	10.0	2		$18
GENESEE						
Philips-Medina #301	34.5		35.0	17	widen	$161
Mortimer-Golah #109	69		10.0	3		$9
		Region	#REF!	20		$170
SOUTHWEST						
Dunkirk-W.Portland #851	34.5	2009	14.0	14	widen	$148
Cold Spring-W.Salamanca #804	34.5	2007	18.0	8	widen	$47
W.Portland-Sherman #867	34.5	2009	23.0	14	widen	$98
S.Wellsville-Andover#541 (Whitesville Ta	34.5	2007	12.0	2.5	widen	$34
Dake Hill-Machias #803	34.5	2009	24.0	4	widen	$117
Dunkirk-Hartfield #852	34.5	2007	30.0	4	widen	$74
Eden Tap #860	34.5	2007	3.7	2.7	widen	$43
Sherman-Ashville #863	34.5	2007	35.0	4	widen	$11
Hartfield-Sherman #855	34.5	2009	11.5	4.1	widen	$120
N.Angola-Bagdad #857	34.5	2013	21.0	1	widen	$26
		Region	91.0	58.3		$718
			TOTAL	230.5		2316.0

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2008 Transmission Right-of-Way Acres by Technique Completed in the Adirondack Park

Line Name	Voltage	Low Volume foliar	Backpack Foliar	Stump treat	Stump Treat chip	Stump treat Windrow	Cut only	Prune	Total Acres
Old Forge - Raquette Lake #22	46	0	34.2	66.5	3.58	0.6	1	0	105.88
Warrensburg - Fort Gage #8	34.5	0	41.3	55.7	3.8	4.1	3	1.5	109.4
Chestertown - Schroon Lake #3	34.5	0	93.9	17.5	1.5	1.3	10.8	0.8	125.8
Totals		0	169.4	139.7	8.88	6	14.8	2.3	341.08

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2009 IVM Schedule New York Capital Region

ROWNUM	LINE	NAME	ACRES
012254	13	Bethlehem - Rensselaer	5.10
012260	3	Patroon - Krumkill	2.40
012266	6	Delmar - Bethlehem	8.90
012272	5	Karner - Patroon	7.40
012274	4	Lansingburg - 7th Ave; Eddy St. Tap	2.00
012278	9	Maplewood - Latham	2.90
012280	2 & 13	Maplewood - Liberty	2.00
012286	9	Menands - Liberty	7.00
012288	16	Newtonville - Patroon	29.80
012290	1	North Troy - Lansingburg	13.80
012292	2	North Troy - Tibbetts	40.10
012296	4	Patroon - Partridge	6.60
012310	6	School St - Maplewood	8.80
012312	19	School St - North Troy	30.80
012314	6	Scotia - Rosa Rd	19.00
012316	1 & 9	Snyders Lk - Hoags	14.90
012006	2	New Scotland - Alps	489.80
012014	205	Rotterdam - Bear Swamp	708.20
012024	993	Greenbush - Stephentown	62.80
012026	15	Grooms - Inman Rd	46.80
012028	13	Grooms - Johnson	44.90
012036	2	Menands - Reynolds Rd	22.20
012044	16	North Troy - Reynolds Rd	171.90
012050	17	Rotterdam - Albany	86.70
012052	14 & 15	Rotterdam - GE	14.20
012056	35	Rotterdam - Woodlawn	122.40
012064	5 & 9	Trinity - Albany	18.30
012068	12	Woodlawn - Menands	131.00
		Total IVM Acres	2,120.70

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2009 IVM Schedule New York Northeast Region

ROWNUM	LINE #	NAME	ACRES
012612	16 & 17	Marshville - Cobleskill	93.40
012706	3	Cambridge - Hoosick	47.10
012714	10	Glens Falls - Bay St	5.90
012726	2	Cement Mt. - Cambridge	58.10
012736	7	Queensbury - Bay St	4.80
012740	14	Queensbury - Henry St	36.70
012508	7	Inghams - Colliers/ Springfield	101.30
012518	5 & 7	Spier - Queensbury	115.70
012520	1 & 2	Spier - Rotterdam	506.40
012522	11	St Johnsville - Marshville	34.80
		Total IVM Acres	1,004.20

2009 IVM Schedule New York Mohawk Valley Region

ROWNUM	LINE #	NAME	ACRES
011426	27	Valley - Inghams	52.70
011438	21	Lighthouse Hill - Camden	54.20
011300	14	Edic - New Scotland	714.70
011306	17	Edic - Porter #17	1.50
011308	30 & 31	Porter - Rotterdam	349.00
011312	4	Boonville - Rome	140.90
011314	10	Edic - Porter #10	2.00
011316	20	Edic - Porter # 20	5.60
011322	8 & 9	Porter - Deerfield	24.10
		Total IVM Acres	1,344.70

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2009 IVM Schedule New York Central Region

ROWNUM	LINE #	NAME	ACRES
011108	34	Burnet - Headson	1.40
011116	21	Cortland - Munson	36.60
011122	26	Curtis - Fay St	24.40
011130	20	Homer - Cortland #20	26.50
011132	23	Homer - Cortland #23	34.20
011140	33	Mallory - Cicero	18.00
011160	31	Teall - Headson	19.00
011162	23	Teall - Industrial Loop #26	2.70
011008	17	Oswego - Lafayette	752.00
011048	2	SUNY - Cortland	35.10
011054	2&5	Teall - Oneida	297.00
012755	11	Gereslock - Kamine #11	2.40
		Total IVM Acres	1,249.30

2009 IVM Schedule New York Northern Region

ROWNUM	LINE #	NAME	ACRES
011706	25	Brownville-Dexter	18.10
011708	21	State St - ATC	5.20
011714	25	Coffeen - Brownville	12.70
011762	26	Little River-State Street	14.50
011764	25	Taylorville - Belfort	3.50
011534	4 & 5	Dennison - Colton	216.80
011536	3	Lake Colby - Lake Placid	87.70
011542	7	McIntyre - Colton	378.60
011544	7&8	Pyrites - Battle Hill	211.80
		Total IVM Acres	948.90

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2009 IVM Schedule New York Genesee Region

ROWNUM	LINE #	NAME	ACRES
010204	107	Lockport - Batavia #107	436.00
010216	13 & 23	"Mortimer - Sleight Rd #13 23"	89.60
		Total IVM Acres	525.60

2009 IVM Schedule New York Frontier Region

ROWNUM	LINE #	NAME	ACRES
010150	405	Lewiston Hts - Mountain #405	0.40
010154	401	Mountain - Youngstown #401	12.40
010158	402	Ransomville - Phillips #402	28.20
010166	403	Youngstown - Sanborne #403	20.90
010000	76	Beck - Packard #76	30.10
010008	77 & 78	"Packard - Huntley #77 78"	152.60
010010	183 & 184	"Adams (Dupont) - Packard #183 184"	13.00
010012	187 & 188	"Adams - Packard #187 188"	20.30
010018	151 & 152	"Gardenville -(Machais) Homer Hill#151/152"	284.00
		Total IVM Acres	561.90

2009 IVM Schedule New York Southwest Region

ROWNUM	LINE#	NAME	ACRES
010524	802	Machias - Maplehurst #802	65.10
010408	160	Dunkirk - Falconer #160	338.60
010426	164	Willowbrook - Brigham #164	1.80
		Total IVM Acres	405.50

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Report on Activities in Compliance with Case #04-E-0822, Order #13: Vegetative Buffer Assessments, Prescriptions and Completions

In accordance with National Grid's plan, vegetative buffers on 69 and 115 kV transmission lines were evaluated in the field during 2007. The buffer evaluation on the 230 &345kV system was completed during 2006. A total of 446 sites were evaluated in the field by a forester. The evaluation included the vegetation height, height of the conductor, species, location of vegetation in relation to the midspan, sensitivity of the site, environmental concerns, site access and deed/easement restrictions. Out of the 446 sites visited, 265 sites required work of some kind. The prescription for most of the sites is to remove the non-compatible vegetation entirely.

As per the implementation plan, National Grid at its discretion may treat the buffers prior to the scheduled treatment year. The work has started and is ongoing. Currently, 184 work sites have been completed to date.

The following is a summary of the buffer sites by operating region.

Region	Evaluated	Work Required	Completed
Capital	49	35	35
Northeast	55	28	28
Mohawk Valley	48	42	42
Central	76	48	48
Northern	47	12	12
Genesee	37	17	17
Frontier	49	20	20
Southwest	61	39	39
West Bulk	24	24	24
Totals	**446**	**265**	**265**

To date National Grid is 100% complete with the identified buffer site work.

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Report on Activities in Compliance with Case #04-E-0822 Order #12, Plan for Identifying Deficiencies in Maintenance rights or ROW Width

In accordance with the plan for compliance filed in September 2005, National Grid is reviewing deeds and/or easements for 69,115, 230, and 345kV transmission line rights-of-way. Each line is done one at a time. The deeds or easements are pulled from the records, and reviewed for accuracy, duplication, and/or legal technicalities. The maintenance "rights" are reviewed by a paralegal and recorded in National Grid's GIS data base. There are a total of 23,092 deed/easement documents to review and record.

The progress as of the end of February 2009 is as follows:

Number of records	Status	Description
12331	Completed	Reviewed and recorded
10761	Not completed	Not yet reviewed

A total of 12,331 records have been reviewed. This accomplishment has taken 3 full time dedicated paralegals two years of effort to review and record 53 % of the documents. It has become apparent that the original work schedule as described in National Grid's "Plan for Implementation of NY Public Service Commission Case 04-E-0822 was optimistic. This is a critical path task which must be completed prior to determining where National Grid might have deficiencies in transmission maintenance rights. National Grid may need to request an extension of time to December 31, 2010 to complete the review and analysis of maintenance right deficiencies.

In addition, National Grid has reconsidered the plan for analyzing maintenance rights deficiencies. The original plan of collecting field data on Risk Factors and correlating to documented rights would expend an inordinate amount of resources for the type of information that is required. As the right-of-way information is recorded in the transmission GIS; National Grid proposes to use the GIS to obtain the information on deficient maintenance rights.

National Grid looks forward to consulting with Staff concerning the extension of time and the alteration of the plan to identify deficiencies in maintenance rights.

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Non-Storm Tree Caused Transmission Outages, Calendar Year 2008

Circuit Name	kV	Outage D/T	Structure	Species	Tree Hgt	Cleared Width	Slope	Tree Condition	Weather
Lockport - Mortimer #114	115	01/13/2008 13:43	407	red maple	75	60	0	Rot in main stem	Fair
Rotterdam-Bear Swamp E205	230	02/13/2008 10:31	36-37	locust	83	46	0	Sound tree, ice laden, uprooted	Freezing rain or sleet
Curtis Street - Teall #13	115	03/08/2008 21:23	218	poplar	65	45	0	Sound tree, uprooted	Snow-wet
Falconer - Homer Hill #154	115	6/6/08 8:30	341	w. ash	50	40	15	Dead tree, white rot in main stem	Fair
Sleight Road - Auburn (State St.) #3	115	9/15/08 1:53	506-507	poplar	65	40	0	Sound tree, uprooted	Rain,High Winds
Coffeen - Black River - Lighthouse Hill #5	115	9/15/08 3:06	151-152	red pine	70	48	0	Sound tree, uprooted	Rain,High Winds
Taylorville - Moshier #7	115	9/15/08 3:33	15-16	balsam fir	60	45	0	Rot in main stem	Rain,High Winds
Spier - Mohican #7	115	9/18/08 10:09	69	poplar	50	16	1	Mainstem failure	Fair
LaFarge Building Materials - Pleasant Valley #8	115	12/12/08 3:46	428	sycamore	72	28	1	Flooded base	Ice/Snow
Oneida - Cortland #3	115	12/30/2008	388	norway Spr.	90	45	18	Cavity in main stem	High winds

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APPENDIX 8

1.0 SCOPE AND RESPONSIBILITIES

The unauthorized dumping or disposal of waste materials on National Grid rights-of-way and other properties may pose a threat to natural resources and/or constitutes violation of environmental regulations. This EG provides guidance to field operations and other National Grid personnel for assisting in identifying unauthorized waste disposal situations and for notifying designated National Grid Security and Legal personnel.

All National Grid personnel are responsible for identifying unauthorized waste disposal situations and for notifying designated National Grid Security and Legal personnel. Environmental Engineers are responsible for assisting Legal personnel, as requested, with a review of such incidents and helping to determine if any protected natural resources are involved and if any environmental regulatory agency notification is required. Environmental Engineers may also be asked to assist with any follow-up environmental regulatory coordination and response activities, as required to resolve the situation.

2.0 IDENTIFIABLE CONCERNS

The most important concerns are those that cause or have the potential to cause an immediate adverse impact to the environment. Also important are materials that may not necessarily pose an environmental threat, but are required by State and/or Federal laws to be disposed of at approved and licensed facilities. Examples of materials or situations that could cause an environmental threat or violation include (but are not limited to):

- X Trash, garbage and/or rubbish
- X Construction and demolition debris
- X Tires
- X Roofing material
- X Foundry sand
- X Utility poles
- X Driveway sealant
- X PCB containing oil
- X Gasoline, motor oil, hydraulic fluid, brake fluid, and other oils, oil containers or oily debris
- X Solvents, sealers, cleaners, degreasers, paint, paint thinners, varnish, pesticides, and other similar chemicals
- X Refrigerators

- X Batteries
- X Mercury or sodium vapor bulbs and related debris
- X Lighting ballasts and spent fluorescent bulbs
- X Thermostats
- X Asbestos debris
- X Flammable or ignitable substances
- X Any type of container or drum which could contain residue or quantities of any of the above materials or unknown materials
- X Any other material which may have the potential to cause an adverse environmental impact
- X Any material which has been deposited in or within 50 feet of a stream or other water body
- X Any material which has been deposited in or within 100 feet of a Federal or State wetland
- X Abandoned motor vehicles

3.0 GUIDANCE

If you see or become aware of any situation potentially involving the Identifiable Concerns listed above on National Grid rights-of-way or other National Grid property or any other situations of potential environmental contamination, please follow the steps listed below.

3.1 **Gather Information** – Note the time, date, and location of the incident; a description of the problem; type of material or contamination found; and any immediate action taken. A sketch, map and photos of the affected area would be helpful.

3.2 **Immediately Call Your Regional Security Representative and Report the Situation – Security Contacts as Follows**:

Central	821-6163	(315) 428-6163
East	831-5920	(518) 433-5920
West	844-7740	(716) 831-7740

Central – Emergency	821-5100	(315) 428-5100
East – Emergency	831-3728	(518) 433-3728
West – Emergency	844-7134	(716) 831-7134
MetroTech		(718) 403-3179
Long Island	889-3270	(516) 545-3270

Your Security Department representative will request the information listed in item 1 above and any additional information deemed appropriate.

3.3 <u>Immediately call William J. Holzhauer, Counsel - Environmental, at (315) 428-6341.</u>

3.4 <u>The Law Department will Notify the Environmental Department if the Incident Poses an Immediate or Potential Threat to the Environment and/or may be Considered as an Illegal or Unauthorized Dumping Activity.</u>

The Law Department is responsible to contact the Environmental Dept. using the above list of Identifiable Concerns and their professional judgement as a guide. The primary Environmental Dept. contacts are as follows:

Activity	Contact	Tie Line	Outside Phone
Matters Affecting NG Rights-of-Way	William Balestra Michael Sherman	821-6078 821-6624	(315) 428-6078 (315) 428-6624
All Other Matters Affecting Non-ROW Company Properties	Chris Read Bob Cazzolli	821-3631 821-3490	(315) 428-3631 (315) 428-3490
New York South and LIPA ROW's	Steve Dalton Adam Yablonsky	889-2560 889-2581	(516) 545-2560 (516) 545-2581

3.5 **Environmental/Law Enforcement Agency Notification** – The Environmental representative, in consultation with the Law Department, will review the information concerning the incident and determine whether or not it is appropriate to notify the New York State Department of Environmental Conservation or any other environmental regulatory agency. The Security Department representative will determine whether or not it is appropriate to notify law enforcement authorities.

3.6 **Follow-up** – The Environmental, Law and Security Departments will, with your assistance, coordinate any necessary follow up, including cleanup if required, to resolve the problem and will keep other National Grid departments apprised of the situation. The Corporate Safety & Health Department will provide guidance on personal protective equipment to be worn by National Grid employees, if cleanup is required. All follow-up activities will be documented by the involved Environmental and Security Department personnel.

Record of Change		
Date of Review/Revision:		
Revision	**Date**	**Description**
1	07/01/08	Added Record of Change.

1.0 SCOPE

In support of its day-to-day operations, National Grid uses pesticides, herbicides and/or biocides for purposes of effectively controlling:

- undesirable vegetation along electric and natural gas line rights-of-way;
- undesirable vegetation at substations, gas regulator stations, and other facilities;
- pests that may pose threats to worker safety and/or facility integrity and reliability; and,
- pests that reduce heat exchanger efficiency in once through cooling water systems.

National Grid's Transmission Forestry Department is the primary user of herbicides, to help maintain more than 100,000 acres of land along 9,000 miles of electric transmission rights-of-way. National Grid uses Integrated Vegetation Management (IVM) techniques to target individual trees or clumps of tall-growing tree species that pose line interference and outage risks.

IVM employs a variety of techniques including biological controls, hand cutting and selective application of herbicides to control tall-growing trees. Biological control involves promoting the establishment of low-growing plant species that help prevent the growth of tall tree species on the rights-of-way.

Selective use of herbicides applied directly to individual tall-growing trees allows low-growing shrubs, grasses, ferns and herbaceous plants to thrive and resist re-growth of trees. These targeted IVM techniques minimize the quantity of herbicides required, which in turn minimizes their impact on stable, low-growing communities of grasses, herbs and shrubs that pose no threat to electric conductors.

National Grid's Electric Generation Department uses biocides in power generating station once through cooling water systems to control microbiological growth in the condensers and associated piping system. The biocide treatment is applied in the warmer water months (>50°F) to maintain heat exchanger cleanliness. The pesticide is applied to the bulk cooling water stream at a rate limited by the station specific residual pesticide concentration leaving the power station in each generating unit cooling water effluent. The treatment may only be applied for two hours each day per generating unit when the inlet cooling water temperature is above a power station specific limit. These restrictions keep the biocide use to a minimum by restricting the amount used per day and only allowing treatment when conditions favor microbiological growth.

Pesticide uses are regulated by the New York State Department of Environmental Conservation (NYSDEC) as set forth in the applicable parts of Title 6, NYCRR including Part 320 – Pesticides – General, Part 325 – Application of Pesticides, and Part 326 – Registration and Classification of Pesticides.

2.0 RESPONSIBILITIES

National Grid Transmission, Distribution Forestry and Electric Generation Departments are responsible for complying with Federal and NYSDEC-specific requirements for use of herbicides, including associated regulatory reporting and registrations, applicator training, spill reporting and response, and product/container disposal. National Grid's field operations are responsible for complying with Federal and NYSDEC-specific requirements for use of other pesticides needed to maintain worker safety and facility integrity and reliability.

Environmental Engineers and/or environmental consultants are responsible for supporting Forestry and field operations with information about protected natural resources, as requested, and helping to obtain any required permits or regulatory approval associated with site-specific use of herbicides or pesticides in protected natural resource areas, such as in New York State-regulated wetlands and/or wetland adjacent areas.

3.0 PROTECTION OF NATURAL RESOURCES

National Grid's Transmission Forestry Department employs various strategies aimed at protecting natural resources, particularly sensitive aquatic resources, from herbicide applications and other right-of-way maintenance activities. Such strategies include:

- maintaining buffer zones of compatible, low-growing vegetation at sensitive aquatic sites;
- utilizing highly selective, stem-specific treatments within these buffers, together with herbicide products that are specifically approved for ditch bank, stream bank, or aquatic use;
- employing non-herbicide management methods within buffer zones when a risk of contamination exists;
- obtaining any required permits for herbicide applications in protected wetlands and buffer zone areas;
- identifying private drinking water supplies within or immediately adjacent to the right-of-way through the field inventory process, and establish appropriate buffer zones to maintain and protect water quality;
- identifying and protecting any known populations of threatened, endangered or other species of special regulatory concern; and,
- conducting all treatment activities adjacent to sensitive aquatic resources to maximize retention of compatible shrub and herbaceous communities, to help reduce or avoid erosion impacts.

National Grid's Electric Generation Department uses biocides in power generating station once through cooling water systems to control microbiological growth in the condensers and associated piping system. Restrictions in the operating permit keep the biocide use to a minimum by restricting the amount used per day and only allowing treatment when conditions favor microbiological growth.

4.0 WHAT IS A PESTICIDE?

As defined by NYSDEC, a "pesticide" is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any insects, rodents, fungi, weeds, or other forms of plant or animal life or viruses and any substance or mixture of substances intended as a plant regulator, defoliant, or desiccant. Pesticides include such things as herbicides, biocides, etc.

How is National Grid Regulated?

By NYSDEC definition, National Grid is regulated as an "agency" and not as a commercial lawn applicator. As such, National Grid is subject to NYSDEC regulations regarding the use of pesticides, disposal of pesticides and pesticide containers, employee training and safety, pesticide applicator certification, business registration, reporting of pesticide use, pesticide product registration, and pesticide spill response and clean up.

Requirements for the Use of Pesticides

Pesticides are to be used only in accordance with label and labeling directions and must be used in such manner and under such wind and other conditions as to prevent contamination of people, pets, fish, wildlife, crops, property, structures, lands, pasturage or waters adjacent to the area of use. During pesticide use, the certified applicator, certified technician or commercial pesticide apprentice must have access to a copy of the label for each pesticide being used and must make each label available for inspection upon request of the NYSDEC.

Cleansing and Disposal of Pesticides and Containers

Generally, empty pesticide containers may be disposed of in an approved sanitary landfill after they are properly rinsed and cleansed. Returnable containers must be tightly closed to prevent leakage, the exterior cleaned, and the containers returned to the supplier.

Unwanted or unusable pesticides may be subject to more stringent disposal requirements including EPA and DEC hazardous waste disposal regulations. The Environmental Department should be contacted to coordinate the removal and disposal of any unwanted or unused herbicides. See the waste disposal EG for additional guidance.

Training and Safety

Prior to any pesticide application, a certified pesticide applicator must provide safety information and training to individuals using pesticides.

Applicator Certification Requirements

The application of pesticides must be accomplished by, or under the supervision of, a certified commercial pesticide applicator certified pursuant to NYSDEC requirements. The certified commercial pesticide applicator must posses a valid identification card issued by the NYSDEC and make such card available upon request. Full certification is not required for "technicians" and "apprentices" who meet the requirements set forth in 6 NYCRR, Part 325 and are using pesticides under the on-site or off-site direct supervision of a certified commercial pesticide applicator as defined in the Part 325 regulations.

Business Registration

As an agency that applies pesticides, National Grid is required to register locations that apply pesticides with the NYSDEC. In addition, NYSDEC regulations require that National Grid have at least one employee who is a certified commercial pesticide applicator or technician in the appropriate certification category.

Reports

Annual reports, listing the quantities of each pesticide used by National Grid personnel during the previous calendar year, are to be filed with the NYSDEC by February 1 of each year by the responsible National Grid organization. Contractors hired by National Grid to apply pesticides are required to file their own reports. Copies of reports and appropriate pesticide use records shall be maintained by the National Grid organization responsible for overseeing the contractor for a period not less than three years.

Pesticide Product Registration

All pesticides used by National Grid, or under contract to National Grid, must be registered by both the EPA and the NYSDEC. Any such pesticide will contain the EPA registration number on the label.

Spills

Pesticide spills of any quantity should be reported to the Environmental Department immediately to determine if a reportable quantity spill threshold has been exceeded. Depending on the specific pesticide spilled regulatory agency notification may also be required. Refer to spill- or release-related EG for detailed guidance on pesticide spill reporting and cleanup requirements.

Public Service Commission Requirements

National Grid's Transmission Forestry Department is the primary pesticide user with the Company having responsibility for vegetation management of thousands of acres of transmission rights-of-way and related facilities. The management of these land holdings is subject to PSC regulation, set forth in 16 NYCRR, Part 84, which requires that National Grid prepare a detailed right-of-way management plan for PSC review and approval. The PSC also requires that annual reports, summarizing right-of-way management activities for the past year and right-of-way management plans for the current year be submitted to the PSC on or about March 31 of each year. The Transmission Forestry Department is responsible to prepare and file these reports. Copies of these reports are provided to the Environmental Department.

NYSDEC Permit Requirements

In addition to the requirements noted above, the NYSDEC regulates the application of pesticides within State-regulated wetlands and the 100-foot buffer zone surrounding such wetlands (300 feet for tidal wetlands). Any such application of pesticides to wetland and wetland buffer zone areas requires a Freshwater or Tidal Wetlands Permit from the NYSDEC and pesticide applications must conform to the conditions of the NYSDEC permit. A copy of a valid permit must be maintained in the field by the supervising certified applicator and must be available for inspection if requested. In regard to once through cooling water pesticide application the concentration, time and temperature restrictions are contained in each power stations State Pollutant Discharge Elimination System (SPDES) permit. This permit is a NYSDEC administered United States Environmental Protection Agency (USEPA) mandated program which regulates all aqueous discharges from the power stations to ground and surface waters. An Environmental Engineer and/or environmental consultant is responsible for obtaining such permits and should be consulted with any questions relating to the need for permits.

APA Requirements

Within the Adirondack Park, National Grid is required to comply with special plan conditions in preparing and implementing its Transmission Right-of-Way Management Program. Such conditions require maintenance of buffer zones at water resources, as well as other restrictions. National Grid's Transmission Forestry should be contacted for information regarding such restrictions within the Adirondack Park.

Questions concerning the above guidance can be directed to:

CONTACTS:

Transmission Forestry	Dawn Travalini	508-389-4295
Environmental	Bill Balestra	315-428-6078

REFERENCE:

6 NYCRR, Parts 320, 325, 326
6 NYCRR, Part 663
16 NYCRR, Part 84

Record of Change		
Date of Review/Revision:		
Revision	**Date**	**Description**
1	07/01/08	Added Record of Change.
2	10/23/08	Added once through cooling water information.
3	11/19/08	Minor clarification changes.

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APPENDIX 9

APPENDIX 8

SPECIAL PLAN CONDITIONS WHICH APPLY WITHIN THE ADIRONDACK PARK

As a result of the PSC order issued July 20, 1988 in Case 27605, NMPC is required to incorporate into its transmission right-of-way management plan certain conditions that apply only to that portion of its transmission system within the Adirondack Park. To clarify how these conditions will be incorporated into the plan, each ordering clause is repeated below, followed by a description of how NMPC's practices will be modified to comply with the requirements of the order.

Ordering Clause 1

"Niagara Mohawk Power Corporation and New York State Electric & Gas Corporation shall revise their systemwide electric transmission right-of-way management plans in accordance with the following provisions, and shall submit the revised plans for approval by the Director of our Office of Energy Conservation and Environment before November 30, 1988."

The NMPC plan has been revised by inclusion of this Appendix 8.

Ordering Clause 1.a.

"Herbicides shall not be applied by helicopter within the Adirondack Park."

The aerial spray method will not be considered as a management technique for rights-of-way within the Adirondack

Park. Therefore, the discussion regarding aerial spray found on pages 40, 41,42, 43 and the approval process described on page 73 of the plan will be disregarded when selecting a vegetation management technique to be utilized within the Adirondack Park.

Ordering Clause 1.b.

"Stem-foliar spraying in the Adirondack Park shall be limited to sites with "dense" or "heavy" density of undesirable species, or to sites with "moderate" or "medium" density of undesirable species and accompanying densities of only "scattered" or "light" desirable species. Stem-foliar spraying shall be limited to sites where undesirable species average less than 10' tall and will be done only when wind speeds are less than 10 mph."

On pages 45 & 46 of the plan NMPC lists conditions 1,2,3 & 4 where the stem-foliar method will be utilized. Conditions 1 and 2 describe species' densities that remain appropriate when stem-foliar method prescriptions are made within the Adirondack Park. Condition 3 on page 46 will not be considered within the Adirondack Park. In addition, stem-foliar spraying shall be limited to sites where undesirable species average less than 10 feet in height and when wind speed is less than 10 mph.

Ordering Clause 1.c.

"Herbicides used within 100 feet of highway traffic corridors, identified in the 1979 APA State Land Master Plan, shall be selected or their application timed to avoid "brown out" until after Labor Day in any year."

Herbicides that have the ability to cause brown out will not be applied by any method of application that could result in brown out more than one week prior to Labor Day within 100 feet of the shoulder of a highway right-of-way identified as a highway travel corridor in the 1979 APA State Land Master Plan. Herbicides or herbicide application methods, not capable of producing brown out, are not subject to this restriction.

Ordering Clause 1.d.

"Rubus spp. (blackberry, raspberry, etc.) shall be included on the list of desirable species inventoried for right-of-way vegetation management purposes and regularly reported to staff when inventories are required."

Brambles or Rubus spp. are listed on page 33 as a compatible specie to be included in rights-of-way inventories for vegetation management purposes. Where brambles comprise one of the three major compatible species, they will be included in the inventory and reported to the PSC Staff when vegetation inventories are required.

Ordering Clause 1.e.

"Herbicides shall not be used within a minimum horizontal distance of 100 feet of a potable water supply or regulated wetlands or protected waters. Buffer zones shall be maintained around other wetlands, perennial and intermittent streams, and waterbodies as follows:"

Herbicide Application Technique	Minimum Approach Distance
Stem-Foliar	50 Feet
Basal	30 Feet
Cut-and-Stump	30 Feet

Herbicides shall not be used within a minimum horizontal distance of 100 feet of a potable water supply, regulated wetland or standing waters where the need for herbicide buffer zones has been established by regulation pertaining to protecting waters or by specific herbicide label restrictions. Herbicide buffer zones shall be maintained around other wetland, perennial and intermittent streams, and waterbodies as follows:

Herbicide Application Technique	**Minimum Approach Distance**
Stem-Foliar	**50 Feet**
Basal	**30 Feel**
Cut-and-Stump	**30 Feet**

The above stated buffer distances replace those found on pages 43,46 and apply for all rights-of-way treatments within the Adirondack Park.

Ordering Clause 1.f.

"Reasonable efforts shall be made to inform persons who may be expected to enter areas treated with herbicides."

The universal pesticide application notification requirements of 6 NYCRR Part 325 will be followed.

Ordering Clause 2.a.b.c.

"2 Niagara Mohawk Power Corporation and New York State Electric and Gas Corporation shall initiate a study during 1988 to determine the efficacy of herbicide buffer zones, in the park and elsewhere. The study shall conform to the following schedule and conditions:

On October 19, 1988 NMPC & NYSE&G reviewed this part of the order with PSC Staff. Staff agreed to review both of the earlier studies completed by NMPC and NYSE&G, and set up a follow-up meeting on this subject.

Ordering Clause 3.

"Niagara Mohawk Power Corporation and New York State Electric & Gas Corporation shall report, to the Secretary, by March 31 of each year, the transmission right-of-way acreage within the Adirondack Park treated or maintained in the preceding year by each technique (using herbicides or not) for controlling undesirable vegetation."

NMPC will submit by March 31 of each year, to the Secretary, a report as described in ordering clause 3 above.

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APPENDIX 10

Ground Based Patrol For:

Vegetation on High Voltage Transmission Lines

Performance of a ground based patrol on 230kV and 345 kV AC and 450 kV DC transmission lines is prescribed annually. The patrol is conducted in the fall and winter of each year and completed no later than June 15th to ensure that vegetation threatening the operation of any line is removed or pruned prior to the growing season.

The following guidance is provided to each member of the patrol team to ensure consistency in identifying vegetation and in reporting.

Vegetation to be Identified:

The ground patrol shall focus on identifying vegetation (including vines) that has grown to **within 15 feet** of conductors and **off-right-of-way hazard trees**. The ground patrol will also check At Time of Vegetation Management clearances on right-of-ways treated the previous calendar year.

Tools:

Each patrol person shall have the following tools at their disposal:

Necessary

- NGrid ID Badge
- ROW Map
- Transmission Conductor Height Meter
- Hypsometer laser Range Finder (or equivalent tools for tree height measurements

Optional

- Binoculars
- Digital Camera
- NGrid Street Atlas
- Specifications for ROW Veg Mgmt
- ATV (when available)

Data Collection: Hand held device and/or spreadsheets.

Corrective Action: Entry on data sheet must include the best means to eliminate the condition, location and access points. These corrective actions shall be completed prior to June 20th.

Definitions: Danger Tree: A tree on or off the right-of-way that if were cut or failed could contact electric lines.

Hazard Tree: Danger Trees which due to species and/or structural defect are likely to fail and fall in to the electric facility. Factors to consider for identifying a hazard tree include the following:

Defect	Tree Condition	Site Conditions
Crack	Lean	Side hill
Decay	Species that are prone to fail	Saturated or unstable soils
Decline	Emergence (Tree crown above canopy)	Human Activity (Logging; compaction, excavation)
Uprooted		Animal Activity
Co dominant stem		Storm damage
Scarring		Topography (Berms, rock outcrops)
Excessive pruning/Topping		