

**REGION II**  
**UNIVERSITY TRANSPORTATION RESEARCH CENTER**

**Part 2**

**Performance Standards for  
Assessing Vegetation Management  
on Rights-of-Way: Case Study of  
New York State DOT's Roadside  
Rights-of-Way Vegetation  
Management Program**

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# **1 EXECUTIVE SUMMARY**

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## **Overall Project: Assessing New York State DOT's Alternatives to Herbicides, Integrated Vegetation Management, and Related Research Programs**

A set of five research projects on roadside right-of-way (ROW) vegetation management were conducted in 2004-2005 by the State University of New York College of Environmental Science and Forestry (SUNY-ESF) for the New York State Department of Transportation (NYSDOT).

Objectives for the research were as follows (as provided in the problem statement provided by NYSDOT):

- Objective No. 1: evaluate NYSDOT's current vegetation management program and "Alternatives to Herbicide" program
- Objective No. 2: develop recommendations for the vegetation management program and "Alternatives to Herbicide" program
- Objective No. 3: develop a systematic framework and research protocol for identification, evaluation and implementation of environmentally sensitive, lower maintenance, and cost-effective vegetation management techniques that can be integrated into the overall vegetation management program

SUNY-ESF met these objectives over the course of 2004-2005 using the following projects (all reports finalized in December 2005).

### ***Research Project #1***

A thorough search for existing information and knowledge on highway ROW vegetation management policies and techniques, and alternatives to herbicides programs and demonstrations, as applicable to New York State

Final report—PHASE 1:

Alternatives to Herbicides: Literature Review and Annotated Bibliography

### ***Research Projects #2 and #3***

Development of assessment standards (Project #2) and assessment of NYSDOT's vegetation management program (Project #3)

Final report—PHASE 2, Part 1 of 2:

Performance Standards for Assessing Vegetation Management on Rights-of-Way: Case Study of New York State DOT's Roadside Rights-of-Way Vegetation Management Program

Final report—PHASE 2, Part 2 of 2:

SUNY-ESF Right-of-Way Vegetation Management Program Assessment Report for New York State Department of Transportation, Albany, New York

**Research Project #4**

Development of a cost-effectiveness model for evaluating alternative vegetation management techniques for research, development, and application.

Final report—PHASE 3:

Developing a Cost-Effectiveness Model for Research, Development, and Application of Herbicide and Non-Herbicide Vegetation Management Treatments for Roadside Rights-of-Way

**Research Project #5**

Proposition of alternative vegetation management techniques and evaluation protocol for testing, demonstration, and operational application of those techniques.

Final report—PHASE 4:

New alternatives to herbicide techniques for treating roadside vegetation: Recommended techniques for future testing.

Phases of work were ordered according to the progression in project accomplishments, proceeding over time from Phases 1 through 4. All four phases of work and the associated five research projects were related to one or more of the other projects, as follows.

Project #1 was used to:

- collect information needed to develop the cost-effectiveness model in Project #4
- define different treatments as alternatives to herbicides as needed in Project #5

Project # 2 was used to:

- construct the performance standards needed for Project #3

Project #3 depended on results from Project #2

Project #4 depended on Project #1 and was used to

- define different treatments as alternatives to herbicides as needed in Project #5

Project # 5 depended on results from Projects #1 and 4.

All five projects together, and separately, can be viewed as foundations for future research and development work on vegetation management issues (especially those related to non-herbicide alternatives) by NYSDOT.

## **Project #2: Performance Standards for Assessing Vegetation Management on Rights-of-Way: Case Study of New York State DOT's Roadside Rights-of-Way Vegetation Management Program**

### ***Study Objective***

Develop an assessment metric that describes and frames the principles, criteria, and indicators consistent with the tenets of sustainability and environmental protection associated with IVM and EMSs, applicable to roadside right-of-way vegetation management.

### ***Rationale***

In order to assess the performance of NYSDOT as a vegetation management organization (see Project #3), a set of standards was needed, but did not exist. The first step to assessment of NYSDOT's performance was to develop performance standards.

### ***Methods***

Standards were developed in early 2004 that combined strategic, tactical and operational-level elements of vegetation management on rights-of-way. These performance standards are based on some of the process- and procedure-oriented elements from EMSs, planning elements from forestry certification systems, and a six- step operational-level model we developed for Integrated Vegetation Management. The performance standards include 10 principles (see attached) and 42 criteria.

### ***Outcome***

The performance standards were shared with many professional as drafts early in 2004. Revised standards were used to assess NYSDOT in summer 2004, with some minor revision early on in the assessment. Final standards were presented at the 8th International Symposium on Environmental Concerns in Rights-of-Way Management in September 2004. These standards were used to critique the draft, national ANSI 300 standards for vegetation management in early 2005.

### ***Future Work***

The standards should be extended in application to other vegetation management organizations (mail surveys and on-site performance assessments). A system of certification could be developed with the standards sanctioned by some independent, credible body (e.g., Society of Arboriculture).

## **Principles for Assessing Performance of Integrated Vegetation Management on Rights-of-Way**

### ***Principle #1: Compliance with Laws***

Laws and regulations are constructs developed to protect natural resources and associated benefits and values accruable to society. IVM practitioners meet or exceed all laws, regulations, and guidelines related to vegetation management on ROWs.

### ***Principle #2: Tenure and Use Rights and Responsibilities***

Sustainable land management, including vegetation management, requires that the land be properly vested, clearly owned, and demarcated.

### ***Principle #3: Community Relations and Workers' Rights***

IVM shall maintain or enhance long-term social and economic well-being of vegetation management workers. A fairly compensated, respected, knowledgeable workforce is critical to long-term, sustainable vegetation management.

### ***Principle #4: Management Planning***

Documentation of philosophy, principles, procedures, and practices are critical to long-term, sustainable management, as embodied by various levels of plans, including resource inventories and maps. Written plans cause managers to be held highly accountable for both successes and failures as judged against stated goals and objectives. Improvement in management practices are predicated on learning from both successes and failures.

### ***Principle #5: Understanding Pest and Ecosystem Dynamics***

Knowledgeable managers and practitioners are needed. Being able to identify pests and desirable organisms in the managed system, and understanding the ramifications of management based on knowing life histories and ecosystem processes, is foundational knowledge for IVM.

### ***Principle #6: Setting Management Objectives and Tolerance Levels***

IVM, as developed from IPM, depends upon basic elements to function as a system. Tolerance levels are one of the top elements as part of IVM, whereby vegetation is only treated if critically necessary to meet objectives. Objectives are set in context of socioeconomics and environmental desires.

### ***Principle #7. Compilation of a Broad Array of Treatment Options***

IVM does not focus on the use of one treatment; instead, every ROW management situation has a treatment prescribed only after considering all possible treatments. A full “toolbox” of treatments is needed to make this consideration full and robust.

### **Principle #8: Accounting for Economic and Ecological Effects of Treatments**

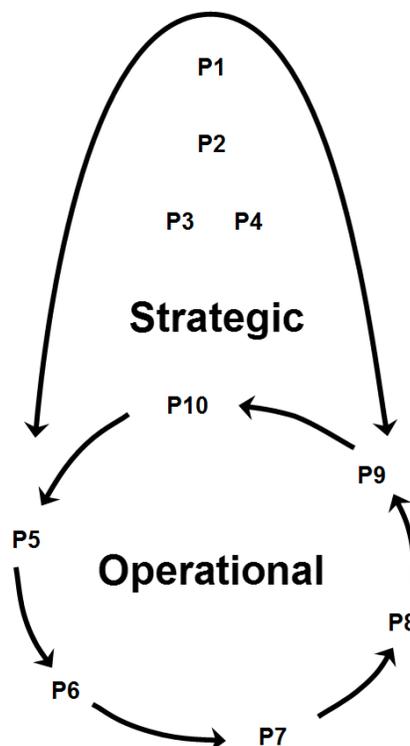
Cost effectiveness of treatments, in its broadest sense, is used as a basis for selecting treatments. A conservative, environmental approach is used that favors prevention. If control is needed, there is an effort to use non-synthetic pesticide alternatives and biological approaches.

### **Principle #9: Site Specific Implementation of Treatments**

ROWs should be divided into ecologically- and socioeconomically-sensible management zones. These zones have vegetation management plans (prescription) that are contemporaneous in development and benchmarks for future evaluations of treatment success.

### **Principle #10: Adaptive Management and Monitoring**

IVM has a self-improvement mechanism: vegetation management objectives are used to evaluate whether management outcomes are acceptable. Monitoring is the collection of appropriate data to judge successes and failures of vegetation management. Monitoring procedures should be consistent and replicable over time to allow comparison of results and assessment of change.



**Figure ES-1. Relationship of strategic and operational principles (P) for assessing right-of-way vegetation management program performance. Operational principles (5-10) can be judged alone for performance on any one section of right-of-way (Nowak and Ballard 2005), but when coupled with strategic principles (1-4), the total vegetation management system can be assessed.**



## **2 PERFORMANCE STANDARDS FOR ASSESSING VEGETATION MANAGEMENT ON RIGHTS-OF-WAY: NYSDOT CASE STUDY**

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### **Abstract**

Rights-of-way vegetation managers are increasingly focused on environmental stewardship. Managers are interested in practices that will produce and demonstrate economically-sound, socially-responsible, and environmentally-sensitive decision making and operational practice. Environmental Management Systems have developed over the past decade to frame and advertise organizational efforts in environmental stewardship, but, to date, these systems have been only strategic/tactical in nature. They have not directly pertained to operations and field performance. In this paper, we present a new system for use in framing environmental stewardship activities via a set of performance standards that combine strategic, tactical and operational-level elements of vegetation management on rights-of-way. These performance standards are based on some of the process- and procedure-oriented elements from EMSs, planning elements from forestry certification systems, and a six- step operational-level model we developed for Integrated Vegetation Management. To date, we have a set of performance standards that include 10 principles and 42 criteria. We present the performance standards to stimulate critique and discussion of what environmental stewardship is for rights-of-way vegetation management.

*Keywords:* Environmental Management Systems, powerline corridors, stewardship, certification, principles and practices.

### **Introduction**

Roadside rights-of-way (ROWs) are important technical and ecological features of the landscape. Hundreds of thousands of miles of such ROWs traverse the United States, covering nearly 20,000,000 acres of land. The New York State Department of Transportation (NYSDOT) alone is responsible for 15,000 miles and 100,000 acres of roadside ROWs, including 3,000 miles of guiderails.

Because ROWs are long-linear features, they are set in the landscape to interact with a wide variety of physiographic features and geographic settings, especially water course areas associated with rivers and streams (roads have regularly been constructed in the flattest terrains associated with valleys). Socioeconomically, roads get people to where they live and work, causing them to interact with each other every day. All of these gross features and interactions heighten the importance of roads in the environment and for society.

An important maintenance activity on roads is roadside vegetation management. Vegetation is managed on roadside ROWs to meet a broad suite of objectives (Table 1). Many of these objectives are directly associated with the influence of roads on the environment: water quality protection, erosion and sedimentation control, wetland mitigation, wildlife habitat, and biodiversity. All of the objectives deal with protecting the values, benefits, and services people want from roads and roadside ROWs.

**Table 1. List of objectives associated with vegetation management on roadside ROWs (after Venner 2004).**

- 
- manage the immediate shoulder for use as a re-control zone for errant vehicles
  - prevent weeds from growing into pavement
  - preserve sight distances for reading signs and cornering
  - offer space for utilities
  - screen on-coming traffic on divided highways
  - maintain slope stability, encouraging drainage of water off the roadway
  - protect water quality
  - protect habitat for wildlife
  - preserve native plant communities
  - maintain open space or green corridors
  - provide for biodiversity
  - produce positive aesthetics
  - protect roadside areas against infestation and spread of noxious weeds
  - keep vegetation back from the edge of the road to improve visibility of wildlife and reduce chance of road kill
  - provide on-site area for wetland mitigation
- 

Many state DOTs are embracing environmental stewardship in their road and roadside management endeavors (Table 2) and have used Environmental Management Systems (EMSs) to further that embrace (Venner 2004). EMSs are generally defined as the part of the overall management system of an organization that includes organizational structure, planning activities, responsibilities, processes, procedures, practices and resources for developing, implementing, achieving, reviewing, and maintaining the corporate environmental policy (ISO 1996). EMSs are used by companies to better manage their environmental affairs and show commitment to

environmental protection (USEPA 2002). Most EMSs are built on the “Plan, Do, Check, Act” Model. This model leads to continual improvement, based upon (after USEPA 2002):

- Planning, including identifying environmental aspects of the managed system and establishing goals (plan);
- Implementing, including training and operational control (do);
- Checking, including monitoring and corrective action (check); and
- Reviewing, including progress reviews and taking corrective action to EMS (act).

An EMS is generally seen as a strategic, process-level model set to meet many key needs associated with environmental stewardship (Table 3) (also see Germain et al., 2002). Its direct value is based on how it guides the development of organization structure (personnel), policy, and standard operating procedures. Organizations are left with the responsibility to make the system more structured and operationally applicable.

**Table 2. List of efforts made by organizations to meet environmental stewardship in transportation (after Venner 2004).**

- 
- make wise choices based on understanding the consequences to natural, human-made, and social environments
  - improve environmental conditions and the quality of life when possible, not just complying with regulations
  - carefully manage environmental resources and values through partnerships among public and private entities
  - elevate attitude, ethics, and behavior by individuals
  - fulfill responsibilities as trustees of the environment for succeeding generations, moving towards a cost-effective and environmentally sustainable future
  - integrating environmental values with partners within all transportation work as a “core business value”
-

**Table 3. List of needs met by using an Environmental Management System as an organizing framework (after Venner 2004).**

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- desire to systematically demonstrate better environmental performance
  - responsiveness to stakeholder preference
  - efficient use of financial resources
  - ensuring coverage of complex liability issues
  - regulator's requests
  - awareness that environmental stewardship leads to regulatory streamlining
  - control over priorities and timelines of the EMS
  - organizational culture and personal commitment
  - integration of environmental systems into strategic planning processes that are already in place. Environmental management systems include elements of quality control, health and safety, finance, and human resource management
  - promotion of a positive organizational image
- 

Recently, the State University of New York College of Environmental Science and Forestry (SUNY-ESF) and the NYSDOT formed a partnership (NYSDOT, 2002) to work on vegetation management issues associated with roadside ROWs. One aspect of that work was to develop an operational-level EMS for roadside ROWs, and frame that system as a set of performance standards that could be used to critically examine environmental performance in vegetation management. In this paper, we present our newly developed performance standards and some of the associated developmental underpinnings.

We will, as objectives for the paper:

- 1) describe the need for and value of an operational-level set of performance standards;
- 2) present a new IVM model, as part of an EMS, for operational-level roadside ROW vegetation management;
- 3) show how the IVM model is connected to an EMS;
- 4) introduce an existing set of operational-level performance standards and application system ("green certification") from the allied field of forestry (sustainable forest management);
- 5) formally propose performance standards for the ROWs vegetation management arena (combining outcomes from Objectives 2 and 4); and
- 6) conclude by outlining what to do next with the performance standards.

We open our operational-level performance standards to professional scrutiny so that their credibility and utility can be improved with criticism, comment, and discussion. We feel that our work may be useful to other organizations interested in planning for, conducting, and demonstrating on-the-ground environmental stewardship. It is our hope that the model could provide impetus for a national referendum on environmental management systems, assessment, and certification of environmental stewardship in the ROWs management industries.

### **Need for and Value of IVM Performance Standards**

ROW owners who carry out responsible vegetation management that is consistent with the performance standards can obtain various benefits (Table 4). Performance standards for IVM can be used to define organizations that manage ROWs in environmentally-appropriate, socially-beneficial, and economically-viable manners (adapted from FSC 2004b). Environmentally appropriate ROW vegetation management means maintaining biodiversity, productivity, and ecological processes. Socially beneficial management means helping local people and society at large enjoy long-term benefits. Economically viable means that vegetation management operations are structured and managed so as to be sufficiently cost effective and profitable, without generating financial profit or cost savings at the expense of ROW resources and their sustainability.

**Table 4. List of various benefits that can be obtained through complete and objective application of IVM performance standards (after FSC 2004a).**

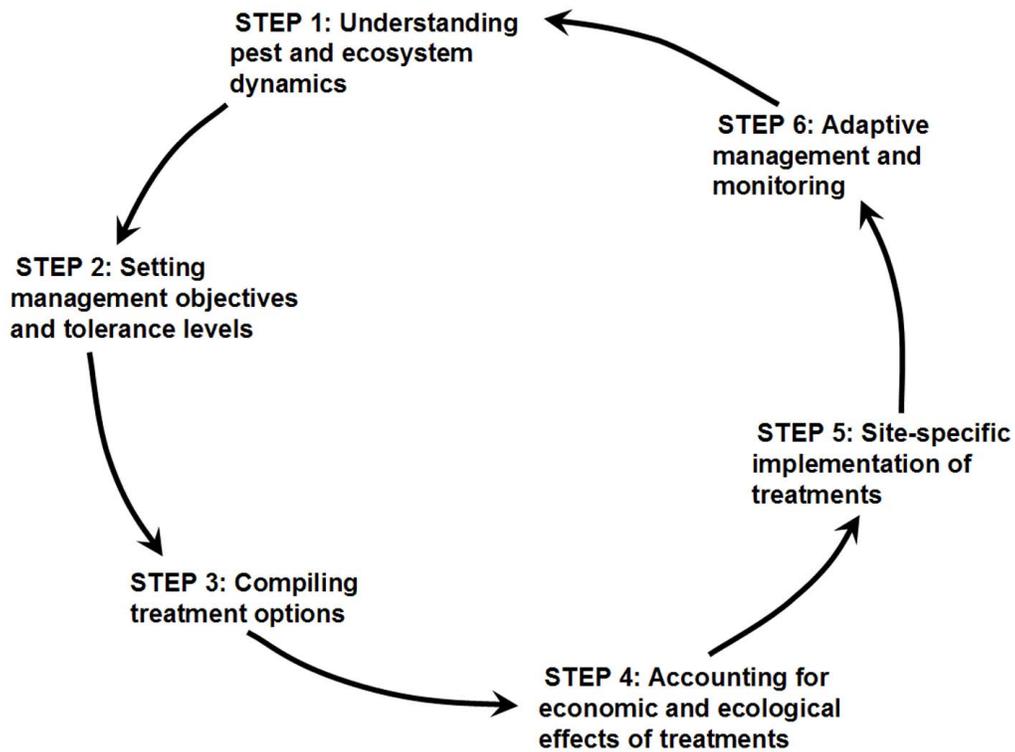
- 
- national, regional, and state recognition that the vegetation management does not put the ROW's and affected land's natural heritage at risk and that management activities are appropriate
  - the opportunity for interaction and cooperation among the various players involved in responsible vegetation management, e.g., ROW owners, social and environmental organizations, to solve problems that ROW managers face
  - the assurance that future generations will enjoy the benefits of the ROW and its environment
  - the assurance that vegetation management practices are responsible and will be further improved
  - the assurance that ownership rights are respected
  - the assurance that vegetation management is legal
  - the assurance that rights of workers are respected
  - the assurance that areas of natural wealth and endangered wildlife habitat are not being negatively affected
-

## **An Integrated Vegetation Management System for Roadside Rights-of-Way: Six Steps Toward Performance Standards**

Pests on roadside ROWs are diverse. Under guiderails and near signs, the pest can be any plant that screens the guiderail or signs from the motoring public's general view. On and near the shoulders, woody plants can act as deadly fixed objects that can pose a hazard to motorists who leave the roadway. Tall-growing plants can affect sight distances. Plants of all kinds can destroy pavement directly by root growth that causes pavement breakup, or indirectly by preventing drainage of water from the roadway.

A common IVM approach to managing vegetation on roadside ROWs is to establish low-growing grasses that are maintained by regular mowing, and to control undesirable vegetation in pavement, near guiderails, road edges, and signs using a variety of chemical and mechanical treatment methods. Establishing and maintaining a managed grass community is an effective biological control of potentially hazardous or undesirable vegetation growth in a ROW (NYSDOT undated). It may be possible to culture other low-growing plants that may provide better biological control. While an IVM approach to vegetation management does not preclude the integration of relatively coarse or broadcast methods, such as mowing, the regular blanket application of these types of treatments, without efforts to integrate other treatments in support of the development of a biological control, is not IVM. Biological control, which leads to fewer undesirable plants and results in reduced needs for treatment, is a core element of IVM (McLoughlin 1997, 2002).

IVM has a focus on eliciting site-specific, ecosystem-sensitive, economically-sensible, and socially-responsible treatment effects that lead to refined prevention and control of target plant pests (Wagner 1994; Nowak and Appelt 2002; Nowak et al. 2002). A model for IVM application for ROWs that fully incorporates this focus, and frames it in a full system context, has been recently developed for the electric utility (Nowak and Ballard 2001; Nowak and Appelt 2002; Nowak and Ballard 2005) and gas pipeline (Nowak et al. 2002) industries. In the IVM model, vegetation management activities for a section of ROW can be viewed as a system of steps that formalize relationships among phases of management to prevent, monitor and control undesirable plants and plant communities (Figure 1). This system is generally applicable to a variety of lands where vegetation management occurs, though ROWs were the original, intended application (Nowak and Ballard 2005).



**Figure 1. A model of Integrated Vegetation Management operations showing the six steps that form a cycle of activities for a right-of-way (after Nowak and Ballard 2005).**

As part of our partnership between SUNY-ESF and NYSDOT, we recently re-defined a six step model for application to roadside ROWs, as follows.

***IVM STEP No. 1: Understanding pest and ecosystem dynamics***

- basic knowledge of the biology and ecology of all organisms that may be affected by management is accumulated
- specific considerations are given to threatened, rare and endangered species, and nonindigenous invasives
- research and development is used to produce new information specific to the managed system
- education and training of key personnel is needed as new information is developed

### ***IVM STEP No. 2: Setting management objectives and tolerance levels***

- for roadside ROW vegetation management the goal is to provide travel corridors for the efficient, effective, and safe travel of motorists, and to do so in a cost-effective, environmentally-sensitive, and socially-responsible manner
- there are many objectives associated with such a goal, including roadway structural integrity, erosion control, storm water management, protection of habitat for desirable plants and animals, and invasive species control
- there is much flexibility as to how managers can meet these various objectives and still achieve the overall goal
- different zones of a roadside ROW—vegetation-free zone vs. operational zone vs. transition zone—may have different tolerances for vegetation
- stakeholders in ROWs—anyone influenced by ROWs and their management—should be engaged in the process of developing management objectives

### ***IVM STEP No. 3: Compiling treatment options***

- different treatments are needed to match variable environmental and site conditions on the ROW or to address stakeholder concerns and interests
- vegetation treatments can be grouped into four categories: physical or mechanical, chemical, cultural, and biological; a fifth category should be included--ecological (see next bullet)
- biological treatments are usually based on culturing the natural enemy of the pest; however, when dealing with plants we often promote interference influences from competing desirable plants, which are not “natural enemies” per se, and are more like ecological control agents rather than biological
- singular use of any one treatment through time, across all sites and conditions, is not an IVM approach
- along any one ROW, site-specific prescriptions of treatments are needed that are sensitive to surrounding land uses, local water resources, topography, variation in vegetation conditions, and opportunities for enhancing wildlife habitat
- minimal use of chemical treatment and preferential use of biological/ecological controls is a core concept in IVM

#### ***IVM STEP No. 4: Accounting for socioeconomic and environmental effects of treatments***

- choice of treatment must be made based on known socioeconomic and environmental impacts, including potential water, air, and noise impacts, and worker and public safety, as defined in part by public involvement
- a useful metric for evaluation of socioeconomic and environmental effects of treatments is cost effectiveness
- cost effectiveness is a measure of the success of a treatment in terms of economics, plant community dynamics, and related environmental considerations
- cost of treatments include economic costs for the materials and/or labor (direct cost), but also costs associated with externalities such as air and noise pollution (indirect cost)
- effectiveness pertains to production of desired vegetation conditions and associated benefits and values, including promotion of positive environmental externalities associated with diverse plant and animal communities, protected riparian areas and water quality, and visual attributes fashioned to minimize impacts to/or enhance aesthetics

#### ***IVM STEP No. 5: Site-specific implementation of treatments***

- site-specific treatments can be applied to various sections of any one ROW, and also across a ROW, e.g., vegetation-free zone vs. operational zone vs. transition zone
- water resources, e.g., streams and wetlands, need concerted protection
- zones associated with a roadside ROW (pavement, pavement edge, guiderail, shoulder) are set for site-specific management
- a predetermined tolerance level (threshold) of the number and size of individual plant pests that can live in a ROW zone and not create an impact that requires immediate treatment should be defined
- with tolerance levels, vegetation is not routinely treated, but is instead treated only as needed
- ROWs are regularly inventoried to judge the conditions of targeted species and the need for treatment, particularly pest species that can interfere with achieving ROW objectives

#### ***IVM STEP No. 6: Adaptive management and monitoring***

- after the basic steps of management have been completed, and treatments have been applied, the effects of the treatments are monitored over the course of a treatment cycle
- monitoring in an adaptive management program is valuable in assuring stakeholders that treatment effects are being gauged
- shortfalls are adjusted for by adapting management schemes to improve IVM
- improvements draw the circle of steps to close in the form of a self-improving cycle (Figure 1)

An organization can apply the six steps of IVM to understand, justify, choose amongst, selectively apply, and monitor different types of treatments—mechanical, chemical, cultural, and biological/ecological (Nowak and Appelt 2002, Nowak and Ballard 2005).

## **The IVM Model compared with US EPA’s Environmental Management System**

A tool to measure the potential effectiveness of an environmental management program—ISO 14001 (ISO 1996)—is being used by organizations around the world to better manage their environmental affairs and to show a commitment to environmental protection. The EMS model has 17 components under five main principles (USEPA 2002):

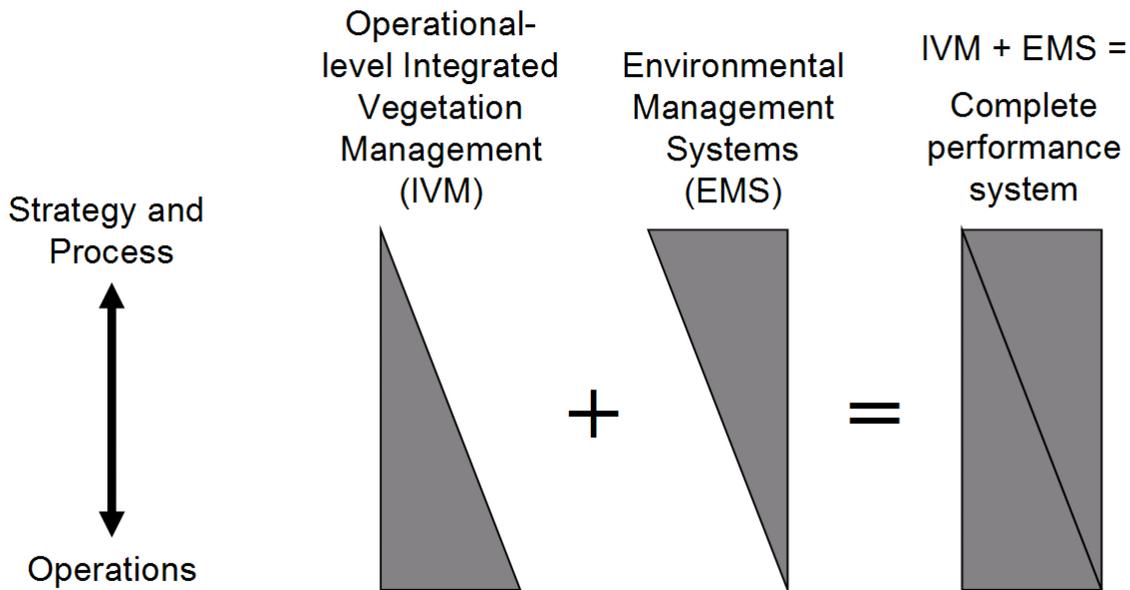
- EMS Principle 1: Environmental Policy
- EMS Principle 2: Planning (environmental aspects; legal and other requirements; objectives and targets; environmental management program)
- EMS Principle 3: Implementation (structure and responsibility; training, awareness, and competence; communication; EMS documentation; document control; operational control; emergency preparedness/response)
- EMS Principle 4: Checking / Corrective Action (monitoring and measurement; nonconformance and corrective and preventive actions; records; EMS audits)
- EMS Principle 5: Management Review

Our IVM model for vegetation management on roadside ROWs is similar in structure to an EMS, though this was not the intent in the original IVM model construction (Nowak and Ballard 2005). All six steps from the IVM model can be matched to one or more of the EMS steps of planning, implementing, checking, and reviewing (Table 5). The EMS Principle 1 on Environmental Policy could not be matched with any one step from the IVM model. This incongruity may be reflective of the difference between a process-oriented system (ISO14001-based EMS) vs. a performance-oriented system (IVM), with policy more on the side of process than performance. In addition, IVM is performed at an operational scale on a single section of ROW, compared to EMS which is more in line with a strategic scale applied to management of a whole ROW system.

**Table 5. The six steps from an Integrated Vegetation Management model (Nowak and Ballard 2005) can be matched to one or more of the Environmental Management Systems steps of planning, implementing, checking, and reviewing (USEPA 2002).**

<b>Environmental Management System</b>		<b>Integrated Vegetation Management Model</b>
EMS Step 1: Planning	matched with	IVM Step 2: Setting management objectives and tolerance levels IVM Step 3: Compiling Treatment Options IVM Step 4: Accounting for economic and environmental effects of treatments
EMS Step 2: Implementing	matched with	IVM Step 5: Site-specific implementation of treatments
EMS Step 3: Checking	matched with	IVM Step 6: Adaptive management and monitoring
EMS Step 4: Reviewing	matched with	IVM Step 6: Adaptive management and monitoring

The notion that EMS is focused more on process than operation-level performance is important for what we are doing and why we are doing it in terms of constructing standards. In EMSs, processes are demonstrated by policy statements and documented standard operating procedures. Organizations can be certified as ISO 14001 Registered Organizations if they have developed an environmental policy statement and supporting documents, and established in-depth EMS training, and rigorous document control procedures. Documentation is required for all 17 components of an EMS, including documents on “organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining environmental policy” (Venner 2004). An EMS sets the stage for operations and provides a framework for implementation and ensuring that feedback from operations is incorporated into relevant processes to more effectively achieve the intended environmental result. If an area of performance is found lacking during an assessment, it is important to be able to trace the shortfall back to its source, which is usually some shortfall in policy or procedure. An IVM plan or system functions as an operation-specific component of an EMS, or an EMS within a subset of the organization, designed to ensure environmentally sound and continually improving performance within vegetation management. Both EMS and IVM systems have top down (policy/leadership/funding/procedure) and bottom up (field input and knowledge application) elements. IVM employs specific operational-level performance standards.



**Figure 2. Relationship of strategy and process versus operations for performance standards via Integrated Vegetation Management and Environmental Management Systems; the former emphasizes operations, the latter emphasizes strategy and process; together they represent a total system.**

### **Green Certification and Sustainable Forest Management as a Model**

Assessments and audits of forest management organizations and their efforts at conducting environmental stewardship through sustainable forest management are becoming important and somewhat commonplace. Such assessments are used to confer a mark of excellence and identify areas needing improvement within the management program or organization.

Forestry has long-standing, mainstream assessment and certification programs, including the program associated with the Forest Stewardship Council (FSC) ([www.fsc.org](http://www.fsc.org)). The FSC is an international organization formed in 1990 to develop performance standards for assessing forest management operations. FSC also sanctions a process of using those standards via FSC-accredited third-party certifiers (SmartWood 2004). A certification seal is awarded to forest management operations that meet the FSC principles and criteria for environmental, economic, and social standards. Certification shows the public and the forestry industry that sustainable forest management is possible, attainable and worthwhile (SmartWood 2004).

Key elements to certification are clear principles, criteria, and indicators used by third-party auditors to assess the performance of an organization (e.g., see SmartWood at [www.smartwood.org](http://www.smartwood.org), the only U.S. FSC-approved, non-profit certification organization). Performance foci are documentation, procedures and field performance of management

activities. In the FSC/SmartWood system, the standards are constructed as a series of 10 principles and associated criteria. Principles are defined as “an essential rule or element; in FSC’s case, of forest stewardship” (NEWG 2002, based on terms as defined in FSC International Principles and Criteria). The FSC defines criteria (singular criterion) as “a means of judging whether or not a Principle (of forest stewardship) has been fulfilled” (NEWG 2002, based on terms defined in FSC International Principles and Criteria). These principles and criteria have developed progressively since 1990 based upon a global consensus of what is meant by sustainable forest management (FSC 2004b).

The 10 FSC principles are as follows (SmartWood 2000).

- *FSC Principle 1: Compliance with laws and FSC principles*  
Forest management shall respect all applicable laws of the country in which they occur, and international treaties and agreements to which the country is a signatory, and comply with FSC Principles and Criteria.
- *FSC Principle 2: Tenure and use rights and responsibilities*  
Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established.
- *FSC Principle 3: Indigenous peoples’ rights*  
The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected.
- *FSC Principle 4: Community relations and workers’ rights*  
Forest management operations shall maintain or enhance the long-term social and economic well being of forest workers and local communities of people.
- *FSC Principle 5: Benefits from the forest*  
Forest management operations shall encourage the efficient use of the forest’s multiple products and services to ensure economic viability and a wide range of environmental and social benefits.
- *FSC Principle 6: Environmental impact*  
Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest.
- *FSC Principle 7: Management plan*  
A management plan—appropriate to the scale and intensity of the operations—shall be written, implemented, and kept up-to-date. The long-term objectives of management, and the means of achieving them, shall be clearly stated.
- *FSC Principle 8: Monitoring and assessment*  
Monitoring shall be conducted—appropriate to the scale and intensity of the operations—to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts.

- *FSC Principle 9: Maintenance of high conservation value forests*  
Management activities in high conservation value forests shall maintain or enhance the attributes which define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach.
- *FSC Principle 10: Plantations*  
Plantations shall be planned and managed in accordance with Principles 1 – 9. While plantations can provide an array of social and economic benefits, and can contribute to satisfying the world’s needs for forest products, they should complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests.

As part of the FSC process, region-specific standards are typically developed by a regional working group, field tested, revised, approved by the regional working group, and then submitted to the FSC for final approval/endorsement (SmartWood 2000). While the focus of the FSC standards are not on the environment, per se, many of the principles either directly (FSC Principles 5 and 6) or indirectly (FSC Principles 1, 7, 8, 9 and 10) deal with conserving or protecting environmental resources.

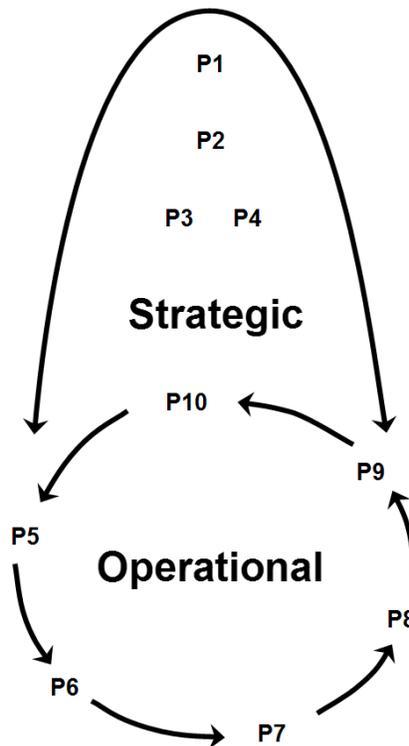
Important socioeconomic and ecological principles have been developed in the FSC/SmartWood system that can be used in the ROW industry. Many of the principles are already accounted for in the IVM and EMS models presented above, but others are not (see Table 6). Three of the unmatched principles (FSC Principles 3, 9 and 10) are specific to forestry and do not appear to have a corollary in vegetation management on roadside ROWs. Four of the principles (FSC Principles 4, 5, 6 and 8) are well-matched to the IVM model, one (FSC Principle 7) is partially matched, and two are not matched at all (FSC Principles 1 and 2); these latter two may be useful in developing a complete model and related set of performance standards for vegetation management on ROWs that fully incorporates both strategic and operational elements.

**Table 6. Forest Stewardship Council (FSC) principles (SmartWood 2000) can be matched with the six steps from the Integrated Vegetation Management (IVM) model (Nowak and Ballard 2005), and collectively, they were used to develop the IVM assessment standards.**

FSC/SmartWood Standards		Integrated Vegetation Management Model		Assessment Standards
FSC Principle 1: Compliance with laws	matched with	Nothing	applied to	Principle 1
FSC Principle 2: Tenure use rights and responsibilities	matched with	Nothing	applied to	Principle 2
FSC Principle 3: Indigenous peoples' rights	matched with	Nothing	applied to	NA
FSC Principle 4: Community relations and worker's rights	matched with	IVM Step 1: Understanding pest and ecosystem dynamics	applied to applied to	Principle 3 Principle 5
FSC Principle 5: Benefits from the forest	matched with	IVM Step 1: Understanding pest and ecosystem dynamics	applied to	Principle 5
		IVM Step 4: Accounting for economic and environmental effects of treatments	applied to	Principle 8
FSC Principle 6: Environmental impact	matched with	IVM Step 4: Accounting for economic and environmental effects of treatments	applied to	Principle 8
		IVM Step 5: Site-specific implementation of treatments	applied to	Principle 9
FSC Principle 7: Management plan	matched with	IVM Step 2: Setting management objectives and tolerance levels IVM Step 3: Compiling Treatment Options	applied to applied to applied to	Principle 6 Principle 4 Principle 7
FSC Principle 8: Monitoring and assessment	matched with	IVM Step 6: Adaptive management and monitoring	applied to	Principle 10
FSC Principle 9: Maintenance of High Conservation Value Forests	matched with	Nothing	applied to	NA
FSC Principle 10: Plantations	matched with	Nothing	applied to	NA

## Putting It All Together: Performance Standards for Operational-Level Environmental Stewardship Associated with Rights-of-Way Vegetation Management

We have developed operational-level performance standards as an amalgamation of the steps, principles, components and criteria from the IVM model (six steps), the EMS framework (five principles) and the FSC/SmartWood standard (10 principles) (see the Appendix for a complete set of performance standards). Our standards are comprised of 10 principles and 42 criteria: six principles directly reflect the six steps of IVM, and four principles were adapted from FSC (FSC Principles 1, 2, 4, and 7) (see Table 6). All principles and criteria are collectively consistent with an EMS and offer an application of an EMS in a specific area of DOT operations where agencies have been struggling to bring about environmental improvement. In addition, the proposed performance standards have an imbedded flow and logic. The cycle of self improvement (see Figure 1) is core to both the EMS and IVM models (Figure 1). Principles 1 through 4 are keyed to strategic elements of performance, whereas Principles 6 through 10 are associated with operational-level performance (Figure 3). Operational-level performance of an organization's vegetation management program/system cannot be fully assessed without including the strategic elements.



**Figure 3. Relationship of strategic and operational principles (P) for assessing right-of-way vegetation management program performance. Operational principles (5-10) can be judged alone for performance on any one section of right-**

**of-way (Nowak and Ballard 2005), but when coupled with strategic principles (1-4), the total vegetation management system can be assessed.**

To date, the performance standards associated with the total management system (Figure 3) have been critically examined by dozens of people from SUNY-ESF and NYS DOT. These standards were field applied/reviewed in summer 2004. Four regions of NYSDOT have been assessed with the standards: Region 4 (Rochester), Region 2 (Utica), Region 8 (Poughkeepsie), and Region 6 (Hornell). Assessments have included interdisciplinary field meetings and interviews with staff, visits to a representative sample of roadsides, and review of various documents, standard operating practices, vegetation conditions, field performances, site challenges, and vegetation management innovations. In each region, assessors from SUNY-ESF spent one-half day in the regional office with NYSDOT personnel reviewing the principles and criteria, and one full day in the field examining the state of roadside ROWs.

In general, the performance standards were well received. We have not removed any of the Principles and Criteria based on field assessment experience, but we did add new criteria related to worker compensation and rights, and investments in organization infrastructure. These additions were modeled after FSC performance standards. We did shift the position of Principle 4 (management planning) from the operational level to the strategic level after this first application so as to clarify the larger role of planning in the total system. Operational-level planning still remains in Principle 9 (site-specific implementation of treatments).

### **What's Next for Vegetation Management Performance Standards and Assessment of ROW Organizations?**

Our NYSDOT assessment will be completed by year's end. A summary of findings from the assessment is currently being developed by SUNY-ESF for each principle and criteria. A report is being developed wherein each principle and criterion will have a series of highlighted strengths and weaknesses, sets of commendations for successes, and recommendations for program improvement.

Early on in the assessment process we learned that vegetation management on roadside ROWs is made complex by various related activities associated with siting and construction and hazard tree management. These operational areas of work need their own performance standards. For example, environmental stewardship in the transportation industry is affected by many different aspects of work, including snow and ice removal, road construction, and wetland mitigation. It is possible to have performance standards for each of these work areas. The performance standards presented in this paper are focused on within ROW vegetation management, but they could be tailored to meet other needs.

Introspective use of the performance standards by NYSDOT is laudable and will likely lead to growth by the organization as environmental stewards. Beyond that, it is our hope that the performance standards and the effort by NYSDOT will be a useful model to other vegetation management organizations, especially roadside vegetation management programs, and also other programs of vegetation management associated with electric transmission lines, gas pipelines, and railroads.

The IVM performance standards can be considered generic, in that they can be applied to a wide array of regions and organizations. It may be useful to tailor the standards by adding specific indicators that define region- or industry-specific elements of environmental stewardship. This is the process used for certification of sustainable forest management by FSC—generic, world-wide performance standards tailored for various regions in the United States.

SUNY-ESF and the NYSDOT will continue to work through the performance standards. We have learned much, and expect to learn more, and will continue to refine the standards, but their usefulness to a broader audience can only be improved with tests with other organizations. In order to improve the credibility and applicability of the IVM performance standards beyond NYSDOT and other local users, it may be necessary to have the standards sanctioned by some professional body, such as the Forest Stewardship Council for forestry or the Association of State Highway and Transportation Officials (AASHTO) for state transportation agencies.

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# **A APPENDIX: STANDARDS FOR ASSESSING PERFORMANCE OF INTEGRATED VEGETATION MANAGEMENT ON RIGHTS-OF-WAY**

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## **Principle #1: Compliance with Laws**

*Laws and regulations are constructs developed to protect natural resources and associated benefits and values accruable to society. IVM practitioners meet or exceed all laws, regulations, and guidelines related to vegetation management on ROWs.*

- 1.1. Vegetation management shall respect all national, state, and local laws and regulations, for example, use of pesticides by certified applicators, Best Management Practices and other protective measures for water quality that exist within the state or other appropriate jurisdiction(s) in which the operations occur.
- 1.2. Vegetation management areas should be protected from unauthorized activities.
- 1.3. Managers and practitioners shall demonstrate a long-term commitment to adhere to the IVM Principles and Criteria.
  - a) Where opportunities afford, IVM Principles and Criteria are explicitly supported in the public arena.
  - b) Commitment is well defined via environmental policy.

## **Principle #2: Tenure and Use Rights and Responsibilities**

*Sustainable land management, including vegetation management, requires that the land be properly vested, clearly owned, and demarcated.*

- 2.1. Clear evidence of long-term land use rights (e.g., land title or lease agreements) shall be demonstrated, including clearly identified, on-the-ground land boundaries.
- 2.2. Appropriate mechanisms shall be employed to resolve disputes over tenure claims and use rights.
  - a) Resource conflicts with adjoining landowners or other resource users are resolved or being addressed in a systematic and legal manner.

### **Principle #3: Community Relations and Workers' Rights**

*IVM shall maintain or enhance long-term social and economic well-being of vegetation management workers. A fairly compensated, respected, knowledgeable workforce is critical to long-term, sustainable vegetation management.*

3.1. The rights of workers to organize and voluntarily negotiate with their employers shall be guaranteed as outlined in Conventions 87 and 98 of the International Labor Organization (ILO).

- a) managers and their contractors develop effective and culturally sensitive mechanisms to resolve disputes between workers and management.
- b) workers are free to associate with other workers for the purpose of advocating for their own employment interests.

3.2. The communities adjacent to the vegetation management area should be given opportunities for other professional services from the vegetation manager such as:

representation in local civic activities, e.g., Earth Day cleanup, Arbor Day plantings, etc.  
contribution to public education about vegetation management practices in conjunction with schools, community colleges, and/or other providers of training and education.

3.3. Vegetation management meets or exceeds all applicable laws and regulations covering health and safety of employees, including the development and implementation of safety programs and procedures that include:

- a) well-maintained and safe machinery and equipment
- b) use of safety equipment appropriate to each task
- c) documentation and posting of safety procedures in the workplace
- d) education and training
- e) contracts with safety requirements
- f) safety records, training reports, and certificates

3.4. Appropriate mechanisms are employed for resolving grievances and for providing fair compensation in the case of loss or damage affecting the legal or customary rights, property, resources, or livelihood of local peoples. Measures shall be undertaken to avoid such loss or damage.

- a) managers attempt to resolve grievances and mitigate damage resulting from management activities through open communication and negotiation prior to legal action.
- b) managers and their contractors have adequate liability insurance.

3.5 Workers are fairly compensated for work, especially in wage levels as matched to the degree of skill and difficulty in job.

## **Principle #4: Management Planning**

*Documentation of philosophy, principles, procedures and practices are critical to long-term, sustainable management, as embodied by various levels of plans, including resource inventories and maps. Written plans cause managers to be held highly accountable for both successes and failures as judged against stated goals and objectives. Improvement in management practices are predicated on learning from both successes and failures.*

- 4.1. A strategic management plan and supporting documents must be in place that provide:
  - a) management policy and objectives
  - b) description of the resources to be managed (e.g., water, soil, wildlife, aesthetics) and socioeconomic conditions, and a profile of adjacent lands
  - c) description of the vegetation management system, based on the ecology of the ecosystem in question and information gathered through resource inventories
  - d) provisions for monitoring, including feedback mechanisms for revising procedures as appropriate to more effectively achieve objectives
  - e) environmental limitations and safeguards, based on environmental assessments
  - f) plans for biodiversity
  - g) maps describing the resource base
- 4.2. Tactical management plans are developed that report local considerations and activity plans on a year-by-year basis.
- 4.3. Strategic and tactical management plans shall be periodically revised to incorporate the results of monitoring or new scientific and technical information, as well as to respond to changing environmental, social, and economic circumstances.
- 4.4. A summary of vegetation management activities is produced annually, and both strategic and tactical management plans are revised at least every 10 years.
- 4.5. Workers shall receive adequate training and supervision to ensure proper implementation of the management plans.
- 4.6 Organization infrastructure, e.g., vegetation treatment equipment, including computers and GPS, is well developed and maintained to ensure proper implementation of the management plans.
- 4.7. While respecting the confidentiality of information, vegetation managers shall make publicly available a summary of primary elements of the management plan, including those listed in Criterion 4.1.

## **Principle #5: Understanding Pest and Ecosystem Dynamics**

*Knowledgeable managers and practitioners are needed. Being able to identify pests and desirable organisms in the managed system, and understanding the ramifications of management based on knowing life histories and ecosystem processes, is foundational knowledge for IVM.*

5.1. Vegetation managers are knowledgeable about the managed ecosystem, especially with regard to the basic biology and ecology of all organisms in the system, and the environment in which they live.

5.2. Research and development activities are engaged to produce missing basic information on ecology of the managed ecosystem.

5.3. Vegetation managers and practitioners are provided opportunities to improve their skills and knowledge through training.

## **Principle #6: Setting Management Objectives and Tolerance Levels**

*IVM, as developed from IPM, depends upon basic elements to function as a system. Tolerance levels are one of the top elements as part of IVM, whereby vegetation is only treated if critically necessary to meet objectives. Objectives are set in context of socioeconomics and environmental desires.*

6.1. Management planning, including the development of management objectives, shall incorporate the results of evaluations of social impact. Consultations shall be maintained with people and groups directly affected by management operations (see also Criterion 6.3 and PRINCIPLE #4).

6.2. Tolerance levels are used to develop thresholds for when vegetation management activities are applied to control vegetation.

6.3. People and groups affected by management operations are apprised of proposed vegetation management activities and associated environmental and aesthetic effects in order to solicit their comments or concerns.

6.4. Significant concerns identified in Criteria 6.1 and 6.3 are addressed in management policies and plans (for example, management activities are modified in response to concerns, or a rationale is provided for not responding to a concern).

## **Principle #7. Compilation of a Broad Array of Treatment Options**

*IVM does not focus on the use of one treatment; instead, every ROW management situation has a treatment prescribed only after considering all possible treatments. A full “toolbox” of treatments is needed to make this consideration full and robust.*

7.1. A wide variety of different mechanical, physical, chemical, cultural, and biological/ecological treatments are available for use/consideration on all sites.

7.2. New treatments are progressively evaluated and added to the vegetation management program, with emphasis on non-herbicide alternatives.

7.3. Where possible, treatments are featured that lead to, directly or indirectly, pest prevention and biological and ecological control of pests.

## **Principle #8: Accounting for Economic and Ecological Effects of Treatments**

*Cost effectiveness of treatments, in its broadest sense, is used as a basis for selecting treatments. A conservative, environmental approach is used that favors prevention. If control is needed, there is an effort to use non-synthetic pesticide alternatives and biological approaches.*

8.1. Vegetation management should strive toward economic viability, while taking into account the full environmental, social, and operational costs of vegetation management. Treatment choices are made with full consideration of cost effectiveness, including a wide array of positive and negative environmental externalities, as follows.

- a) water resources: perennial and ephemeral streams, wetlands, vernal pools, seeps (see also Criterion 8.5)
- b) wildlife: common plants, animals and their habitats, and imperiled, threatened, and endangered species and their habitats (according to state and federal statutory listings)
- c) biodiversity: efforts are made to control invasive, exotic plants; also, if state or federal listings and species databases indicate the likely presence of a rare, threatened or endangered species or plant community type, either a survey is conducted prior to management activities being carried out (to verify the species presence or absence) or the vegetation manager manages as if the species were present. If an applicable species and plant community type is determined to be present, its location is reported to the manager of the applicable database, and necessary modification are made in both the management plan and its implementation.
- d) aesthetics: visual impacts of treatments are assessed.

Written guidelines shall be prepared and implemented to address management of these resources.

8.2. Management systems shall promote the development and adoption of environmentally-sensitive, non-chemical methods of pest management and strive to minimize the use of chemical pesticides. If chemicals are used, proper equipment and training shall be provided to minimize health and environmental risks. (see also Criterion 1.1)

8.3. Chemicals are used to control plants only when non-chemical management practices have proven ineffective or cost prohibitive.

8.4. When chemicals are used, a section is included in the prescription that fully describes the risks and benefits of their use and the precautions that workers must employ. Records are kept to document the occurrence of pests, measures to control them, and incidences of worker exposure to chemicals.

8.5. Broken and leaking equipment and parts are repaired and removed from a right-of-way as they may contaminate a site with fuel, oil, or other chemicals; discarded parts are taken to a designated disposal facility. Equipment is not parked in riparian zones, or near groundwater supplies, where fluid can leak into them.

8.6. Chemicals, containers, and liquid or solid non-organic wastes including fuel and oil shall be disposed of in an environmentally appropriate manner at off-site locations. (see also Criterion 1.1)

8.7. Use of exotic species in planting is minimized, carefully controlled, and actively monitored to avoid adverse ecological impacts. Furthermore, use of exotic plant species is contingent on peer-reviewed scientific evidence that any species in question is non-invasive and does not diminish biodiversity. If non-invasive exotic plant species are used, the location of their use is documented, and their ecological effects actively monitored.

8.8. Special cultural, ecological, economic or religious resources shall be clearly identified, recognized and protected by vegetation managers.

### **Principle #9: Site Specific Implementation of Treatments**

*ROWS should be divided into ecologically- and socioeconomically-sensible management zones. These zones have vegetation management plans (prescription) that are contemporaneous in development and benchmarks for future evaluations of treatment success.*

9.1. Land management units are designated within right-of-way for areas that warrant different management treatments, for example, buffers to protect water resources, conservation areas, and vegetative communities that may cause a change in successional directions or rate.

9.2. Written prescriptions (or, operational plans) are used to describe/prescribe treatments on a land management unit basis, and justify treatment choices using ecological, socioeconomic, and administrative opportunities and constraints.

Prescriptions should include:

- a) Land management unit designation
- b) Description of current vegetation and environmental conditions
- c) Desired future conditions
- d) Definition of treatment
- e) Justifications for treatment based on tolerance thresholds (also see PRINCIPLE # 6) and ecological, environmental, socioeconomic, and administrative considerations
- f) Site-specific maps that detail land management units, and show important cultural and environmental features

9.3. Prescriptions and the decision to treat are based on contemporary inventories of vegetation and environmental conditions.

## **Principle #10: Adaptive Management and Monitoring**

*IVM has a self-improvement mechanism: vegetation management objectives are used to evaluate whether management outcomes are acceptable. Monitoring is the collection of appropriate data to judge successes and failures of vegetation management. Monitoring procedures should be consistent and replicable over time to allow comparison of results and assessment of change.*

10.1 Implementation of the strategic and tactical management plans are periodically monitored to assess:

- a) The degree to which the management vision, goals and objectives have been achieved
- b) Deviations from the plan
- c) Unexpected effects of management activities and other disturbances
- d) Social and environmental effects of management

10.2. Vegetation management should include the research and data collection needed to monitor, at a minimum, the following indicators:

- a) Condition of the right-of-way
- b) Composition and changes in the flora and fauna
- c) Environmental and social impacts of operations
- d) Chemical use
- e) Cost, productivity, effectiveness and efficiency of vegetation management

10.3. Results of monitoring shall be incorporated into the implementation and revision of the management plan.

10.4. While respecting the confidentiality of information, vegetation managers shall make publicly available a summary of the results of monitoring indicators, including those listed in 10.1.