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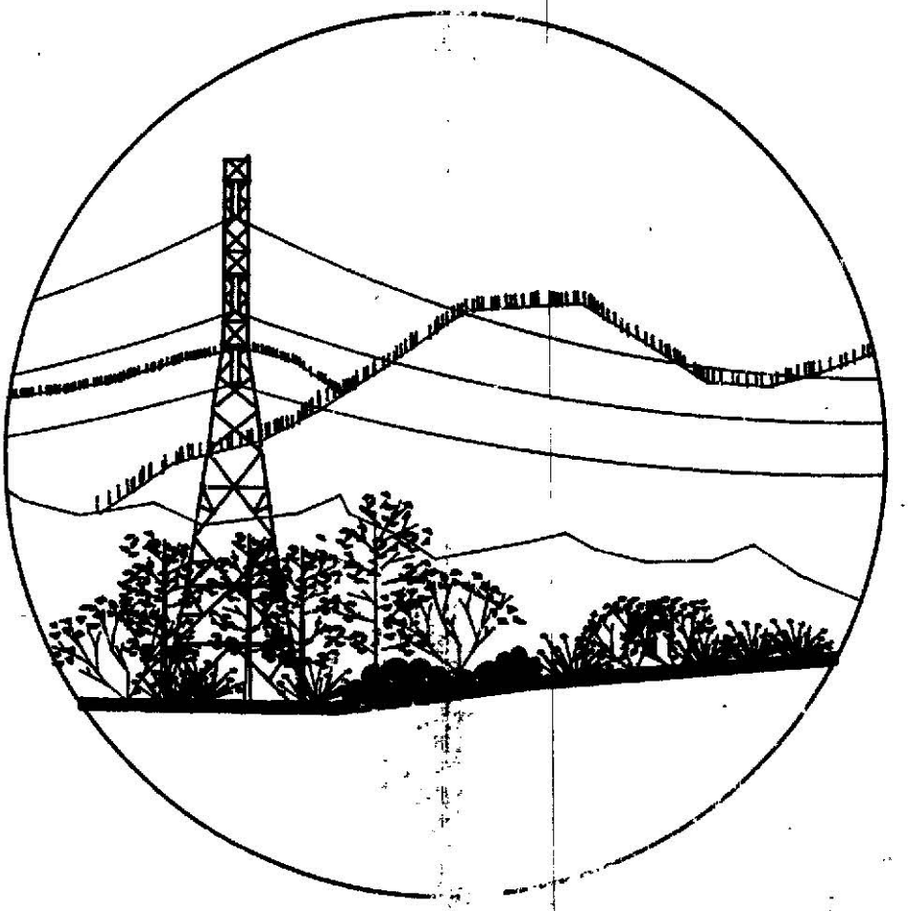
TRANSMISSION RIGHTS OF WAY VEGETATION MANAGEMENT PLAN

FINAL REPORT

PREPARED FOR

SEATTLE CITY LIGHT

PROJECT MANAGER
MARY SOLDT



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PROJECT MANAGER
DIANA E. DUKE

FEBRUARY 1990

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PROJECT MONITOR
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February, 1990

EXECUTIVE SUMMARY

In December of 1983, Seattle City Light (SCL) adopted policy and procedures for maintenance of the utility's transmission rights-of-way (ROW). Policy objectives highlight a concern for continual worker safety and uninterrupted transmission of power along the network system. The proper management of vegetation within and bordering the ROW corridors is, therefore, of primary importance. With regard to vegetation management, the Department's policy supported the aggressive investigation, evaluation and, where feasible, implementation of an integrated vegetation management approach along ROW corridors.

In response to its own Departmental goals and with a sensitivity to the multiple-uses inherent with the administration of the public lands within the Ross Lake National Recreation Area (NRA), SCL contracted a study to evaluate opportunities to enhance their Integrated Vegetation Management Program along the 20-mile segment of the Skagit line that transects the NRA. Vegetation management issues that are correlated with herbicide use, aesthetic impacts, and identification of threatened, endangered and sensitive plant species were targeted for evaluation.

SCL currently uses the herbicide dicamba (Banvel) to treat the noxious weed, tansy ragwort, and to control regrowth of cut broadleaf stumps. A comprehensive technical review of this compound and a similar review of appropriate herbicide alternatives has shown that a number of other compounds may have properties which are of use in the Department's Vegetation Management Program. Five compounds (glyphosate, imazapyr, sulfometuron, tebuthiuron and triclopyr) were included with dicamba in the data review process. A data matrix summarizing the toxicological, chemical and environmental fate properties of the compounds has been constructed. The data profile of all compounds is sufficient for making comparative use selections based on (1) the control need and (2) the environmental conditions of the surrounding areas. Comparative costs are also presented for equivalent hypothetical use situations.

The North Cascades Highway (SR20) is the primary transportation corridor that provides access to the numerous locations suitable for scenic viewing and recreation offered by the NRA. The Skagit Hydroelectric Power Project's 230 kV transmission system alignment runs parallel to much of this highway in the NRA.

An inventory was conducted of the Skagit transmission towers, lines and ROW corridor visible from the North Cascades Highway. Site reconnaissance and consultation with SCL personnel resulted in the identification of seven areas (Aesthetic Target Areas) in the project area that were recommended for visual impact reduction. The Aesthetic Target Areas are located along SR20 and within the Ross Lake National Recreation Area between Bacon Creek and Ross Dam. A range of vegetative management scenarios to mitigate the visual impacts of the seven Aesthetic Target Areas are proposed in the form of Vegetation Mitigation Management Prescriptions.

Field surveys were conducted to investigate the potential occurrence of threatened, endangered and sensitive species along the entire Skagit ROW corridor in the NRA. A list was developed of rare species that could potentially occur in the study area. Field searches were not limited to locating new populations of previously reported rare plants. Rather, a floristic survey was perfomed, where each species observed was identified to a taxonomic level that would allow a determination of its rarity. Results of the survey indicate that no rare plant populations occur in the study area. New populations of state or federally listed or candidate rare plants were not found during the field surveys. No modifications are required in vegetation management practices with regard for the protection to rare plant species.

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PROJECT INTRODUCTION

1.0 PROJECT INTRODUCTION

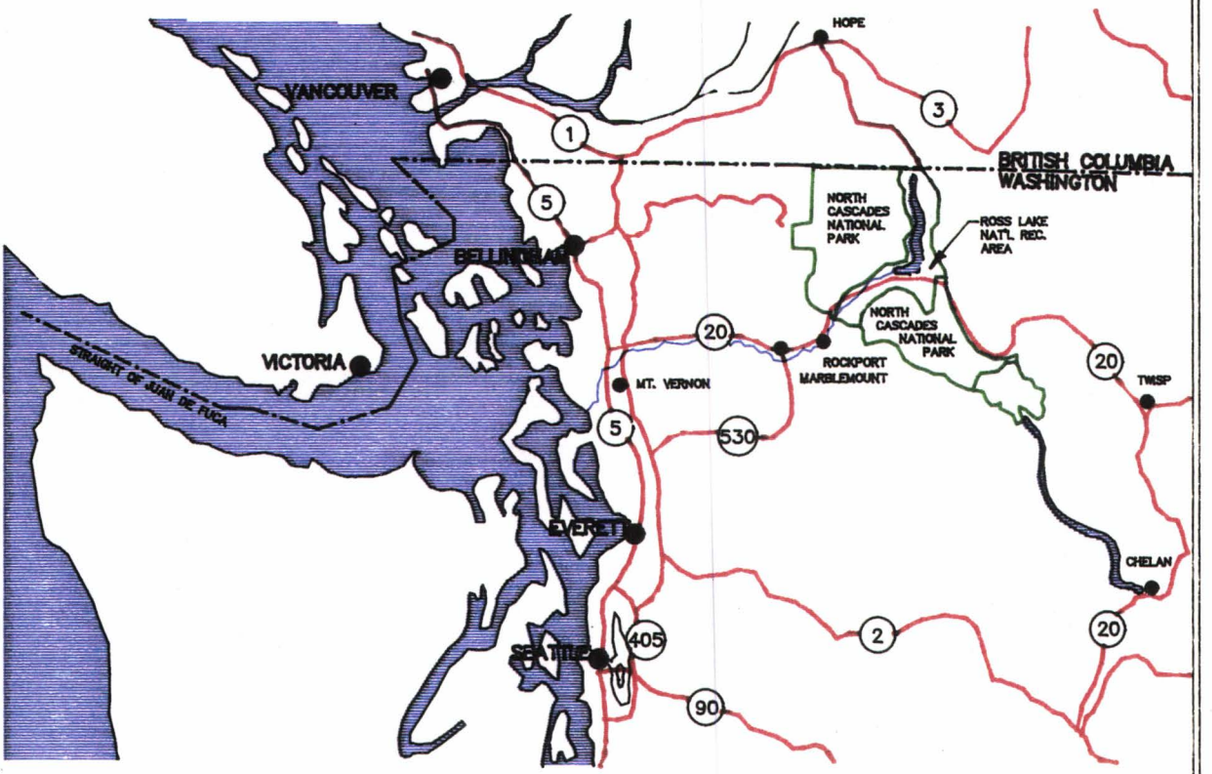
1.1 PROJECT STUDY AREA

The Ross Lake National Recreation Area (NRA) is one of four major and contiguous park units that comprise the North Cascades National Park Service Complex, an area which is noted for its natural scenic beauty and multitude of recreational attractions. The NRA divides the neighboring North Cascades National Park into its north and south units. Lake Chelan National Recreation Area is the third park unit of the complex. It is located at the southern boundary of the North Cascades National Park - South Unit. The configuration of the NRA follows the Skagit River drainage from the north at the Canadian/United States border southward and then continues in a general southwest direction. Lands within the Ross Lake National Recreation Area are administered by the National Park Service (NPS).

The project study area (Figure 1-1, Project Vicinity Map) is defined as the Seattle City Light (SCL) Skagit transmission line rights-of-way (ROW) corridors located in the NRA. The eastern boundary of the project study area is located at Ross Dam which is approximately 1,200 feet (ft) above mean sea level. The western boundary of the NRA is located at the confluence of the Bacon Creek tributary to the Skagit River (approximately 800 ft above mean sea level). The north and south boundaries of the project study area correspond with the ROW boundaries.

Of the 190 miles of ROW developed and maintained by SCL in northwestern Washington, approximately 20 linear miles of the utility's Skagit line transects the NRA. Figure 1-2, Project Transmission Line, overlays the 230 kV Skagit transmission line alignment on a project area base map. As depicted by this figure, the transmission corridor generally parallels both the North Cascades Highway and the Skagit River corridor. The Skagit transmission system consists of two lines. The line designated as the B line is situated to the north of and runs a parallel course to the southern D line. As shown in Figure 1-2, on a number of occasions, segments of the parallel lines split and temporarily run separate courses. The ROW width varies from 75 ft for wood-pole lines to 150 ft for each of the two steel lattice tower lines B and D.

The North Cascades Highway (SR20) was built by the state to provide recreation access to the North Cascades and Ross Lake. Additionally, it provides access to the three Seattle City Light hydroelectric power generation facilities located on the Skagit River. It presently provides one of the more popular scenic transportation routes across the Cascade Mountains.



SEATTLE CITY LIGHT TRANSMISSION RIGHT–OF–WAY VEGETATION MANAGEMENT PLAN	FIGURE 1–1 PROJECT VICINITY MAP

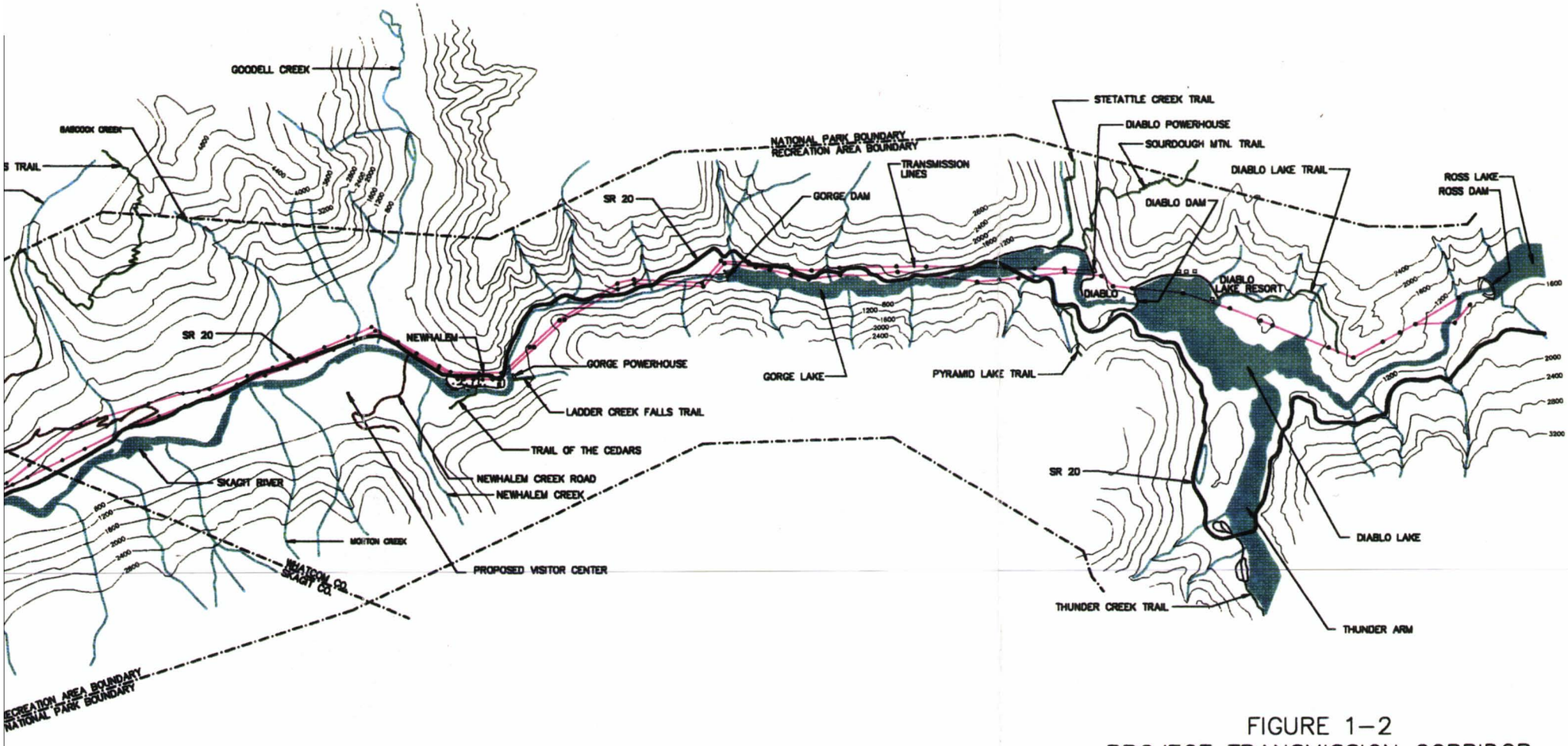


FIGURE 1–2
PROJECT TRANSMISSION CORRIDOR

LEGEND / NOTES

- POWERLINES AND TOWERS
- BOUNDARY LINE
- SR 20 ROADWAY
- SECONDARY ROADWAY
- DIRT ROAD

HERBICIDE USE EVALUATION

2.0 HERBICIDE USE EVALUATION

2.1 OPTIONS AVAILABLE FOR CHEMICAL WEED CONTROL

The purpose of this section is to support SCL's objective to make a thoroughly informed decision on herbicide use, current pesticide labeling, current and upcoming state regulations, and current practices of various other agencies as presented in this and the following sections, and to find the safest possible effective pesticide for current use and to evaluate Banvel in comparison.

SCL is primarily concerned with the control of tansy ragwort and cut stumps of alder, big leaf maple and birch, but anticipates a potential need to control the state-listed noxious weed, Russian thistle. For the purposes of this project, available chemical weed control methods were of interest. Consequently, we interviewed the Noxious Weed Control Program Supervisors in Thurston, Clallum, Pacific, Pierce and Lewis County with regard to their herbicide use on these species. Additionally, we spoke with the Supervisor of the State Department of Transportation's Roadside Maintenance Program, and to the State Department of Agriculture. The State Department of Agriculture was contacted in order to identify any particular use restrictions on state-registered herbicides which could apply to SCL's intended use areas. In conjunction with these investigations, we attended recent State Department of Agriculture hearings on pesticide use related to efforts in prevention of ground water contamination.

As a result of this information gathering process, we have developed not only a list of chemical options, but also have suggested a select number of compounds which may be of special interest to SCL. Discussions that follow (Section 2.1.1 through 2.1.4) summarize the results of our screening investigation.

2.1.1 Application Alternatives

Visual disturbance ("brown out") caused by the use of some non-selective compounds can be minimized by application methods or cultural practices, thus leaving some non-selective compounds on the final, shortened list. Application modifications include not only spot treatments with hand held equipment, but also the use of newer application technologies such as herbicide bullets, boluses (capsules) and injections for brush with significant

trunk diameter; or a rope, wiper and wick application for herbaceous species. Cultural practices include treatments of areas in bands or subsections, to minimize visual changes, or applications (where labeling permits) just before anticipated seasonal color changes from the greens of spring and summer to the typical autumn colors.

One area not investigated but of possible interest to SCL in the future is the use of plant growth regulators (PGR's). These compounds affect plant growth and competition and can be useful in certain weed control programs. There are both older chemistries (such as maleic hydrazide) and newer chemistries (yet to be fully marketed) which could be of use in certain areas. PGR's are an active research area for companies with rights-of-way weed and tree control needs.

2.1.2 Explanation of Pesticide Terminology

The terms **"parent chemical"** and **"parent compound"** refer to the herbicidal chemical itself, such as glyphosate or imazapyr. A **"formulated product"** or **"formulation"** is the tradename end-use product sold to the customer ready for dilution and application, such as Spike, Roundup or Banvel. A formulation may be in any of a number of forms. Spike, for example, is available in the form of pellets for broadcast on the ground and subsequent controlled release of the herbicide, as well as a **"dry flowable"** (DF) form that mixes easily with water. Other formulations may be dry forms such as **"emulsifiable concentrates"** (EC), **"wettable powders"** (WP), **"granulars"**, or they may be **"liquid concentrates"**. Manufacturers attempt to tailor formulations to achieve specific needs such as long release time, ease of application, more even coverage, and reduced toxicity.

Formulated products consist of the **"active ingredient"**, which may be either the **parent compound** or a slightly modified form of the compound termed a **"salt"**, such as a dimethylamine or isopropylamine salt. In addition, formulations may contain one or more of the following: emulsifiers, solvents, dispersants, carriers, wetting agents, and preservatives, as well as other materials. The environmental behavior of an active ingredient, its toxicity to fish and wildlife, and its efficacy may vary depending on the nature of the formulated product and active ingredient employed, whether parent compound or salt; the salt generally being less toxic to wildlife after application than the parent compound. Some parent compounds are not suitable for use in any formulation due to their chemical or physical properties (solubility, susceptibility to rapid breakdown from sunlight or con

tact with water, excessive toxicity), and only salts are used in their formulations. The active ingredient to be used in a particular formulation is chosen to meet a specific set of application/usage needs such as compatibility with other pesticides, solubility, specific target vegetation, aquatic use, specific chemical characteristics necessary to make a formulation, and so on. Ultimately, however, the environmental fate of a compound after application is nearly always the same regardless of whether the formulation contains the parent compound or a salt.

The word **"pesticide"** is a general term in the industry that includes herbicides, fungicides, insecticides and rodenticides.

A pesticide **"label"** is a more authoritative document than the label on an average consumer product, for instance, a can of corn. All of the wording on a pesticide label is closely regulated by the United States Environmental Protection Agency (USEPA), including the target species, application rates, application timing and the number of applications. It should be emphasized that label instruction are not suggestions: they represent federal and state regulations as to how the product may be used. All pesticide labels carry the statement **"It is a violation of Federal law to use this product in a manner inconsistent with its labeling".**

2.1.3 Herbicide Compounds Available for ROW Uses

Based on a comprehensive review of currently registered herbicides commonly in use in Washington for purposes similar to SCL's needs, a list of most frequently used compounds was developed (Table 2-1). This list is not meant as a recommendation for use of a particular product, but is instead presented to show the spectrum of compounds available and in use in situations similar to those of transmission line ROW maintenance. A comprehensive list of active ingredients (not mixtures) used on the west coast and registered for ROW uses is presented in Table 2-2. For reasons pertinent to SCL's needs, based on preliminary decision criteria such as elimination of Category I compounds and elimination of phenoxy compounds, some compounds on these lists can be eliminated based on factors related to and characteristics of certain types of herbicides.

TABLE 2-1
COMPOUNDS COMMONLY USED FOR RIGHT-OF-WAY
WEED CONTROL IN WASHINGTON

COMPANY	COMPOUND	TANSY	BRUSH	NOTES
Rhone-Poulenc	Amiben	X		Non-selective
	Amizine	X	X	Contains Simazine
	Amizol	X	X	ROW Labeled Contains Amitrole
	Buctril	X	X	May be useful on Russian Thistle
	Envert 171	X	X	ROW Labeled Contains 2,4-D
	Weedar	X	X	2,4-D formulations
	Weedone	X	X	ROW Labeled Contains 2,4-D
Cyanamid	Atrazine	X	X	Triazine, residual
Fermenta	Bueno 6	X	X	MSMA (arsenical)
	Decamine 4D	X	X	2,4-D formulation
Uniroyal	Ded-Weed Sulv	X	X	2,4-D formulation
DuPont	Hyvar	X	X	Bromacil can move
	Karmex	X	X	Diuron used by WDOT
	Krenite	X	X	Non-selective
	Krovar	X	X	Mixture of bromacil and diuron
	Velpar	X	X	Hexazione
Ciba-Geigy	Atrazine	X	X	Triazine, residual
	Atratrol	X	X	Triazine, residual
	Pramitol	X	X	Triazine, residual
	Simazine	X	X	Triazine, residual
ICI	Gramoxone	X	X	Paraquat; highly toxic
Sandoz	Weedmaster	X	X	Dicamba + 2,4-D

SOURCE: Pacific Northwest Weed Control Handbook, 1988, and CSI interviews with Noxious Weed Control Supervisors.

TABLE 2-2
COMPREHENSIVE LIST OF COMPOUNDS REGISTERED FOR
NON-CROPLAND WEED CONTROL

Amitrole (various trade names)	Imazypyr (Arsenal*, Chopper*)
Ammonium sulfamate (Ammate*)	Magnesium chloride ("salt")
Atrazine (Aatrex*)	Metasulfuron-methyl (Escort*)
Bensulide (Betasan*)	MSMA (Daconate*, Bueno*)
Bromacil (Hyvar*, Krovar*)	Oryzalin (Surflan*)
Bromoxynil (Brominal*, Buctril*)	Oxadiazon (Ronstar*)
Cacodylic Acid (Phytar*)	Oxyfluorfen (Goal*)
Chlorflurenol (Maintain*)	Paraquat (Gramoxone*)
Chloramben (Amiben*)	Petroleum oil (Agri-Dex*)
Chlorsulfuron (Telar*)	Prometon (Pramitol*)
Dicamba (Banvel*)	Sethoxydim (Poast*)
Dichlobenil (Casaron*)	Simazine (Princep*)
Diphenamid (Dymid*)	Sulfometuron-methyl (Oust*)
Diquat (Diquat*)	Tebuthiuron (Spike*)
Diuron (Karmex*)	Triclopyr (Garlon*)
DSMA (various trade names)	Trifluralin (Treflan*)
Fluazifop (Fusilade*)	2,4-D (Weedar*, etc.)
Fosamine (Krenite*)	MCPA
Glyphosate (Round-up* or Rodeo*)	
Hexazione (Velpar*)	

*Registered tradename for the chemical formulation containing the active ingredient named.

SOURCE: Specimen label books of all major manufacturers and composit of interviews with state and private personnel.

2.1.4 Screening Criteria for Final Compounds to be Researched

Residual Compounds: Compliance Services suggests that broad-spectrum residual compounds, such as triazines, organic arsenicals and other persistent herbicides be dropped from consideration for the uses proposed here. Use of such compounds in the vegetative areas with which SCL is concerned is likely to result in the creation of bare soil "windows," where new weed seedlings of the same or alternate pest species can quickly become reestablished. Non-residual or selective compounds are better suited for use in an integrated management program, where techniques such as increasing competitive (non-noxious) vegetation can bring biological competition to a treated site, thus discouraging or delaying the reestablishment of undesirable species.

Regulatory Constraints: There are some compounds which require special handling or use patterns. For example, picloram cannot be used west of the Cascades, and use restrictions apply to 2,4-D formulations in some Washington counties. Also, the State Department of Agriculture has published a list of state-restricted pesticides, based on their efforts to prevent ground water contamination. Listed compounds will require purchase limitations and record keeping requirements similar to federally restricted use products. The final list of regulated compounds is provided here in Table 2-3. WAC 16-228-162 (Rules Relating to General Pesticide Use) also places certain restrictions on dicamba and phenoxy-hormone type herbicides (2,4-D, MCPA, and related compounds), largely in response to the use of such compounds in the vicinity of vineyards. Grapes are extremely sensitive to low amounts of phenoxy compounds.

Performance on Target Species: Compounds selected for review should be efficacious on cut stumps of alder, birch and big-leaf maple, tansy ragwort, and/or Russian thistle. Compounds should be effective on at least one of these three target species in order to be useful in SCL's vegetation management program.

Compounds in Noxious Weed Control Programs within Washington: Various agencies within the state are faced with legal requirements for control of undesirable and noxious plant species. All state counties, except King County, fund a Noxious Weed Control Board, which in turn manages county-wide noxious weed eradication. The State Department of Natural Resources and the State Department of Transportation also have roadside, forestry and noxious weed control programs. The compounds most often used as polled by telephone interviews of county or agency vegetation management supervisors are listed in Table 2-4. Other compounds used throughout the state are noted in the attached sections excerpted from the 1988 Pacific Northwest Weed Control Handbook (Appendix A).

TABLE 2-3
STATE RESTRICTED USE PESTICIDES FOR USE BY CERTIFIED APPLICATORS ONLY

COMMON CHEMICAL NAME	SELECTED TRADENAMES
Alachlor*	Lasso
Aldicarb	Temik
Atrazine*	Aatrex, Atratol
Bromacil*	Hyvar, Krovar
Carbofuran	Furadan
Cyanazine*	Bladex
1,3-Dichloropropene	Telone
Disulfoton	Di-Syston
Diuron*	Karmex, Krovar
Heptachlor	----
Hexazinone*	Velpar
Metolachlor*	Dual
Metribuzin*	Lexone, Sencor
Oxamyl	Vydate
Picloram*	Tordon
Prometon*	Pramitol
Simazine*	Princep
Tebuthiuron*	Spike

*These products are herbicides

SOURCE: Rules Related to General Pesticide Use (WAC 16-228-162)

TABLE 2-4
COMPOUNDS MOST COMMONLY USED IN WESTERN WASHINGTON
NOXIOUS WEED CONTROL PROGRAMS

ACTIVE INGREDIENT	NOTES
2,4-D and combinations	Various formulations
Triclopyr	Trade name "Garlon", as well as others
Metasulfuron-methyl	Escort
Chlorsulfuron	Telar
Glyphosate	Round-up
Dicamba	Banvel,predominately as "Weedmaster"
Tebuthiuron	Spike

SOURCE: Telephone interviews with Noxious Weed Control Supervisors, WDOT Landscape Maintenance Supervisor, and chemical company technical representatives.

2.1.5 Options of Highest Interest

Based on the considerations above and upon knowledge of the general properties of various compounds, certain herbicides from the lists above can be eliminated from consideration for use by SCL. Additionally, in 1981, SCL made the decision to drop the use of phenoxy compounds from their program. SCL has confirmed that this decision still stands, although a substantial amount of new data has been produced, especially on 2,4-D and 2,4-DP, since 1981. These actions are in accordance with the major criterion for herbicide selection, which is minimum health and environmental impact.

Table 2-5 presents a shortened list of herbicides which are believed to be of potential in SCL's vegetation management program. All of these products, save one, are currently in use in various other noxious weed control programs. The only compound not found to be in use are formulations of Imazapyr. This may be due to the fact that it has been very recently registered and not well known, or may be due to efficacy or other properties not known to us at this time.

These compounds were selected by SCL for detailed review. Because the sulfonylurea class of herbicides contains a large number of compounds with similar properties, a representative compound, sulfometuron-methyl, was selected to give an overview of the behavior and fate of this compound class. This compound was chosen because it has been in use for some time in many areas, and we believed more information would be available relating to it than to other sulfonylureas. Other factors considered in the final decision to research the six herbicides listed in Table 2-5 include available information on basic compound characteristics. This basic information is presented in Table 2-6.

TABLE 2-5
COMPOUNDS OF INTEREST FOR RIGHT-OF-WAY MAINTENANCE

MANUFACTURER	COMPOUND	TANSY	BRUSH	NOTES
Cyanamid	Imazypyr	X	X	Imazapyr is a fairly new chemistry. Some tradenames are Arsenal and Chopper.
Monsanto	Glyphosate	X	X	Short lived compound, tradenames are Accord, Round-up, Rodeo, and others
DuPont and others	Sulfonylureas	X	X	Extremely low rates required
Elanco	Tebuthiuron	X	X	Similar to above compound
Dow	Triclopyr	X	X	Especially good on brush
Sandoz	Dicamba	X	X	Currently used by SCL

SOURCE: Specimen labels for compounds named.

TABLE 2-6
RANGES FOR ACTIVITY VALUES - HERBICIDES OF INTEREST

COMPOUND	RAT ORAL LD50	MODE OF ACTION	NOTES
Dicamba	1707 mg/kg	Systemic	Absorbed by both leaf and root
Glyphosate	4900 mg/kg	Systemic	Absorbed by leaf only
Imazapyr	5000 mg/kg	Systemic	Absorbed by both leaf and root
Sulfonylureas	>5000 mg/kg (generally)	Systemic	Absorbed by both leaf and root
Tebuthiuron	644 mg/kg	Systemic	Absorbed primarily by root
Trichlopyr	630 mg/kg	Systemic	Absorbed by both leaf and root

SOURCE: Farm Chemicals Handbook, 1989. (Meister Publishing)

2.2 OVERVIEW OF COMPOUNDS AND RESEARCH

The final list of parent compounds ("active ingredients") which may be of use in SCL's vegetation management program were reviewed by the appropriate SCL personnel so that, in turn, Compliance Services could proceed on the compilation of data on Dicamba and other compounds of interest. Labels for some common formulations of the active ingredients of interest are presented in Appendix B.

2.2.1 General Compound Characteristics

The compounds selected for final evaluation have a fairly similar set of characteristics in that:

- all of these compounds are relatively short-lived in soil under typical Western Washington forest and grassland environmental conditions,
- all of these compounds are of fairly low acute toxicity,
- all of these compounds come in various formulations which provide diverse ranges of selectivity,
- all of these compounds are of relatively low environmental impact (non-target organisms and persistence properties) when compared to some compounds already eliminated from the final list, and
- all of these compounds are very competitive in the marketplace from a cost perspective.

In addition, the sulfonylureas and tebuthiuron are better suited to broadcast applications or treatment of strips or large areas.

Data on these compounds were gathered from two primary sources: published literature (by means of computerized database search) and summaries supplied by the appropriate manufacturer of each active ingredient.

2.2.2 Search Strategy

Information was collected for the purpose of completing a "data matrix" which gives a summary of compound information by category. The categories of division (which correspond to USEPA Guide-

lines for Pesticide Registration, Title 40 of the Code of Federal Regulations, Part 158) are selected from the USEPA data requirement categories for compounds registered for use on noncropland and in forests. A summary of those categories is presented in Appendix C. Data not available in published literature was obtained directly from chemical manufacturers for any study categories not filled by published literature but required by the USEPA for pesticide registration.

In order to locate relevant literature citations, computer online database searches were made using the Dialog Information Service. Several chemical information databases within Dialog were searched for relevant citations. The nature of these sources and their identity are given in Table 2-7.

In conducting a database search, criteria are entered for the information service to match. For example, the words "toxicity" and "reproductive" are searched for, in combination with the synonyms and Chemical Abstracts Services Number for the compound of interest. The count of literature citations matching those criteria are returned by Dialog and may be printed off-line and mailed to the searcher. The articles listed in the citations are then acquired from libraries, universities and similar sources for review.

Initially, a search was made of Analytical Abstracts, The Agrochemicals Handbook, Agricola, and CA Search (Chemical Abstract Services On-Line) asking for matches based on the six herbicides of interest. As expected, the Agrochemical Handbook had one entry per chemical, which we had printed. Analytical Abstracts returned a total of 46 citations, ranging from one each for imazapyr and triclopyr to 25 for glyphosate. These were not printed, as we did not require analytical methodology data, but the search indicated the quantity of information available if required. The Agricola search indicated a total of 391 (1970-1978) and 1108 (1979-1989) articles concerning the six herbicides. CA Search is divided into five databases, each covering part of the period 1967-1989. Returns within the databases ranged from zero for several of the herbicides at various periods to 596 and 660 for glyphosate (1977-1981 and 1982-1986). A total of 2,960 citations were found in CA Search (1967-1989) for all six herbicides.

2.2.3 Data Reporting

When the printouts were received, they were screened to select the citations most likely to be relevant, on the basis of title

and any other information given, such as keywords. Articles or papers occurring in journals or books that are not commonly available were eliminated. Ultimately, 1297 articles of interest were identified. A search for the selected subset of citations was then made in various libraries in Washington and Oregon which are likely to have collection which contain the cited professional journals and books. Copies of 143 scientific papers were obtained and carefully reviewed for relevant data and to evaluate the validity of the data presented. These papers are listed in a bibliography that forms Appendix D.

TABLE 2-7
DIALOG INFORMATION SERVICES - DATABASES SEARCHED

DATA SET NAME	YEARS	DESCRIPTION OF CONTENTS
The Agrochemical Handbook	General	Repository of basic information regarding agrochemicals such as physical characteristics, environmental fate data and toxicity data. Data on each pesticide is very condensed and typically one page long.
Analytical Abstracts	1980-89	Contains primarily data on pesticide analytical methodology, with occasionally other data on the pesticides.
Agricola (2 subfiles)	1970-78 1979-89	Deals primarily with data on agriculture, soil science and weed and pest control.
Chemical Abstracts (5 sub-databases)	1967-71 1972-76 1977-81 1982-86 1987-89	Perhaps the most complete source of general information regarding chemicals

SOURCE: Dialog Information Services Product Catalog - Index to Data Bases, 1989.

Data from reviewed articles found to present sound (valid and scientifically acceptable) data were grouped into categories based on the USEPA Pesticide Registration Data Requirements presented in Appendix C. Data that was unsound or suspect was rejected and not included in the data matrix. This rejection was based solely on the validity of the data itself, and not on its content. That is, rejection was not based on what the data said, but only on whether the data were generated from, or supported by, scientifically valid research as evidenced in the article being reviewed. Therefore, no bias was introduced in the data selection process.

2.3 HERBICIDE DATA MATRIX

The resulting Data Matrix is presented in Tables 2-8a through 2-8f. A list of the abbreviations used in the tables and their meanings is presented as Table 2-9. These tables are lenghty and for ease of review are presented at the end of Section 2.3. Additional terms are presented in a USEPA Glossary of Environmental Terms as Appendix E.

Only information that is supported by the above sources and is, in our opinion, valid, has been included in this data summary. Where conflicting data were reported in two or more papers, we have used our experience and professional judgment in evaluating the data for presentation. In some cases, we have included more than one value for a parameter; this does not indicate that one or more of the values must be in error. Quite often, minor differences in testing conditions employed by different researchers can yield different results for nominally the same type of test. This is especially true when tests are conducted in the highly variable heterogeneous real world of soil, living systems, forests, natural waters, sunlight and air.

Despite the large number of information sources, a few gaps still exist in the data for some compounds. This is particularly true for the newer compounds that have not been investigated by scientists outside of the manufacturers' laboratories. Despite all efforts, this information has not been obtainable. These data gaps do not represent a significant barrier to the evaluation of a particular herbicide in view of the available information in related categories.

Some of the six compounds are used in formulations as the parent compound while others are only usable as their chemical salts. In order to standardize the comparison of data between the compounds, the information presented in the data matrix pertains to the parent compounds themselves (e.g. triclopyr, dicamba, tebuthiuron), rather than to any of their salts (dimethylamine salt, potassium salt, etc.).

As stated above, data matrix categories are based on USEPA regulatory requirement classifications. Many of the EPA data requirements, particularly product chemistry (e.g. explodability, melting point) and residue chemistry, would have no particular relevance to SCL's decision-making process and were not included. The following is an overview of the data categories in the data matrix with explanatory comments for some of the categories that may not be familiar to those not in frequent contact with this material. The comments below are arranged in the same order as in the data matrix.

2.3.1 Identification

2.3.1.1 Compound -

The common name of the "parent chemical"; one of the six investigated.

2.3.1.2 Typical Formulated Products -

Selected examples of formulations. Commonly used salts are noted.

2.3.2 Chemical Data

2.3.2.1 Chemical Name -

The exact, descriptive name(s) for the parent compound as used by the manufacturer on the product label and as required by the professional naming conventions, IUPAC and CA (See Table 2-9). Because of differences in their approaches to nomenclature, the IUPAC and CA names will usually be different, although both are "correct". They are presented here for reference purposes and exact identification of the compounds.

2.3.2.2 Signal Word/Toxicity Class -

The USEPA requires every formulated pesticide to display a "signal word" [danger and danger poison (Category I), warning (Category II) or caution (Categories III and IV)] on its label depending on the level of oral, dermal and inhalation toxicity and the potential for eye and dermal irritation of that formulation. This entry pertains to the typical formulated products above. A more detailed listing of the classifications is given in Table 2-10, while USEPA's criteria for inclusion in the various categories are presented in Table 2-11.

2.3.2.3 Molecular Formula, Molecular Weight -

Data pertaining to the parent compound.

2.3.2.4 CAS Number -

A number assigned to the parent compound by Chemical Abstract Service that is internationally recognized. A unique identifier.

2.3.2.5 Solubility -

The water solubility of the parent compound. Where available, solubility in a light alcohol and acetone have also been included for comparison.

2.3.2.6 Vapor Pressure -

This parameter indicates the volatility of the compound. Compounds with high vapor pressures tend to volatilize or evaporate from the surface of the soil and foliage following application.

2.3.2.7 Dissociation Constant -

The higher this number, the greater the tendency for the parent compound to dissolve in water and to form salts.

2.3.2.8 Octanol/Water Partition Coefficient -

A measure of the tendency of the parent compound to migrate from a water solution into octanol (an 8-carbon alcohol that is a lipophilic solvent) when the liquids are shaken together. The higher this coefficient (that is, the more of the parent compound that will migrate into solution in octanol), the more likely the

material is to pass from water into fish tissue and to accumulate there.

Regulatory agencies use this parameter to judge potential bioaccumulation in organisms. The USEPA considers that a potential for adverse effects exists if the coefficient is greater than 1000.

2.3.2.9 pH -

The pH of a solution of the parent compound in water at standard test concentrations.

2.3.2.10 Stability -

The stability characteristics of the parent compound.

2.3.2.11 Corrosiveness -

The corrosiveness of the parent compound, with particular regard to metals that may be encountered in spray application equipment.

2.3.3 Environmental Fate

2.3.3.1 Animal Metabolism -

Data regarding metabolism and elimination of the parent material by animals is presented here, along with the identity of any significant metabolites found in the literature search.

2.3.3.2 Plant Metabolism -

The same type of data as Section 2.3.3.1., but for plants.

2.3.3.3 Mode of Action -

This entry is a general statement of the compound's method of uptake by the plant and the manner in which it acts as an herbicide.

2.3.3.4 Hydrolysis -

Hydrolysis is a term describing the tendency of a chemical molecule to break down into other forms or into fragments as the result of the action of water. The term does not pertain to

solubility, but to an actual chemical change. Compounds that are susceptible to hydrolysis are more likely to be broken down by the action of rain, irrigation, or soil interstitial water than those that are not. This usually ends their effectiveness as herbicides.

2.3.3.5 Photodegradation -

Also known as "photolysis", this term describes the breakdown of a molecule by the action of light, usually the more energetic near-ultraviolet wavelengths of light found in sunlight. Chemicals liable to photodegradation are susceptible to breakdown while on the surface of soil or on foliage, particularly during seasons with long days. Like hydrolysis, this usually renders them ineffective as herbicides.

2.3.3.6 Soil Metabolism -

All of the six herbicides considered in this data summary are eventually broken down to yield "degradation products" or "metabolites" if they move into the soil. The most frequently encountered cause of this breakdown is uptake and incorporation by soil microflora (bacteria, fungi, etc.) and subsequent metabolism by these microorganisms. The resulting products are termed "metabolites". If excreted by the microflora, the metabolites may in turn be subject to hydrolysis, further metabolism, or inorganic chemical changes. Frequently, though not always, the metabolites are less toxic than the parent compound, and are usually not effectively herbicidal. The atoms from many herbicides that are metabolized end up being incorporated in cell constituents by microflora; the carbon is frequently respired as carbon dioxide. An herbicide that binds strongly to soil particles may become unavailable to microorganisms.

In addition to biological breakdown, some compounds also undergo hydrolysis in the soil, or break down as the result of interaction with soil chemical constituents. A few are not broken down by microflora to any significant degree. The reaction products of these inorganic processes may be termed "degradation products", although that term is sometimes also used for the results of microflora action. Degradation products will subsequently undergo biological and/or chemical breakdown.

2.3.3.7 Soil Half-Life -

The time required for the active ingredient in a formulated product to reach half of the amount present in the soil or on the soil surface immediately following application is termed the "half-life". By definition, products with longer soil half-lives are more "persistent". It should be noted that the half-life time (x days or weeks, etc.) does not necessarily define the effective life of the material. The effective life of an application of a particular soil-acting herbicide may be one half-life or several half-lives, depending on the formulation and the sensitivity of various plant species.

2.3.3.8 Aquatic Metabolism -

This data category is similar to Soil Metabolism (Section 2.3.3.6.), but refers to processes occurring in bodies of water and their sediments (streams, rivers, lakes, swamps, etc.).

2.3.3.9 Aquatic Half-Life -

Similar to Soil Half-life (Section 2.3.3.7.); however this parameter refers to persistence in water bodies and their sediments.

2.3.3.10 Soil Leaching/Mobility -

The movement of herbicides through the soil may be generally regarded as occurring with the downward (and to some extent, lateral and upward) movement of soil water as the result of rain or irrigation. The mobility of herbicides in soil is dependent upon several factors. Some herbicides chemically bind or "adsorb" to soil minerals and may subsequently unbind or "desorb". Adsorption delays or prevents movement of the chemical through the soil, while desorption frees herbicide back into soil water, usually slowly. A large proportion of herbicides exhibit greater soil adsorption if the soil contains a higher percentage of organic matter or clay.

A few herbicides display little or no soil adsorption and tend to move fairly readily through the soil. These materials do not necessarily represent a groundwater contamination potential unless they exhibit very long half-lives, are applied in excess of labelled rates, or if the groundwater is shallow. On the other hand, herbicides with lower soil adsorption potentials may be carried laterally in surface runoff water if significant rain or

irrigation events occur within a few hours to several weeks after application.

The terms "K_{oc}" and "K_d", termed "soil/water partition coefficients", found in this category in the tables are indications of the soil mobility potential of a compound. K_{oc} indicates the mobility potential with regard to soil organic carbon content, while K_d is a general indication of mobility potential with regard to a particular soil type, regardless of the organic carbon content. The higher the value of either number, the lower the potential for mobility through the soil. It should be noted that the K_d or K_{oc} value will differ from soil to soil for a given compound, depending upon a number of factors such as soil composition, soil chemical characteristics, and organic carbon content.

2.3.3.11 Accumulation in Non-target Organisms -

The term "non-target organisms" is used here to specifically refer to animals. The entries here are essentially summary statements that take several factors into account, such as octanol/water partition coefficient and routes and speed of metabolism and excretion in animals. These statements are usually direct quotes from published papers or manufacturers' technical bulletins.

2.3.4 Toxicity

The values and comments reported for the categories in this section are the results of a series of specifically-delineated, standardized tests required by USEPA to be conducted for the registration of an herbicide.

2.3.4.1 Acute Oral LD_{50} -

This is perhaps the most frequently cited toxicity parameter. It is the amount of parent material that is statistically calculated as causing death in one-half of the animals (LD_{50}) exposed, usually given in a single oral dose. The standard test animals are usually laboratory rats. Results are usually expressed as milligrams of test compound per kilogram of animal body weight (mg/kg).

2.3.4.2 Acute Dermal LD_{50} -

Test material is applied to the shaved skin of a test animal, usually a rabbit, and allowed to remain for 24 hours. The LD_{50} is calculated as the concentration of the material, in mg/kg of body weight, that kills half of the test animals exposed at that dose.

2.3.4.3 Acute Inhalation LC_{50} -

Test animals, usually rats, are exposed to a compound in the form of a dust or aerosol, depending on the chemical, for four hours. The LC_{50} is the calculated concentration, expressed as milligrams of compound per liter of air (mg/liter) at which half of the test animals die.

2.3.4.4 Eye Irritation -

The test material is applied to one eye of a laboratory rabbit and cleansed out after 24 hours. The resulting injury to the eye, if any, is then reported as the test result using a standardized reporting scale. Compounds signal-worded as "Danger", without skull and crossbones, typically are labelled in this manner due to their ability to cause irreversible eye damage.

2.3.4.5 Skin Irritation -

A patch with the test material on its surface is placed in contact with the shaved skin of a test animal, usually a rabbit, and allowed to remain for four hours. The resulting irritation or damage, if any, is reported as the test result using a standardized reporting scale.

2.3.4.6 Skin Sensitization -

The shaved skin of a guinea pig is subjected to multiple small doses of the test compound, followed by a resting period, then a "challenge dose" to determine if sensitivity (i.e. allergy) to the material has occurred. The resulting skin response is reported as the test result.

2.3.4.7 Subchronic - Rat -

Typically a 3-month feeding study with a fixed concentration of test compound mixed with the animal's food for the entire test period. Body weight, growth, health, blood parameters and serum

chemistry are evaluated throughout the trial, and organ weights and pathology are evaluated at the end of the study. Results are usually reported as the highest concentration of the compound in the feed at which there were no observed adverse effects (NOAEL, see Table 2-11). The feed concentration may also be reported as mg of test compound/kg of animal body weight/day.

2.3.4.8 Subchronic - Nonrodent -

The typical test animal here is the dog, although other animals are sometimes used. Same as the subchronic rat study (Section 2.3.4.7.), although the duration of exposure may be longer.

2.3.4.9 Chronic - Rat -

This test is essentially the same as the subchronic rat study (Section 2.3.4.7.), but runs for two years.

2.3.4.10 Chronic - Other -

This is essentially the same as the subchronic rat study (Section 2.3.4.7.), but is run for a longer period. If the test animal is a dog, the test typically runs for one year; if a mouse, 18 months is the usual duration.

2.3.4.11 Oncogenicity - Mouse -

"Oncogenicity" is the tendency of a compound to induce tumor formation (i.e. "cause cancer"). This study is similar to the "chronic - other" study (Section 2.3.4.10.), but tests and observations of the animals are specifically targeted at identifying malignancies and benign tumor induction.

2.3.4.12 Oncogenicity - Other -

The "other" animal is frequently a rat, in which case this test can be combined with the chronic rat study (Section 2.3.4.9.). Otherwise, a separate test is conducted in a manner similar to the mouse oncogenicity study (Section 2.3.4.11.).

2.3.4.13 Teratogenicity - Rat -

Essentially, "teratogenicity" refers to the ability of a compound to cause malformation of fetuses in pregnant animals exposed to the compound at a dose which does not affect the mother. Pregnant

rats are fed a single high dose during the most critical phase of the gestation period. The highest dose of the range tested is typically high enough to produce observable toxic, but not fatal, effects in the mother. The animal is then sacrificed and the fetuses are observed for malformation.

2.3.4.14 Teratogenicity - Other -

Same as the rat teratogenicity study (Section 2.3.4.13.). Rabbits are typically the test animals.

2.3.4.15 Reproductive Effects -

This is typically a 3-generation feeding study, wherein test animals from succeeding generations are constantly fed a given concentration of test compound in their food. The animals are observed for any interference with the reproductive cycle (fecundity, fertility, survival of young, etc.).

2.3.4.16 Gene Mutation -

Specific bacterial strains and mammalian cells are subjected in vitro to various concentrations of the test compound for a specific length of time. The cell cultures are then examined for mutations. Testing is also done in vivo using mice, rats, fruit flies or other organisms, followed by counts of specific genetic trait variations or dissection and examination for abnormalities in cell reproduction.

2.3.5 Wildlife and Aquatic Organisms

2.3.5.1 Avian LD_{50} -

Similar to the acute oral LD_{50} (Section 2.3.4.1.). The usual test animals are the mallard duck and bobwhite quail, which are used to evaluate the general effects on waterfowl and upland game birds, respectively.

2.3.5.2 Avian (Dietary) LC_{50} -

An eight-day test wherein birds are fed specific concentrations of the test compound mixed with the diet for five days, then fed untreated diet for three days. The LC_{50} is the feed concentration of the test material calculated to cause 50% mortality by

the end of the study. A NOAEL may be reported if the highest dose fed to the birds does not produce any effects, provided that dose is high. The test birds are usually mallard and bobwhite quail.

2.3.5.3 Avian Reproduction -

Similar to the mammalian reproductive effects study (Section 2.3.4.15.). This is a multi-generation study typically conducted using mallard and bobwhite quail. In addition to typical reproductive parameters observed, egg production, hatch and shell thickness are monitored.

2.3.5.4 Fish LC_{50} (96 Hour) -

In this test, groups of fish are subjected to several single concentrations of the test compound in their water for 96 hours. The LC_{50} is the concentration of the test compound in the water, expressed as mg of test compound/liter of water (ppm), calculated to cause 50% mortality among the fish. Typically the test is conducted under static (non-flowing) water conditions, but some tests are conducted using flow-through aquaria. Test subjects are typically rainbow trout and bluegill sunfish, representing cold- and warm-water species, respectively. Additional tests are sometimes conducted for only 48 or 72 hours, but 96 hours is the required duration for submission of data to USEPA for pesticide registration.

2.3.5.5 Invertebrate LC_{50} -

Similar in concept to the fish LC_{50} test (Section 2.3.5.4.). The test is typically run for 48 hours, and the test subject is usually Daphnia sp. Other crustaceans and aquatic invertebrates have been used as test subjects in addition, however. This test is conducted in a static or flow-through aquarium systems.

2.3.5.6 Marine LC_{50} -

This test, nearly always conducted in a flow-through system, is similar to the invertebrate LC_{50} test (Section 2.3.5.5.) using typical marine organisms such as the Atlantic oyster, pink shrimp, and fiddler crab.

2.3.5.7 Honey Bee Effects -

This test is typically conducted as either an oral or contact test. For the oral test, honey bees are given a single dose of the test material in honey. Oral LD_{50} is reported as micrograms of test compound per bee (ug/bee). In the contact test, the test material is applied to the bee's integument either topically or as a (water) spray. Contact LD_{50} is reported as ug/bee.

2.3.6 Efficacy

This section contains data regarding the efficacy (effectiveness) of the compound with regard to target and non-target vegetation. Because of SCL's earlier-stated interest in controlling tansy ragwort, red alder, bigleaf maple and Russian thistle, particular literature references to those plants have been noted in this section.

2.3.7 Other information

Miscellaneous relevant data regarding the compound or its use have been included in this section.

TABLE 2-8A

Compound	DICAMBA	TEBUTHIURON
Typical formulated products	Banvel, Trooper (both dma salt)	Spike
Manufacturer	Sandoz	Elanco
CHEMICAL DATA:		
Chemical name	Sandoz: 2-methoxy-3,6-dichlorobenzoic acid IUPAC: 3,6-dichloro-o-anisic acid CA: 3,6-dichloro-2-methoxybenzoic acid	IUPAC: 1-(5-tert-butyl-1,3,4-thiadiazole-2-yl)-1,3-dimethylurea Elanco, CA: N-(5-1,1-dimethylethyl)-1,3,4-thiadiazole-2-yl)-N,N'-dimethylurea
Signal word/toxicity class	Warning/II	Warning/II, Caution/III (depending on formulation)
Molecular formula	C8H6C1203	C9H16N4OS
Molecular weight	221.0	228.3
CAS number	1918-00-9	34014-18-1
Solubility @ 25C	water: 4.5-6.5 g/liter ethanol: 922 g/liter acetone: 810 g/liter	water: 2.3 g/liter methanol: 170 g/liter acetone: 70 g/liter
Vapor pressure	4.5 mPa @ 25C (3.4×10^{-5} mm Hg)	0.27 mPa @20C (2×10^{-6} mm Hg)
Dissociation constant	1.16×10^{-2}	DNF
Octanol/water partition coefficient	3.5	$\log_k$ (1.79)
pH	2.5 - 3.0	7.4 (50% aqueous solution)
Stability	Stable in acids & alkalis; decomposes at ca. 200C. Acidic in reaction, forming water-soluble salts	Stable in aqueous media at pH 5-9. Hydrolyzed at higher temperatures by strong alkalis and strong acids
Corrosiveness	Slight	Non-corrosive to metals and polyethylene

TABLE 2-8A

Compound	TRICLOPYR	IMAZAPYR
Typical formulated products	Garlon, Turflon	Arsenal (isopropylamine [IPA] salt), Chopper
Manufacturer	Dow	Cyanamid
CHEMICAL DATA:		
Chemical name	Dow, IUPAC: 3,5,6-trichloro-2-pyridyloxyacetic acid CA: ((3,5,6-trichloro-2-pyridinyl)oxy) acetic acid	IUPAC: 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid Cyanamid and CA: 2-(4,5-dihydro-4-methyl-4-(1-methyl ethyl)-5-oxo-1H-imidazo 1-2-yl)-3-pyridinecarboxylic acid
Signal word/toxicity class	Danger/I (Garlon 3A, Turflon Amine) Caution/III (Garlon 4, others)	Caution/III
Molecular formula	C7H4CL3NO3	C13H15N3O3
Molecular weight	256.5	261.3
CAS number	55335-06-3	81334-34-1
Solubility @ 25C	water: 440 mg/liter acetone: 989 g/liter n-octanol: 307 g/liter	water: 10-15 g/liter
Vapor pressure	0.17 mPa @ 25C (1.3×10^{-6} mm Hg)	<0.03 mPa @45C (2.0×10^{-7} mm Hg)
Dissociation constant	DNF	DNF
Octanol/water partition coefficient	DNF	1.3 @22C
pH	DNF	3.0-3.5 as 1% water solution @25C
Stability	DNF	DNF
Corrosiveness	Not corrosive	DNF

TABLE 2-8A

Compound	SULFOMETURON-METHYL	GLYPHOSATE
Typical formulated products	Oust	Rodeo, Roundup, Honcho, Ranger (all isopropylamine salt)
Manufacturer	DuPont	Monsanto
CHEMICAL DATA:		
Chemical name	IUPAC: methyl 2-(3(-4,6-dimethylpyrimidin-2-yl)ureidosulphonyl)benzoate DuPont and CA: methyl 2-(((((4,6-dimethyl-2-pyrimidinyl)amino)carbonyl)amion)sulfonyl) benzoate	Monsanto, IUPAC, CA: N-(phosphonomethyl)glycine
Signal word/toxicity class	Caution/III	Danger/I (Ranger) Warning/II (Roundup) Caution/III (Rodeo, Honcho)
Molecular formula	C15H16N4O5S	C3H8NO5P
Molecular weight	364.4	169.08
CAS number	74222-97-2	1071-83-6
Solubility @ 25C	water: 10 mg/liter at pH 5, and 300 mg/liter at pH 7 ethanol: 13.7 mg/kg acetone: 2.40 g/kg	water: 12 g/liter Insoluble in common organic solvents. The alkali metal and amine salts are readily soluble in water.
Vapor pressure	8 mPa @25C (6.0×10^{-5} mm Hg)	Negligible
Dissociation constant	DNF	DNF
Octanol/water partition coefficient	0.31 @pH 7 (phosphate buffer used to stabilize)	1.7×10^{-4} @20 ppm 6×10^{-4} @ 100 ppm
pH	DNF	DNF
Stability	Stable in neutral and alkaline media and when dry at normal temperatures and storage conditions.	DNF
Corrosiveness	DNF	Corrosive to iron and galvanized steel

TABLE 2-8B

Compound	DICAMBA	TEBUTHIURON
ENVIRONMENTAL FATE:		
Animal metabolism	Rapidly (80-90% in 24 hours) eliminated in urine, mainly as dicamba and partly as the glycine conjugate of dicamba	Studies with rats, rabbits, dogs, mallard and fish indicate the material is rapidly absorbed, metabolized, and nearly all (85%) excreted in urine and feces within 96 hours. There is no significant retention of the material or its metabolites.
Plant metabolism	Several metabolites are formed, including: major: 5-hydroxy-3,6-dichloro-o-anisic acid minor: 3-6 dichlorosalicylic acid minor: 5-hydroxy-3,6-dichloro-2-methoxy-dichlorobenzoic acid	Metabolism by N-demethylation and hydroxylation of the tert-butyl sidechain.
Mode of action	Selective systemic herbicide. Absorbed by leaves and roots and readily translocated throughout the plant. Acts as auxin-like growth regulator.	Systemic herbicide. Absorbed by roots very rapidly and translocated to the leaves, where it inhibits photosynthesis.
Hydrolysis	Resistant to hydrolysis under normal environmental conditions	Generally resistant to hydrolysis under normal environmental conditions.
Photodegradation	Limited	Essentially none
Soil metabolism	Undergoes microbial breakdown through 3 or 4 stages to citric acid cycle intermediates and thereafter largely to CO_2. Soil Ph 5.3 favored rapid breakdown, while pH of 4.3 or 7.5 slowed breakdown.	There is some disagreement whether metabolism by soil microorganisms is the primary or secondary mechanism for breakdown of tebuthiuron in soil, as opposed to chemical breakdown.
Soil half-life	Ranges from 7 to 14 days under favorable soil microbial conditions to 32 days or less. Degradation slows under lower temperature and soil moisture conditions	11-18 months in areas with average rainfall (12-15 months for 40-60 inch annual rainfall). Half-life is greater in areas of low rainfall, and in high organic-content soils, regardless of rainfall. Half-life of 5 years was reported in arid region near Fresno, CA.
Aquatic metabolism	DNF	Preliminary results of recent studies indicate limited degradation under aerobic and anaerobic conditions.

TABLE 2-8B

Compound	TRICLOPYR	IMAZAPYR
ENVIRONMENTAL FATE:		
Animal metabolism	Is rapidly excreted primarily via urine as unaltered triclopyr. Human tests indicated 1/2 excreted in 5 hours after 0.5 mg/kg body weight dose.	Studies in rats indicate approximately 87% of a dose is excreted in urine and feces within 24 hours as the unmetabolized acid.
Plant metabolism	DNF	Residues rapidly decline in the 24 hours following application to the plant. Excreted through roots largely as unmetabolized acid. A half-life of 12-40 days has been reported for trees and brush.
Mode of action	Selective systemic herbicide, absorbed by foliage and roots and translocated throughout plant and concentrated in meristematic tissue. Induces auxin-type responses in growing plants.	Non-selective systemic herbicide. Absorbed by roots and foliage and rapidly translocated to the meristematic regions, where it accumulates. Blocks synthesis of certain plant amino acids leading to interference with cell growth.
Hydrolysis	In aqueous solution, the acid is stable in the dark, but breaks down very rapidly in the presence of light. The triethylamine (TEA) salt (Garlon 3A) and butoxyethyl ester (BEE) (Garlon 4) break down rapidly in water to the acid.	In aqueous solution, is stable in the dark, but breaks down very rapidly in the presence of light.
Photodegradation	Half-life in sunlight of 2-6 hours at 40 degrees north latitude in spring, summer and fall.	Stable in light in the absence of water.
Soil metabolism	Undergoes microbial breakdown in soil. Major degradation product is 3,5,6-trichloro-2-pyridinol, with a soil half-life of 30-90 days. A second metabolite is 3,5,6-trichloro-2-methoxypyridine. The metabolites are thence converted by soil microbes to CO_2 and soil organic matter.	The isopropylamine salt (Arsenal active ingredient) degrades slowly in soil. Its major route of breakdown is photodegradation, with some contribution by soil microbes.
Soil half-life	Varies over a large range, depending primarily on soil moisture and temperature. Typically 8-30 days in well-aerated soil, 42-130 days in anaerobic soil. An experiment in two sites in western Oregon and Washington gave values of 75-81 days.	Few data are available. Calculated half-life in an Alabama forest soil was 19-34 days, and 37-44 days in leaf litter.
Aquatic metabolism	DNF	DNF

TABLE 2-8B

Compound	SULFOMETURON-METHYL	GLYPHOSATE
ENVIRONMENTAL FATE:		
Animal metabolism	DNF	Eliminated largely in feces, some in urine, in rabbits. Rapidly eliminated in fish and aquatic insects.
Plant metabolism	DNF	Not metabolized. In one study, no significant degradation of the compound was found in plants after 20 days.
Mode of action	Broad-spectrum herbicide, absorbed rapidly by roots and foliage, then translocated throughout the plant. Stops cell division in the growing tips of roots and plants by mitotic inhibition.	Nonselective systemic herbicide. Absorbed by foliage with rapid translocation throughout the plant. Acts on various enzyme systems, interfering with amino acid and other biosynthesis.
Hydrolysis	In the dark, the acid is stable at pH 7 and 9 (approx. 10% loss after 30 days). At pH 5, the acid breaks down to methyl 2-(aminosulfonyl)-benzoate and saccharine. The dark half-life at pH 7 is approximately 14 days. For light conditions, see photodegradation, below.	Stable
Photodegradation	No data were found regarding photodegradation of the dry material. In pH 7.4-8.6 water solution at a UV/blue light intensity about 1/2 that of summer noon sunlight, half-life is about 1.5-3 days. Major product is CO_2 as well as numerous other compounds in small quantities.	Negligible in water and on soil.
Soil metabolism	Degraded mainly by hydrolysis, also by soil microbial action. In acid soils, hydrolysis is the most important factor, while microbial action is more important in neutral and alkaline soils. In addition to CO_2 and saccharin, at least three major aromatic sulfonyl breakdown products have been identified in soil.	Soil microbial attack is the major and possibly only mechanism of breakdown in soil. The primary metabolite is aminomethylphosphonic acid, which is also biodegradable; three other phosphonic acids are also usually produced. Further microbial action results in conversion to CO_2.
Soil half-life	Degradation rate is primarily dependent on soil pH and moisture content, with faster degradation occurring in moister soil. Limited available data indicate half-lives from 4 to 16 weeks or longer.	Typically less than 60 days. Half-lives ranging from 2.5 weeks to 25 weeks have been reported for various soils including sand, sandy loams and clay loams.
Aquatic metabolism	DNF	If material comes into contact with suspended or bottom sediment, will bind to particles and be degraded by microbial action. If no sediment is present, degradation is dependent on microflora in the water. No significant chemical degradation/hydrolysis occurs.

TABLE 2-8C

Compound	DICAMBA	TEBUTHIURON
Aquatic half-life	DNF	DNF
Soil leaching/mobility	K_{oc}: 511 K_d: 0 to 0.9 Dicamba readily leaches in most soils except those with high organic content and kaolinite clays. The degradation product 3,6-dichlorosalicylic acid adsorbs more readily and is less mobile.	K_d: sand:0.11, sandy loam:0.62, loam:0.82, clay:1.82 (0.5, 1.4, 1.8, 2% organic matter, respectively). Moderately mobile in most soils. Is adsorbed by clay and organic matter in soil, so movement is inversely proportional to the soil clay and organic matter content, and is directly proportional to the amount of precipitation. Rarely moves below 18 inches depth.
Accumulation in non-target organisms	Does not accumulate in mammalian tissue due to rapid excretion	Does not accumulate due to rapid excretion and lack of binding to animal tissues.

TABLE 2-8C

Compound	TRICLOPYR	IMAZAPYR
Aquatic half-life	Rapid hydrolysis indicates that a short half-life would be expected in surface waters exposed to sunlight, but longer half-life in deeper water. Values of 0.5-3 days for a formulated product and 8 days (aerobic)/42 days (anaerobic) for the acid have been determined.	DNF
Soil leaching/-mobility	K_d: 10.0 (soil type not specified) The acid has low leaching potential.	K_d: 0 (clay), 0.07 (clay loam), 0.17 (loamy sand),0.19 (sandy clay loam) Fairly mobile. Relation of soil pH to mobility is poorly understood.
Accumulation in non-target organisms	Rapid excretion suggests that accumulation is not to be expected.	Does not accumulate in animals, including fish.

TABLE 2-8C

Compound	SULFOMETURON-METHYL	GLYPHOSATE
Aquatic half-life	While no data were found, photodegradation and hydrolysis data suggest that half-life in neutral and alkaline natural water the acid would have a half-life on the order of a few days. Material that was carried to greater depths where light does not penetrate would persist longer in neutral and alkaline water.	Following have been reported: Aquatic sediment: approx. 7 weeks Sphagnum bog (pH 4.2): 7 weeks Cattail swamp (pH 6.3): 9 weeks Pond water (pH 7.3): 10 weeks
Soil leaching/-mobility	K_d: 0.12 (clay) - 0.68 (sandy clay loam) Fairly mobile in soil. More mobile in soils of pH 7 or greater, less mobile in clay soils. Known soil metabolites are also fairly mobile.	Very little potential mobility. Rapidly and strongly adsorbed to soil, particularly to clay particles and at lower pH values.
Accumulation in non-target organisms	Data not found regarding mammals. Does not accumulate in fish.	Does not accumulate in fish or other animals.

TABLE 2-8D

Compound	DICAMBA	TEBUTHIURON
TOXICITY:		
Acute oral LD_{50}	757-1707mg/kg (rat)	579-671 mg/kg (rat) 568-644 mg/kg (mouse) 256-316 mg/kg (rabbit)
Acute dermal LD_{50}	> 2000 mg/kg (rabbit)	> 5000 mg/kg
Acute inhalation LC_{50}	9.6 mg/liter (rat)	≥ 3.70 mg/liter (rat)
Eye irritation	Extremely irritating and corrosive	Slight
Skin irritation	Moderate (rabbit)	Non-irritating (rabbit)
Skin sensitization	Moderate (guinea pig)	None (guinea pig)
Subchronic - rat	NOAEL: 5000 ppm in diet (250 mg/kg/day)	NOAEL: 1000 ppm in diet
Subchronic - nonrodent	DNF	NOAEL: 1000 ppm in diet (dog) NOAEL: 1000 ppm in diet (chicken)
Chronic - rat	NOAEL: 1000 ppm in diet	NOAEL: ≥ 400 ppm in diet (20 mg/kg/day)
Chronic - other	NOAEL: 1000 ppm in diet (dog, mouse) 52 mg/kg/day (dog)	NOAEL: 25 mg/kg/day (1 year dog)
Oncogenicity - mouse	Not oncogenic	Not oncogenic
Oncogenicity - other	Not oncogenic (dog)	Not oncogenic (rat)
Teratogenicity - rat	Not teratogenic	Not teratogenic
Teratogenicity - other	Not teratogenic (rabbit) NOAEL: 3.0 mg/kg/day	Not teratogenic (rabbit)
Reproductive effects	NOAEL: 500 ppm in diet (25 mg/kg/day) (rat)	Not a reproductive toxin
Gene mutation	Not mutagenic	Not mutagenic

TABLE 2-8D

Compound	TRICLOPYR	IMAZAPYR
TOXICITY:		
Acute oral LD_{50}	630-730 mg/kg (male, female rat) 310 mg/kg (guinea pig) 550 mg/kg (rabbit)	> 5000 mg/kg (rat) > 2000 mg/kg (female mouse) 4800 mg/kg (rabbit)
Acute dermal LD_{50}	> 2000 mg/kg (rabbit)	> 2000 mg/kg (rabbit) > 2000 mg/kg (rat)
Acute inhalation LC_{50}	DNF	> 5.1 mg/liter (rat)
Eye irritation	Mildly irritating	Irritating (rabbit)
Skin irritation	Non-irritating (rabbit)	Mildly irritating (rabbit)
Skin sensitization	DNF	None (guinea pig)
Subchronic - rat	NOAEL: 100 mg/kg/day (female) and 30 mg/kg/day (male)	NOAEL: ≥ 10,000 ppm in diet
Subchronic - nonrodent	NOAEL: 2.5 mg/kg/day (7.5 month) (dog)	DNF
Chronic - rat	NOAEL (2 year): 10 mg/kg/day	DNF
Chronic - other	NOAEL (2 year): 240 ppm in diet (5 mg/kg/day) (mouse) NOAEL: 5 mg/kg/day (12 month) (dog)	DNF
Oncogenicity - mouse	Not oncogenic	DNF
Oncogenicity - other	Not oncogenic	DNF
Teratogenicity - rat	NOAEL: 100 mg/kg/day Not teratogenic	NOAEL: ≥ 1000 mg/kg/day (rat) Not teratogenic
Teratogenicity - other	NOAEL: 75 mg/kg/day (rabbit) Not teratogenic	NOAEL: ≥ 400 mg/kg/day (rabbit) Not teratogenic
Reproductive effects	NOAEL: ≥ 30 mg/kg/day (3 generations)(rat) Not a reproductive toxin	NOAEL: ≥ 1000 mg/kg/day (rat) ≥ 400 mg/kg/day (rabbit) Not a reproductive toxin
Gene mutation	Not mutagenic	Not mutagenic

TABLE 2-8D

Compound	SULFOMETURON-METHYL	GLYPHOSATE
TOXICITY:		
Acute oral LD_{50}	> 5000 mg/kg (male rat)	4300-5600 mg/kg (rat) 3800 mg/kg (rabbit)
Acute dermal LD_{50}	> 8000 mg/kg (male rabbit) > 2000 mg/kg (female rabbit)	> 5000 mg/kg (rabbit)
Acute inhalation LC_{50}	5 mg/liter (rat)	> 12.2 mg/liter (rat)
Eye irritation	Slightly irritating	Slightly irritating
Skin irritation	Slightly irritating (rabbit)	Non-irritating (rabbit)
Skin sensitization	Non-sensitizing (guinea pig)	DNF
Subchronic - rat	DNF	NOAEL: ≥ 2000 ppm in diet (90 day)
Subchronic - nonrodent	DNF	NOAEL: ≥ 350 mg/kg/day (rabbit) ≥ 2000 ppm in diet (90 day dog)
Chronic - rat	NOAEL: 50 ppm in diet (2 year)	NOAEL: ≥ 300 ppm in diet (2 year)
Chronic - other	NOAEL: 200 ppm in diet (1 year, dog)	NOAEL: ≥ 300 ppm in diet (2 year dog)
Oncogenicity - mouse	Not oncogenic	NOAEL ≥ 300 ppm in diet Not oncogenic
Oncogenicity - other	Not oncogenic	Not oncogenic (rat)
Teratogenicity - rat	DNF	NOAEL: ≥ 3500 mg/kg/day NOAEL (fetotoxicity): 100 mg/kg/day Not teratogenic
Teratogenicity - other	DNF	NOAEL: 175 mg/kg/day (rabbit) Not teratogenic
Reproductive effects	NOAEL: 500 ppm in diet	NOAEL: 10 mg/kg/day (3 generation rat) Not a reproductive toxin
Gene mutation	Not mutagenic	NOAEL: ≥ 2000 mg/kg (mouse, "Dominant lethal") Not mutagenic

TABLE 2-8E

Compound	DICAMBA	TEBUTHIURON
WILDLIFE AND AQUATIC ORGANISMS:		
Avian LD_{50}	2000 mg/kg (mallard)	> 500 mg/kg (mallard, quail, chicken)
Avian (dietary) LC_{50}	>10,000 mg/kg in diet (8 day mallard, quail)	NOAEL: ≥ 2500 ppm in diet (mallard, quail)
Avian reproduction	90% hatch when hen's eggs injected with 10 ppm dicamba	NOAEL: ≥ 100 ppm in diet (mallard, quail)
Fish LC_{50} (96 hour)	28-35 mg/liter (rainbow trout) 23-40 mg/liter (bluegill) 465 mg/liter (carp)	144 mg/liter (rainbow trout) 112 mg/liter (bluegill) > 160 mg/liter (goldfish)
Invertebrate LC_{50}	> 100 mg/liter @15-21C (6 spp freshwater crustaceans) (48 hours)	NOAEL: 225 ppm (Daphnia) (no time given)
Marine EC_{50}	DNF	NOAEL: 180 ppm (oyster) 10 ppm (shrimp) 32 ppm (fiddler crab)
Honey bee effects	LD_{50} contact: > 100 ug/bee oral: > 10 ug/bee Essentially non-toxic	Contact LD_{50}: ≥ 100 ug/bee Non-toxic

EFFICACY:		
Target vegetation	Controls annual and perennial broad-leafed plants (weeds, hardwood brush, certain trees), including Russian thistle and tansy ragwort. Banvel and Trooper are labelled for cut-stump use.	Controls herbaceous and woody plants and trees, including red alder and Russian thistle. Grasses are less impacted than broadleaf plants. Exhibits some postemergence activity on annual grasses and broadleaf weeds.
Non-target vegetation	Little or no effect on grasses. Some phytotoxic effects on conifers sprayed at high rates, including partial or complete defoliation. This is usually followed by recovery the following year.	Will damage ornamentals if allowed to come into contact with even part of the root system.

TABLE 2-8E

Compound	TRICLOPYR	IMAZAPYR
WILDLIFE AND AQUATIC ORGANISMS:		
Avian LD_{50}	1698 mg/kg (mallard)	> 2150 mg/kg (mallard, quail)
Avian (dietary) LC_{50}	> 5600 ppm diet (mallard) 2935 ppm diet (quail)	> 5000 ppm diet (mallard, quail)
Avian reproduction	NOAEL: > 500 ppm diet (mallard, quail)	DNF
Fish LC_{50} (96 hour)	117 mg/liter (rainbow trout) 148 mg/liter (bluegill)	> 100 mg/liter (rainbow trout, bluegill, channel catfish)
Invertebrate LC_{50}	133 mg/liter (48 hour) (Daphnia)	> 100 mg/liter (48 hour) (Daphnia)
Marine EC_{50}	DNF	DNF
Honey bee effects	Oral LD_{50} > 60.4 ug/bee Essentially non-toxic	Contact LD_{50}: > 100 mg/bee Non-toxic

EFFICACY:		
Target vegetation	Controls woody plants and many broad-leafed weeds. Suitable for use in uncultivated land, grassland, coniferous forests. Garlon gives good control of red alder and fair control of broadleaf maple with foliar or cut stump applications. Good control of tansy ragwort.	Good control of annual and perennial grasses. Controls broad leaf weeds and many brush and deciduous tree species. Effective against red alder.
Non-target vegetation	Clover, larch, lodgepole pine and ornamentals are sensitive. Little or no effect on grasses.	Generally low to moderate phytotoxicity to conifers, but in Oregon trials for red alder control some damage to Douglas fir was noted, with subsequent recovery. White pine may also be susceptable. Conifer damage is also dependent on the application rate.

TABLE 2-8E

Compound	SULFOMETURON-METHYL	GLYPHOSATE
WILDLIFE AND AQUATIC ORGANISMS:		
Avian LD_{50}	DNF	> 3850 mg/kg (quail)
Avian (dietary) LC_{50}	5000 ppm (mallard) 5620 (quail)	> 4640 mg/kg (mallard, quail)
Avian reproduction	DNF	DNF
Fish LC_{50} (96 hour)	> 12.5 ppm (rainbow trout)	86 mg/liter (rainbow trout); 120-170 mg/liter also reported 110-160 mg/liter (bluegill) 115 mg/liter (carp) 97 mg/liter (fathead minnow)
Invertebrate LC_{50}	DNF	780 mg/liter (Daphnia) (48 hour)
Marine EC_{50}	DNF	96 hour: 281 mg/liter (shrimp) 934 mg/liter (fiddler crab) > 10 mg/liter (oyster)
Honey bee effects	DNF	48 hour LD_{50}: >100 ug/bee Not toxic to bees

EFFICACY:		
Target vegetation	Controls annual and perennial greases and broad-leaf weeds; used in forestry to control woody trees in pine tree stands. Success with grasses is variable, depending on the species. Effective pre- or post-emergence. A related sulfonourea, metsulfuron-methyl, gives good tansy control.	Controls a variety of annual, biennial and perennial grasses, sedges, broad-leaved weeds and shrubs.Reportedly effective against tansy ragwort. Variable success against red alder. Roundup is labelled for cut-stump use.
Non-target vegetation	Can cause growth retardation and other adverse effects of young blue spruce and some pines and other conifers.	Has caused temporary browning of conifers in forestry uses.

TABLE 2-8F

Compound	DICAMBA	TEBUTHIURON
OTHER INFORMATION:		
	A test in Oregon and Washington has shown good continuing control (about 70% after 1 year) of tansy ragwort when applied at 0.5 lb ai/acre in early April. Another test indicated that when tansy is large or when flower stalk has elongated, 1.0 lb ai/acre will afford control.	Because of long soil half-life, gives long-lasting control. Pelleted formulations can be stable on the soil surface up to six months with no precipitation. Efficacy suffers if used on soil with >5% organic matter or >30% clay.

TABLE 2-8F

Compound	TRICLOPYR	IMAZAPYR
OTHER INFORMATION:		
	A study in Oregon has shown continuing control (about 70% after 1 year) of tansy ragwort when applied at 1.5 to 2.0 lb ai/acre in early April.	Arsenal "Applicator's Concentrate" has an EPA Supplementary Label for control of big-leaf maple and red alder in forestry lands in Oregon and Washington.

TABLE 2-8F

Compound	SULFOMETURON-METHYL	GLYPHOSATE
OTHER INFORMATION:		
	Tests in Oregon coastal range forest indicated poor red alder control; major Douglas fir damage at 4 oz/acre and minor injury at 2 oz/acre.	

TABLE 2-9
LIST OF ABBREVIATIONS

ai	Active ingredient. The actual herbicidal material (acid, salt or other form) used in a formulated product, exclusive of other adjuvants and solvents such as emollients, surfactants and water.
C	Degrees Centigrade (Celsius) (e.g. @20C)
CA	Chemical Abstracts. As used in this report, refers to a professionally recognized Standard for chemical compound naming.
DMA	Dimethyl amine
DNF	Data Not Found. Despite all efforts, data could not be found concerning the specific items in Tables 1-3 with this designation.
EC50	Effect Concentration. The concentration at which 50% of the test population exhibits an effect from the test.
g	Grams
Hg	Chemical symbol for the element mercury. The term "mm Hg" is a measure of vapor pressure. One atmosphere is 760 mm Hg.
IPA	Isopropyl amine
IUPAC	International Union of Pure and Applied Chemistry. A designation for a professionally recognized Standard for chemical compound naming.
Kd	A partitioning coefficient for a pesticide in soil based on the amount of pesticide adsorbed to a soil from a water solution (or, if specified, desorbed from a soil back into water solution). The higher the Kd for a particular soil/pesticide combination, the more pesticide that will adsorb to that soil (or the less that will desorb from that soil) and the less the leaching potential.

Koc — A partitioning coefficient for a pesticide in soil based on the amount of pesticide adsorbed to a soil from a water solution and the amount of organic carbon in that particular soil. The higher the Koc for a particular soil and pesticide, the more of that pesticide that will adsorb on that soil and the less the leaching potential.

LC50 — Lethal Concentration. The concentration at which 50% of the test population dies as a result of the test treatment.

LD50 — Lethal Dose. The dose level at which 50% of the test population dies as a result of the test treatment.

mPa — MilliPascals. A measure of gas pressure, as in vapor pressure. One mPa is equal to 7.5x10-6 mm Hg (or, 1 atmosphere of pressure = 1x108 mPa).

NOAEL — No Observed Adverse Effects Level. The level of dosage in a toxicity test at and below which none of the adverse effects that were being tested for, occurred.

$\geq$ Greater than or equal to

TABLE 2-10: USEPA toxicity classification of typical products (formulations) of the six herbicidal compounds considered in this review.

Compound	Typical product	Signal word	USEPA toxicity category	Reason
Dicamba	Banvel (DMA salt) Trooper (DMA salt)	Warning	II	Eye irritation
Tebuthiuron	Spike 80W Spike 20P,40P Spike 5G	Caution	III	(*)
	Spike DF	Warning	II	Oral toxicity, dermal toxicity, eye irritation
Triclopyr	Garlon 3A (TEA salt) Turflon Amine (TEA salt)	Danger	I	Eye damage
	Garlon 4 (BE ester)	Caution	III	(*)
Imazapyr	Arsenal (parent + IPA salt) Chopper (parent + IPA salt)	Caution	III	(*)
Sulfometuron methyl	Oust	Caution	III	(*)
Glyphosate	Ranger (IPA salt)	Danger	I	Eye damage
	Roundup (IPA salt)	Warning	II	Eye damage
	Rodeo, Honcho (IPA salt)	Caution	III	(*)

DMA = dimethylamine IPA = isopropylamine TEA = triethylamine BE = butoxyethyl

(*) NOTE: No reason is given for inclusion in Category III since this is, realistically, the default Category into which pesticides are placed if they are not Category I or II. There are virtually no Category IV pesticides.

TABLE 2-11: USEPA criteria for the assignment of a pesticide to a given toxicity category.

Criterion	Toxicity Category			
	I	II	III	IV
Acute oral LD_{50} (mg/kg body weight)	50 or less	50 - 500	500 - 5000	> 5000
Acute dermal LD_{50} (mg/kg body weight)	200 or less	200 - 2000	2000 - 5000	> 5000
Acute inhalation LC_{50}, 4 hour exposure (mg/liter air)	0.05 or less	0.05 - 0.5	0.5 - 5.0	> 5.0
Eye irritation	corrosive, or corneal involvement lasting more than 21 days	corneal involvement or irritation clearing in 8-21 days	corneal involvement or irritation clearing in 7 days or less	minimal effects clearing in less than 24 hours
Dermal irritation	corrosive, with tissue destruction	severe irritation at 72 hours	moderate irritation at 72 hours	mild to slight irritation at 72 hours

2.4 HERBICIDE USE

2.4.1 Specific Target Vegetation

From the data in Table 2-8, and conversations with agrochemical representatives and distributors, the following assessments of the candidate herbicides may be made with regard to specific target vegetation that SCL has indicated an interest in controlling.

2.4.1.1 Tansy Ragwort -

Triclopyr and dicamba have been reported to give about 70% continuing control of tansy ragwort one year after application in tests in Washington and/or Oregon. Imazapyr as also been used with some degree of success against ragwort, while glyphosate reportedly affords some control, although no specific references to this were found in the literature search. Triclopyr and dicamba are most effective for tansy ragwort control when applied in spring, around early April. Metsulfuron-methyl gave good lasting control of tansy ragwort in tests in Oregon. Sulfometuron-methyl, from the same chemical family of herbicides (sulfonylureas) might be expected to perform well, but no specific data to this effect were found.

2.4.1.2 Cut Stump; Red Alder, Big Leaf Maple, Birch -

Dicamba is not particularly effective for cut stump control. The two most effective compounds for control of red alder are probably triclopyr and imazapyr. Garlon (triclopyr) is said to give good red alder control as a foliar spray, as well as good cut stump control with a directed cambium spray, and somewhat less control of big leaf maple. On the other hand, Arsenal (imazapyr) is being used extensively in the Pacific Northwest with a good degree of success for control of big leaf maple using foliar sprays, but is not labelled for cut stump use. The rapid absorption of imazapyr by plants makes it less sensitive to rainfall (and subsequent washoff) shortly after application, although application during rainy weather should generally be avoided. Spike (tebuthiuron) can also control red alder fairly well, as well as big leaf maple, when applied as a spray. This material is also frequently applied as pelleted formulations that slowly release the active ingredient into the soil. Because of the ease and rapidity with which tebuthiuron is taken up and its nonspecificity, however, tebuthiuron can easily kill nearby desira-

ble vegetation if it reaches even a small portion of their root systems. Roundup (glyphosate) is labelled for cut stump use on, and gives variable control of, red alder; no unbiased data could be found regarding its efficacy against big leaf maple. Banvel and Trooper (dicamba) are labelled for cut stump use and exhibit some degree of control of alder with this application method. No data could be found regarding its efficacy against big leaf maple.

Control of birch by the candidate herbicides varies greatly with the species of birch, climate, application rate and timing. In general, the compounds that afford good broad-spectrum control of woody plants, such as triclopyr, will control different species of birches to varying degrees.

2.4.1.3 Russian Thistle -

Based on reviewed research data, dicamba (Banvel, Trooper) and tebuthiuron (Spike) are probably the most effective of the six herbicides for control of Russian thistle, although other products also claim to afford good control. At the present time, Russian thistle does not appear to constitute much of a weed control problem west of the Cascades.

2.4.2 Herbicide Choice

It is obvious from the preceding sections that the choice of an herbicide for a given application requires consideration of a number of factors. Efficacy, persistence, and soil mobility are among the parameters that can vary depending on several factors. Examples of factors that should be considered in choice of an herbicide are discussed in this section, using data from Table 2-8 and manufacturer/distributor sources.

The method of application used, whether broadcast spray, aerial application, directed spray, foliar, basal, or stump spray, affects the choice of product. Some herbicides are only effective as foliar sprays, while others are most efficient when absorbed through the roots. Aerial or ground broadcast spraying of all of the six candidate herbicides carries some potential for at least temporary damage to conifers or desirable broadleaf species, at least at the higher application rates. Directed spraying allows better control of herbicide dispersal, but require a larger worker-hour outlay.

Timing of application is one of the more important application variables that should be considered. Depending on the mode of action of the material, vegetation is more sensitive at certain stages of their growth cycles. Herbicide labels reflect this sensitivity in their application instructions.

The general character of the areas to be treated, such as forest, grassland, or rural/suburban, must also be taken into consideration, as well as the type of non-target vegetation present. Each type of area will have characteristics requiring attention. For instance, the nature and density of non-target vegetation will vary between a forest and grassland, between rural and suburban locations. An herbicide chosen for woody plant control in grassland where usually all woody plants are to be suppressed could very likely cause damage to desirable woody species or trees in a forest. In addition, a grassland situation would require care to be taken in selecting an herbicide such as triclopyr that does not harm most grasses, or an herbicide that does not damage the particular species of grasses present.

Climate can have a large impact on the efficacy and persistence of an herbicide. Tebuthiuron, for instance, is less efficacious if applied during rainy weather; tebuthiuron half-lives tend to be much shorter in wet climates and soil, while half-lives on the order of years can occur in dry climates. Herbicides that are very susceptible to hydrolysis, such as triclopyr and imazapyr, would be less likely to persist on the surface of plants and soil in the rainy Pacific Northwest than hydrolysis-resistant compounds. It should be noted that hydrolysis and photolysis processes can be interactive, as with imazapyr and sulfometuron-methyl, which are stable in water in the dark, but break down rapidly in the presence of both light and water. These two compounds would undergo much less hydrolysis once beneath the soil surface than while on top of the soil (other degradation processes would still be at work, however). Strong sunlight, as during the summer, would be likely to photodegrade triclopyr on plant and soil surface, whether or not water was present.

The type of soil at an application site has some effect on persistence and mobility of an herbicide. Many herbicides, such as dicamba and tebuthiuron are less mobile in soils with high clay and/or organic matter content. The adsorption of the herbicide to soil clays or organic matter that causes the reduced mobility can also remove some of the herbicide from availability to the vegetation.

2.4.3 Dicamba vs. Other Herbicides

SCL has requested a recommendation as to whether the present use of dicamba for vegetation management should be discontinued in favor of alternative herbicides, specifically the five other candidate herbicides investigated in this document. As the previous paragraphs in this section illustrate, specific information regarding an Herbicide Management Program is required in order to make specific herbicide recommendations. Compliance Services has not been supplied with the details of SCL's Program, and cannot make such a recommendations. Certain data that was presented elsewhere in this document are reviewed below for the purpose of aiding SCL in making such a decision.

For tansy ragwort, triclopyr and dicamba appear to be equally effective; imazapyr has also been reported to be effective. Imazapyr and triclopyr have had better success in cut stump and/or foliar treatment for control of red alder, big leaf maple, and some species of birch than dicamba, while sulfometuron methyl gives poorer control. In fact, dicamba appears to be not very effective at all in cut stump control. For Russian thistle control, which may or may not be necessary in the near future, dicamba and tebuthiuron have been shown in tests to be effective.

A half-life of 12-15 months has been reported for tebuthiuron in rainfall conditions similar to those in the Pacific Northwest. It is moderately mobile, but rarely moves deeper than 18 inches in soil. Imazapyr is also fairly mobile in soil, but has a half-life on the order of only 20-40 days. Sulfometuron methyl also exhibits a significant degree of mobility, but also has a relatively short half-life of 4-16 weeks. Triclopyr and glyphosate have low soil mobility potentials. Glyphosate has a wide range of persistence, with half-lives from 2 to 25 weeks depending on soil conditions. Triclopyr was determined by experiments in western Washington and Oregon to have a half-life of about 80 days.

Three of the compounds are of a lesser degree of acute toxicity than dicamba (imazapyr, sulfometuron-methyl, glyphosate), and two are about the same (tebuthiuron, triclopyr). None of the compounds, however, are of a degree of toxicity to be of concern if used according to label instructions.

There are no data we have found that indicate significantly more adverse environmental impacts would be expected from use of any of the five other herbicides as compared to the use of dicamba if used according to label instructions.

2.5 HERBICIDE COSTS

Presenting a generalized cost analysis of herbicides for comparative purposes must be done carefully and on a site specific basis. Without testing the efficacy of specific active ingredient use rates, which typically are offered as a range on herbicide labels, the exact use rates cannot be predicted. Since the cost per unit treated cannot be presented for this cost analysis, we have assumed that (1) Seattle City Light will pay full list price for each chemical as of the date this information was collected; (2) spray mixtures will be made up in water as 100 gallon increments where 100 gallons may treat variable acreages; (3) the lowest labeled rates will be used; and (4) no combinations will be used.

Labor costs are not included in these estimates, but would be equal where application methods are equal. The use of specialized devices (guns which deliver "bullets" to tree trunks, wipes which turn the applicator wand into a "swab", etc.) would require added time but also would reduce the total material needed per plant controlled; consequently for the purposes here, increases in labor are assumed to be offset by savings in materials.

Cost comparisons are presented in Table 2-12. These figures should be used for comparative purposes only and not as the actual prices to be paid should Seattle City Light seek products on competitive bid. Cost per unit prices were provided by the Seattle Office of Wilbur-Ellis, based on smallest container, manufacturer list pricing.

TABLE 2-12
COMPARATIVE HERBICIDE COSTS

HERBICIDE	COST/GALLON	MIX RATE*	COST
Arsenal/Chopper	$ 166.75	0.5 gal	$ 83.38
Garlon 4	73.35	0.25 gal	18.34
Oust	150.72	3.0 fl oz	28.26
Escort	448.00	1.0 fl oz	28.00
Roundup	69.80	1.0 gal	69.80
Banvel 4 lb/gal	61.95	2.5 pint	19.36
Banvel CST[1]	23.00	--	--
Spike 80WP	21.25 [lb]	1.5 lb	31.88
Spike 5G [2]	2.85 [lb]	--	--

* Mix Rate = The amount of the formulation mixed with 100 gallons of water for a use solution mixture. Acreage treated by 100 gallons of spray mix may vary.

1. Banvel CST is a ready-to-use formulation applied directly from the container.

2. Spike 5G is a granular formulation and as so is ready-to-use.

SOURCE: Private communication with the Seattle office of Wilbur-Ellis, distributors of industrial weed control and agricultural chemicals.

AESTHETIC IMPACT EVALUATION

3.0 AESTHETIC IMPACT EVALUATION

3.1 INTRODUCTION

SCL Departmental Policy and Procedure (DPP) goals for the maintenance of the utility's transmission rights-of-way were adopted in 1983 (DPP 500 P I-506). The policy goals included the development of an integrated vegetation management approach that would be reviewed annually and used as a guide by SCL to maintain the integrity of the utility's transmission network system and associated ROW. This policy further states objectives to maintain the ROW in cooperation with governmental agencies having jurisdiction over neighboring lands and to encourage multiple uses of the ROW for public benefit, as long as those uses do not compromise the maintenance or repair of the line.

More recent attention to multiple-use issues which affect portions of SCL's transmission and ROW network occurred with the passage of the Washington Park Wilderness Act of 1988 (Public Law 100-668) and with SCL's submittal of a relicensing application to the Federal Energy Regulatory Commission (FERC) for the Skagit Hydroelectric Power Generation Project (Project No. 553-005-Washington). As discussed in paragraphs that follow, vegetation management activities in the project study area must comply with restrictions set forth in the Washington Park Wilderness Act since the study area is located within the Ross Lake NRA.

The Washington Park Wilderness Act designated wilderness area within the North Cascades National Park Complex as well as within two other national parks in the state of Washington. A 20-mile segment of the SCL Skagit transmission line and ROW corridor traverses public lands within the NRA. These public lands are administered by the NPS. The manner in which the ROW vegetation is maintained along this segment of the corridor is of interest to the NPS, as they are responsible for the management of NRA lands in accordance with the objectives of the aforementioned wilderness act. With specific reference to the NRA, the Washington Park Wilderness Act allows the removal and disposal of trees within power line rights-of-way as is necessary to protect transmission lines, towers and equipment, provided that, to the extent possible, such activity is required to be conducted in a manner to protect scenic viewsheds. Appendix F provides a copy of the

Washington Park Wilderness Act. The following is an excerpt from Section 205., Renewable Natural Resource Use in Recreation Areas, concerning the removal and disposal of trees within power line rights-of-way:

> "Within the Ross Lake National Recreation Area the removal and disposal of trees within power line rights-of-way are authorized as necessary to protect transmssion lines, towers, and equipment;": Provided, That to the extent practicable, such removal and disposal of trees shall be conducted in such a manner as to protect scenic viewsheds.".

Following review of Seattle City Light's relicensing application, FERC requested additional information concerning aesthetic impacts of the Skagit Project. In a letter to SCL concerning a review of the relicensing application (October 31, 1988), FERC noted both the high scenic quality and recreational use of the NRA/Skagit Project lands and the public's heightened awareness of the altered natural landscapes, as well as their increasing concern for visual quality. As a result, FERC is requesting a more detailed analysis of the aesthetic impact issue.

In response to these developments, SCL has conducted an aesthetic impact evaluation of the 20-mile 230 kV Skagit transmission line and ROW located in the Ross Lake National Recreation Area. The evaluation presented here supplements a comprehensive aesthetic impact evaluation prepared for the Skagit Hydroelectric Power Project, conducted under separate contract.

The scope of this task is to:

- conduct an evaluation of the visibility of the transmission structure and ROW from the North Cascades Highway (SR20) within the NRA and identify areas that should be targeted for visual impact reduction (Aesthetic Target Areas);
- document the extent of visibility, character and magnitude of visual impact for the Aesthetic Target Area ROW segments; and
- evaluate and recommend viable vegetative management techniques (mitigation prescriptions) for minimizing the visual impacts of the transmission structures and corridor.

The results of this evaluation will be reviewed by SCL. The utility will then decide which of the recommended mitigation prescriptions will be incorporated in the utility's Integrated Vegetation Management Program for the Skagit transmission line and ROW corridor that is located between the Sauk River crossing and the line's northern terminus at Ross Dam.

3.2 EVALUATION APPROACH

3.2.1 Data Collection and Review

Initial activities focused on a review of the available data concerning the project segment of the Skagit transmission corridor. Data sources include:

- Seattle City Light Departmental Policy and Procedure for transmission ROW maintenance (DPP 500- P I-506),
- supplemental information requests from FERC (FERC 1988),
- the Washington Park Wilderness Act of 1988 (Public Law 100-668),
- prior data inventories (Envirosphere 1985) conducted as part of SCL's Integrated Vegetation Management Program,
- maps, aerial photographs, aerial video documentation, and plan and profile engineering design and detail drawings for the project transmission ROW (refer to References).

3.2.2 Seattle City Light and Interagency Consultation

Operational and Safety Constraints

SCL staff responsible for vegetation maintenance along the project ROW were consulted to obtain a familiarity with the vegetation management techniques that are currently being implemented to guard visual resources of the neighboring lands. Additional information was obtained concerning SCL's operational and safety constraints that are integral to the successful and uninterrupted distribution of power via the Skagit line.

One of the key objectives is to manage the vegetation in the ROW corridor to prevent vegetation from contacting the power lines, thus preventing transmission failure, fire hazards and potential safety hazards to SCL maintenance personnel. Additionally, unimpaired access is important for quick response to repair transmission failure or control the spread of fires. Other aspects that affect worker safety and the transmission system's integrity include line sag and sway, tree size and age, and soil type, slope and stability. Costs associated with an inability to quickly respond to such adverse scenarios are substantial (Newby 1989). Consequently, it is necessary for SCL maintenance crews to routinely manage vegetation to control height and clear vegetation within and along the ROW margins. The proximity of vegetation to overhead power lines is dictated, in part, by the Washington General Safety and Health Standards (WAC 296-24-960) and Safety Standards for Electrical Construction Code (WAC 296-44-21230) presented in Appendix G and H, respectively.

Interagency Consultation

Early in the project's development an agency consultation meeting was held with the NPS, SCL and the consulting contractor project staff. The meeting provided an opportunity to review NPS issues of concern regarding the management of the public lands adjacent to the transmission ROW. The objectives and approach to determining the key aesthetic impacts of the transmission line corridor to viewers enroute along SR20 and the development of mitigation recommendations was presented. No issues, in addition to those targeted by the objectives of this contract subtask, were presented by the NPS.

Additional presentation of this contract workscope was made to members of the Forest Service (FS), the North Cascades Conservation Council (NCCC), and the consulting team contracted to prepare supplemental documentation to support FERC's relicense of the Skagit Hydroelectric Power Project.

3.2.3 Visual Impact Determination

In addition to a review of the database of materials made available from SCL, a site reconnaissance of the project area was conducted. The entire length of SR20 in the project study area was traveled to identify areas where the transmission line towers and ROW had a high level of visibility to travelers along the highway. A number of areas which had a history of concern were pointed out by SCL staff. Additional areas of concern were included as a result of the survey of the project study area.

3.3 AESTHETIC TARGET AREAS (ATA)

Reconnaissance of the project study area and consultation with key SCL personnel resulted in the identification of seven areas (Aesthetic Target Areas) that are recommended for visual impact reduction.

The selection of ATAs was based upon the visibility of the transmission line features and its likely adverse impact to viewers traveling SR20. Of primary concern is the visual compatibility of the transmission features in the areas observed. The varying level of contrast of the visual characteristics of the transmission line and corridor (i.e. form, line, color, texture) with those of the surrounding natural landscape elements will impact the viewer. The extent of impact can be determined from an evaluation of the following:

1) Viewer Exposure - the visibility of the transmission corridor to travelers enroute or located at key viewpoint locations along SR20. The significance of the viewer's exposure is affected by:

   - the viewing distance zones (i.e. views of the project features experienced from foreground, middleground and background distances [USDA 1974]),
   - the duration of the viewing activity (affected by whether views are experienced while moving or stationary),
   - the portion of the transmission line features and ROW exposed to viewers at key viewpoint locations (i.e. lines, towers, ROW cleared vegetation), and
   - the visual magnitude or the extent of the visibility of the transmission features and ROW corridor.

2) Viewer Sensitivity - based upon the numbers of viewers, the visual characteristics of the natural environment, and the viewer's probable expectations.

Figure 3-1 locates the seven areas on the project base map. Following an upstream progression from the western project boundary near Bacon Creek, the Aesthetic Target Areas named in the figure are:

1) Bacon Creek
2) Pinkie's
3) Thornton Creek
4) Goodell Creek
5) Gorge Dam Viewpoint
6) Diablo "Y"
7) Diablo Overlook

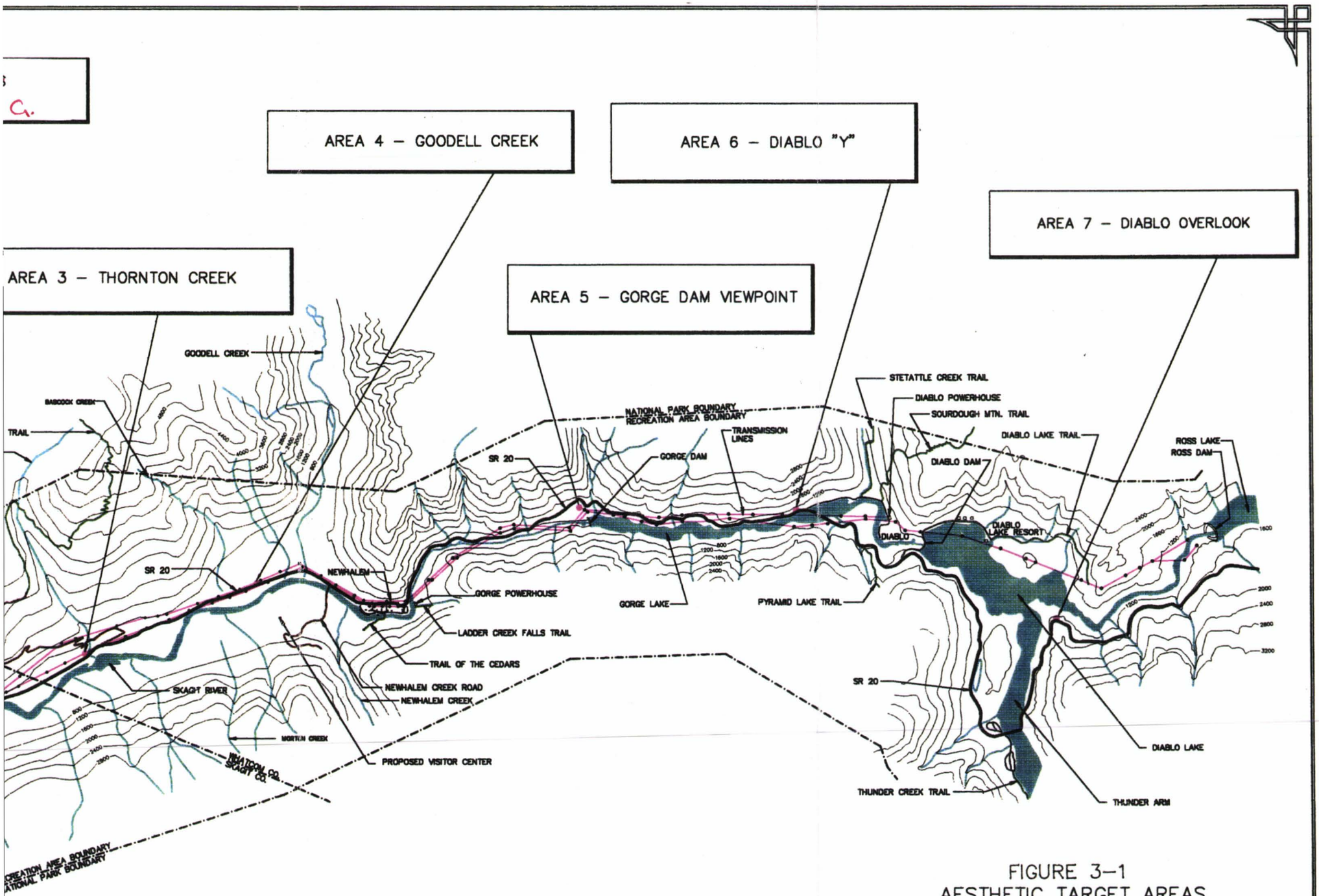


FIGURE 3–1
AESTHETIC TARGET AREAS

LEGEND / NOTES

- AREA LOCATION
- POWERLINES AND TOWERS
- BOUNDARY LINE

The ATAs are somewhat evenly distributed along the highway between the Bacon Creek tributary and the eastern end of the project study area at Ross Dam. At each of the areas a location was selected for stationary viewing. Stationary viewing activities increase the significance of the visual impact experience due to the extended period of time over which the viewer is exposed. Consequently, the associated evaluation of impact represents a worst-case scenario. As much as possible, the viewing site was selected based upon a location which was reasonably safe and likely to attract a recreationist to pull off the highway to rest or to participate in some level of recreational activity (i.e. hiking, fishing, temporary rest/picnicking, scenic viewing). Boundaries of the ATAs correspond to the farthest steel lattice transmission towers that are visible in either direction along the transmission ROW corridor from the stationary viewpoint. Views of the transmission corridor, when traveling east and westbound along SR20 through each of the ATAs, were recorded.

The degree to which viewers are impacted by the visibility of the transmission towers, lines and cleared ROW is highly variable among the seven ATAs. Together these areas represent an overview that could be presented to a viewer traveling along or through a significant part of the ROW. Table 3-1, Aesthetic Target Area Visual Impact Determination, presents the aesthetic impact parameters (i.e. viewer exposure, viewer sensitivity) which were evaluated to determine the significance of the visual impacts of the transmission corridor from each of the ATA sites. Table 3-1 is preceded by a definition of terms and the impact rating scores assigned to the visual parameters evaluated in the table. Aesthetic impact evaluation tasks undertaken under this contract support the FERC supplemental information request which discusses, in some detail, numbers of recreationists/viewers that experience the visual resources of the project study area.

Based on the relative impact significance rating scores in Table 3-1, the ATAs were prioritized from highest to lowest as follows: Goodell Creek; Bacon Creek; Diablo Overlook; Thornton Creek; Gorge Dam Viewpoint; and Diablo "Y" and Pinkie's (both ranked sixth).

TABLE 3-1

SEATTLE CITY LIGHT T-LINE VEGETATION MANAGEMENT
AESTHETIC TARGET AREA VISUAL IMPACT DETERMINATION

DEFINITION OF TERMS AND IMPACT RATINGS

PARAMETER OF CONCERN	IMPACT RATINGS	DEFINITION
VISIBILITY OF T-LINE FEATURES		These are the structural components of the transmission corridor.
Transmission Tower	1 - 3	At any one site, tower visibility is rated as 1 (minimum), 2 (moderate) or 3 (maximum).
Transmission Lines	1 - 3	At any one site, visibility of lines between towers are rated 1 (minimum), 2 (moderate) or 3 (maximum).
T-Line ROW Clearing	1 - 3	At any one site, maintenance clearing zones, depending upon their visual impact, are rated 1 (minimum), 2 (moderate) or 3 (maximum).
OBSERVER POSITION/VIEWING ANGLE		Note: Not all viewing angles are achieved at each site; applicable angles are ranked when they are appropriate viewing angles for the site.
Inferior	1	An inferior view (below the target viewed) is considered of least impact, and is assigned a ranking of 1.
Normal	2	An average normal line of sight with respect to the target viewed is considered of moderate impact, and is assigned a ranking of 2.
Superior	3	A superior view (above the target viewed) is considered of maximum impact, and is assigned a ranking of 3.
Perpendicular	1	A view which is perpendicular to the viewed object or target is considered of minimum viewer impact and is assigned a ranking of 1.

PARAMETER OF CONCERN	IMPACT RATINGS	DEFINITION
Linear	2	A view along the length of the viewed object or target is considered of moderate impact and is assigned a ranking of 2.
VIEWING DISTANCE ZONE		Most viewpoint locations will have only one zone, that is the target viewed will be in the foreground, background, or middleground of the viewer's scope of vision.
Background	1	A viewed object at background distances (5 miles plus) is considered of minimal impact and is rated as 1.
Middleground	2	A viewed object at middle ground distances (3-5 miles) is considered of moderate impact and is rated 2.
Foreground	3	A viewed object in the foreground (¼ - ½ mile) is considered to have maximum impact and is rated 3.
VIEWING OPPORTUNITY TYPE		The frequency of use and the accessibility of an area will determine the ranking for these categories. The opportunity type, viewer category and view duration are interdependent and require some subjective interpretation of the viewing potential and duration.
Primary Travel Route	3	A maximum ranking is given to primary travel routes since the frequency of viewer contact is highest at these areas.
Informal Turnout	2	A moderate ranking is given to pull-off sites, as movement through these areas is usually associated with specific purposes (to let faster traffic pass, etc.) and views may be secondary.
Formal Turnout	3	Campgrounds, scenic view turnouts, and in some cases trailheads are areas in which viewers have a specific interest in their visual surroundings. These areas are, therefore, rated with a maximum score of 3.

DEFINITION OF TERMS AND IMPACT RATINGS (continued)

PARAMETER OF CONCERN	IMPACT RATINGS	DEFINITION
Non-ROW Changes	1	Structural modifications such as the proposed NPS visitor center have their own impact on surrounding viewsheds and thus interrelate indirectly with the T-Line needs. These areas are given a rating of minimum impact (1).
VIEWER CATEGORY		People passing through the areas evaluated have specific activities or goals for their movement. Depending upon their likely intent and presence, viewer categories are given a ranking of 1 to 3 as described below.
Pleasure driver	1	A pleasure driver is likely to pass through an area rather quickly and make observations while moving, without stopping to concentrate on any particular view. Therefore, this viewer opportunity for activity is rated as minimum for visual impact purposes.
Recreationist	2 - 3	Visitors who come specifically to use the area under review will be moderately to maximally impacted by T-Line views, depending upon their activity and use areas. Multiple use areas (i.e. hiking, boating and picnicking) will be scored for each activity.
Scenic Viewing	3	Areas where scenic viewing is likely to be a high interest are given a maximum rank of 3.
VIEW DURATION		Not all durations will apply to a given site; those which do apply are given an appropriate score as described below.
Traveling	1	A viewer moving through the area and not typically stopping is rated with a minimum score of 1.
Still Viewing	2	A viewer provided with an opportunity to stop briefly will be more cognizant of the surrounding areas and thus is moderately impacted and rated as 2.

PARAMETER OF CONCERN	IMPACT RATINGS	DEFINITION
Extended Viewing	3	Extended views are likely in scenic view areas, resort and camping areas, and similar use situations. This type of viewing is assigned a maximum rating of 3.

Compiling Scores: Once the parameters of an area under evaluation are determined, and scores are assigned, a subtotal for each category is derived by adding the scores. A total for the area is added to achieve a score for the viewpoint location. Scores can then be used to rank the location itself, with the highest scores having the highest priority.

TABLE 3-1
SEATTLE CITY LIGHT T-LINE VEGETATION MANAGEMENT
AESTHETIC TARGET AREA VISUAL IMPACT DETERMINATION

AREA 1: BACON CREEK

VIEWSHED DESCRIPTION	VISIBILITY	IMPACT RATING 1 - 3 (min - max)		IMPACT SIGNIFICANCE SUBTOTAL	TOTAL
VIEWPOINT LOCATION	Visibility of T-line Features				
SR20;(M.P. 111)	* transmission towers	3			
Skagit River: R.M. 83.00	* T-lines	3			
	* ROW clearing	3			
			SUBTOTAL	9	
	Observer Position / Viewing Angle				
	* inferior (1)	1	Westward		
	* normal (2)	2	at Site looking		
	* superior (3)		eastward		
	* perpendicular (1)				
	* linear (2)	2			
			SUBTOTAL	5	
VIEWSHED CHARACTERISTICS	Viewing Distance Zone				
	* background (1)				
	* middleground (2)				
Transmission lines B & D cross SR20 west of Bacon Creek target area and again east of Bacon Creek Campground access road.	* foreground (3)	3			
			SUBTOTAL	3	17

VIEWER SENSITIVITY				
VIEWING POTENTIAL / DURATION	IMPACT RATING			
Transmission lines, towers and cleared vegetation within ROW dominate views of and through the target area.	Opportunity Type			
	* Primary travel route	3		
	* Informal turnout	2		
	* Formal campground site			
	Bacon Creek Campground (West of project boundary)	3		
			SUBTOTAL	8
	Viewer Category			
	* Pleasure driver	1		
	* Recreationist			
	- picknicking/ temporary rest	3		
	- fishing	3		
	- informal hiking (no establ. trails)	2		
			SUBTOTAL	9
	View Duration			
	* traveling (1)	1		
	* still viewing (2)	2		
	* extended viewing (3)			
			SUBTOTAL	9	26
			TOTAL		43

TABLE 3-1
SEATTLE CITY LIGHT T-LINE VEGETATION MANAGEMENT
AESTHETIC TARGET AREA VISUAL IMPACT DETERMINATION

AREA 2: PINKIES

VIEWSHED DESCRIPTION

VIEWPOINT LOCATION

SR20;(M.P. 114.4)
Skagit River: R.M. 87.75

VIEWSHED CHARACTERISTICS

The transmission ROW parallels SR20 to the north. Line D is adjacent to the highway and line B is situated up slope and above the highway along a steep embankment.

Sporadic views of Line D, its towers and ROW cleared of vegetation are partially screened by the rugged terrain and vegetation. Line B would be visible from a stationary position and only slightly visible while traveling on SR20.

VIEWER EXPOSURE			IMPACT SIGNIFICANCE	
VISIBILITY	IMPACT RATING 1 - 3 (min - max)		SUBTOTAL	TOTAL
Visibility of T-line Features				
	D-line			
* transmission towers	2			
* T-lines	2			
* ROW clearing	1			
		SUBTOTAL	5	
Observer Position / Viewing Angle				
* inferior (1)	1			
* normal (2)				
* superior (3)				
* perpendicular (1)	1			
* linear (2)			2	
Viewing Distance Zone				
* background (1)	1			
* middleground (2)				
* foreground (3)				
		SUBTOTAL	1	8
VIEWER SENSITIVITY				
VIEWING POTENTIAL / DURATION	IMPACT RATING			
Opportunity Type				
* Primary travel route	3			
* Informal turnout	2			
		SUBTOTAL	5	
Viewer Category				
* Pleasure driver	1			
* Recreationist				
- picknicking/ temporary rest	3			
- fishing	3			
- informal hiking (no establ. trails)	2			
		SUBTOTAL	9	
View Duration				
* traveling (1)	1			
* still viewing (2)	2			
* extended viewing (3)				
		SUBTOTAL	3	17
		TOTAL		25

TABLE 3-1
SEATTLE CITY LIGHT T-LINE VEGETATION MANAGEMENT
AESTHETIC TARGET AREA VISUAL IMPACT DETERMINATION

AREA 3: THORNTON CREEK

VIEWSHED DESCRIPTION	VIEWER EXPOSURE: VISIBILITY	IMPACT RATING 1 - 3 (min - max)		IMPACT SIGNIFICANCE: SUBTOTAL	TOTAL
VIEWPOINT LOCATION	Visibility of T-Line Features				
SR20;(M.P. 117) Skagit River: R.M. 90	* transmission towers	3			
	* T-lines	3			
	* ROW clearing	3			
			SUBTOTAL	9	
VIEWSHED CHARACTERISTICS	Observer Position / Viewing Angle				
	* inferior (1)				
	* normal (2)	2			
Line D closely parallels SR20 to the north and Line B is situated above the highway along a steep bank north of Line D.	* superior (3)				
	* perpendicular (1)				
	* linear (2)	2			
			SUBTOTAL	4	
Line D, its towers and cleared ROW dominate views to the north side of the highway. Line B can be from a stationary and only slightly visible while traveling along the highway.	Viewing Distance Zone				
	* background (1)				
	* middleground (2)				
	* foreground (3)	3			
			SUBTOTAL	3	16

VIEWER SENSITIVITY: VIEWING POTENTIAL / DURATION	IMPACT RATING			
Opportunity Type				
* Primary travel route	3			
* Informal turnout/trail-head	2			
		SUBTOTAL	5	
Viewer Category				
* Pleasure driver	1			
* Recreationist				
- picknicking/ temporary rest	3			
- fishing	3			
		SUBTOTAL	7	
View Duration				
* traveling (1)	1			
* still viewing (2)	2			
* extended viewing (3)	3			
		SUBTOTAL	6	18
		TOTAL		34

TABLE 3-1
SEATTLE CITY LIGHT T-LINE VEGETATION MANAGEMENT
AESTHETIC TARGET AREA VISUAL IMPACT DETERMINATION

AREA 4: GOODELL CREEK

VIEWSHED DESCRIPTION	VISIBILITY	IMPACT RATING 1 - 3 (min - max)		IMPACT SIGNIFICANCE SUBTOTAL	TOTAL
VIEWPOINT LOCATION SR20;(M.P.120.2 Skagit River: R.M. 92.25	Visibility of T-Line Features				
	* transmission towers	3			
	* T-lines	3			
	* ROW clearing	3			
			SUTOTAL	9	
	Observer Position / Viewing Angle				
VIEWSHED CHARACTERISTICS	* inferior (1)				
	* normal (2)	2 eastward			
	* superior (3)				
The transmission lines are aligned along both sides of SR20, Line B to the north and Line D to the south of the highway.	* perpendicular (1)				
	* linear (2)	2			
			SUBTOTAL	4	
The transmission lines, towers and cleared ROW dominate views from the highway. For the entire length of the Goodell Creek Target area.	Viewing Distance Zone				
	* background (1)				
	* middleground (2)				
	* foreground (3)	3			
			SUBTOTAL	3	16
Only tops of two or three towers of the T-Line are slightly visible at a distance from the proposed visitor's center site west of the Goodell campground.	VIEWER SENSITIVITY				
	VIEWING POTENTIAL / DURATION	IMPACT RATING			
	Opportunity Type				
	* Primary travel route	3			
	* Informal turnout	2			
	* Formal campground site nearby Goodell Campground	3			
A microwave distribution line, along Trapper's peak ridge north of the highway would not be visible from the highway or visitor's center.	* Proposed NPS Visitor's center loc. on south side of river.	1			
			SUBTOTAL	8	
	Viewer Category				
	* Pleasure driver	1			
	* Recreationist				
	- picknicking/ temporary rest	3			
	- fishing	3			
	- informal hiking (no establ. trails)	2			
	* Formal scenic viewing activity	3			
			SUBTOTAL	12	

TABLE 3-1
SEATTLE CITY LIGHT T-LINE VEGETATION MANAGEMENT
AESTHETIC TARGET AREA VISUAL IMPACT DETERMINATION

AREA 4: GOODELL CREEK (Continued)

VIEWSHED DESCRIPTION	VIEWER EXPOSURE		IMPACT SIGNIFICANCE	
	VISIBILITY	IMPACT RATING 1 - 3 (min - max)	SUBTOTAL	TOTAL
	View Duration			
	* traveling extended viewing while traveling due to parallel alignment of T-lines and SR20.	2		
	* still viewing (2)	2		
	* extended viewing-still (3) from NPS Visitor's Center	3		
		SUBTOTAL	7	
		TOTAL		43

TABLE 3-1
SEATTLE CITY LIGHT T-LINE VEGETATION MANAGEMENT
AESTHETIC TARGET AREA VISUAL IMPACT DETERMINATION

AREA 5: GORGE DAM VIEWPOINT

VIEWSHED DESCRIPTION

VIEWPOINT LOCATION

SR20;(M.P. 123.
Skagit River: R.M. 96.5

VIEWSHED CHARACTERISTICS

The site is situated south of SR20 and overlooks Gorge Dam and its reservoir to the southeast. The surrounding area is dominated by rugged terrain and covered by dense evergreen forest vegetation.

The transmission lines are located between the viewpoint site and SR20 on the top of a ridge which separates the two. The T-Line crosses over the Skagit River west of the dam and is clearly visible from the viewpoint, as are the T-line towers along the north side of Gorge Lake.

VIEWER EXPOSURE		IMPACT SIGNIFICANCE	
VISIBILITY	IMPACT RATING 1 - 3 (min - max)	SUBTOTAL	TOTAL
Visibility of T-Line Feature			
* transmission towers	3		
* T-Lines	3		
* ROW clearing	3		
	SUBTOTAL	9	
Observer Position / Viewing Angle			
* inferior (1)	1		
* normal (2)			
* superior (3)			
* perpendicular (1)			
* linear (2)	2		
	SUBTOTAL	3	
Viewing Distance Zone			
* background (1)			
* middleground (2)	2		
* foreground (3)			
	SUBTOTAL	2	14

VIEWER SENSITIVITY			
VIEWING POTENTIAL / DURATION	IMPACT RATING		
Opportunity Type			
* Primary travel route	3		
* Formal turnout	3		
* Proposed formal scenic viewpoint	3		
	SUBTOTAL	9	
Viewer Category			
* Pleasure driver	1		
* Recreationist - picknicking/ temporary rest	3		
	SUBTOTAL	4	
View Duration			
* traveling (1)			
* still viewing (2)	2		
* extending viewing (3) - future	3		
	SUBTOTAL	5	18
	TOTAL		32

TABLE 3-1
SEATTLE CITY LIGHT T-LINE VEGETATION MANAGEMENT
AESTHETIC TARGET AREA VISUAL IMPACT DETERMINATION

AREA 6: DIABLO "Y"

VIEWSHED DESCRIPTION

VIEWPOINT LOCATION

SR20;(M.P. ___)
Skagit River: R.M. 99.0

VIEWSHED CHARACTERISTICS

Line B crosses diagonally over the east end of Diablo Lake and continues up a ridge east of the lake. Line D crosses over Diablo Lake further west of Line B and parallels the lake along a steep rocky embankment. It later rejoins Line B at the east end of the lake.

The views of transmission lines of Line B are clearly visible from SR20. Views of Line D's lines and towers are minimized by the light colored backdrop of the rocky embankment. Where the two lines converge at the east end of Lake Diablo, distant views of the transmission lines, towers and cleared vegetation is exposed by the west-facing ridge.

VIEWER EXPOSURE			IMPACT SIGNIFICANCE	
VISIBILITY	IMPACT RATING 1 - 3 (min - max)		SUBTOTAL	TOTAL
Visibility of T-line Features	B-Line	D-Line	B / D	B / D
* transmission towers	3	2		
* T-lines	3	2		
* ROW clearing	3	1		
		SUBTOTAL	9 / 5	
Observer Position / Viewing Angle				
* inferior (1)	1		D-Line	
* normal (2)	2		B-Line at lake elevation	
* superior (3)				
* perpendicular (1)				
* linear (2)		SUBTOTAL	2 / 1	
Viewing Distance Zone	B-Line	D-Line		
* background (1)				
* middleground (2)		2		
* foreground (3)	3			
		SUBTOTAL	3 / 2	14 / 8

VIEWER SENSITIVITY			
VIEWING POTENTIAL/DURATION	IMPACT RATING		
Opportunity Type			
* Primary travel route	3		
* Informal turnout	2		
	SUBTOTAL	5	
Viewer Category			
* Pleasure driver	1		
* Recreationist - fishing	3		
	SUBTOTAL	4	
View Duration			
* traveling (1)			
* still viewing (2)	2		
* extended viewing (3)			
	SUBTOTAL	2	11
	TOTAL (B / D)		25 / 19

TABLE 3-1
SEATTLE CITY LIGHT T-LINE VEGETATION MANAGEMENT
AESTHETIC TARGET AREA VISUAL IMPACT DETERMINATION

AREA 7: DIABLO OVERLOOK

VIEWSHED DESCRIPTION

VIEWPOINT LOCATION

SR20;(M.P. ___)
Skagit River: R.M. 102.75

VIEWSHED CHARACTERISTICS

A single transmission line crosses over the northern most tip of Lake Diablo traversing over steep heavily forested terrain.

Distant views of the T-Line towers are clearly visible where it crosses over Diablo Lake from the viewpoint situated above the lake and at the south side. A portion of cleared land is visible west of the lake where the terrain is exposed to the viewer. The heavy vegetation screens the remainder of the cleared areas, exposing only the tips of the towers and transmission lines which tend to be highlighted by the dark background provided by the evergreens.

VIEWER EXPOSURE		IMPACT SIGNIFICANCE	
VISIBILITY	IMPACT RATING 1 - 3 (min - max)	SUBTOTAL	TOTAL
Visibility of T-line Features			
* transmission towers	3		
* T-lines	3		
* ROW clearing	2		
	SUBTOTAL	8	
Observer Position / Viewing Angle			
* inferior (1)			
* normal (2)			
* superior (3)	3		
* perpendicular (1)			
* linear (2)			
	SUBTOTAL	3	
Viewing Distance Zone			
* background (1)			
* middleground (2)	2		
* foreground (3)			
	SUBTOTAL	2	13

VIEWER SENSITIVITY			
VIEWING POTENTIAL / DURATION	IMPACT RATING		
Opportunity Type			
* Primary travel route	3		
* Formal scenic viewpoint Diablo Overlook	3		
	SUBTOTAL	6	
Viewer Category			
* Pleasure driver	1		
* Recreationist			
- picknicing/temp. res	3		
- boating/resort	3		
- fishing	3		
- hiking (Diablo Lake Trail)	3		
	SUBTOTAL	13	
View Duration			
* traveling (1)	1		
* still viewing (2)	2		
* extended viewing/ boating (3)	3		
	SUBTOTAL	6	19
	TOTAL		38

3.4 DEVELOPMENT OF VISUAL IMPACT MITIGATION RECOMMENDATIONS

The objective of this task is to formulate from the visual impact analysis results management recommendations that can be integrated with other key issues of SCL's Vegetation Management Program. The ATAs represent model points along the ROW for the demonstration of the mitigation of visual impacts along some of the most heavily visited parts of the ROW. Using the techniques outlined here, SCL personnel can implement mitigation activities along the rest of the ROW as needed. The purpose of this document is to provide not only a thorough aesthetic evaluation, but also to provide a tool which can be utilized repeatedly. Accordingly, a range of Vegetation Mitigation Management Prescriptions have been developed that can be used to reduce the visual impact characteristics of each of the ATAs. These prescriptions can be used in other areas.

Computer Aided Design (CAD) drawings (Figures 3-2 through 3-7) illustrate a variety of mitigation management prescriptions and their anticipated results. These figures graphically show how visual impacts can be minimized as a result of each of the vegetation management prescriptions. Table 3-2 provides an interpretive key to the figure's plant symbols. The table shows a plant symbol, a correlating plant size and the vegetative species that typically have growth characteristics which correspond to the desired plant height shown.

The graphic figures illustrate a range of viable vegetation management techniques which can be standardized as vegetation mitigation prescriptions for visual impact reduction. The mitigation prescriptions are intended to be developed to an appropriate level of detail which will allow their application along the project ROW or along any of the other SCL rights-of-way as similar impact scenarios occur. The mitigation prescriptions can be applied individually or combined as necessary to address the varying impact circumstances as they arise.

For ease of review, Table 3-2 and Figures 3-2 through 3-7 are presented at the end of the following discussion of the goals and objectives of the mitigation prescriptions.

3.5 VEGETATION MITIGATION PRESCRIPTIONS

3.5.1 Prescription Goals and Objectives

The mitigation prescriptions illustrated in Figures 3-2 through 3-7 demonstrate ways in which supplemental planting techniques

and/or natural infill techniques within the transmission line ROW can effectively screen views of transmission lines, towers and cleared corridors from SR20 and designated viewpoints. Plantings outside the ROW are also utilized where views of transmission line corridors cannot be effectively and/or economically screened by managing vegetation within the ROW. Establishing vegetative screening close to the viewers allows a larger section of the transmission line corridor to be screened using the minimum amount of vegetation. In such cases, the further the transmission line is from the viewer, the greater the portion of the corridor is screened from the viewer. Screening also lessens the impact of non-vegetative features by drawing the viewer's eye to closer objects, more visually attractive features or increasing the variety of features visible to the viewer.

Size and location of vegetation that is either planted or encouraged to grow within the transmission corridor is governed by the line sag and sway clearance requirements, from transmission lines (primary) and towers (secondary) of vegetation at mature size. The SCL standard for minimum clearance of the lines is 16 ft 6 inches for 230 kV lines and 18 ft for 240 kV lines. Not So

The feathering treatment of vegetation along the ROW margins will minimize the generally abrupt visual contrast in the color, line and texture of the ROW, which typically contains a minimal amount of vegetation, with that of the adjacent and more dense forest vegetation. Use of variable trees and shrub heights will give the appearance of a natural infill of vegetation within the ROW. Application of this mitigation technique, at key locations in the project study area, will minimize the visual impact of the transmission structures and corridor on the natural and scenic visual character of the NRA. This objective can also be accomplished by utilizing a mix of vegetation with variable fast and slow growth characteristics.

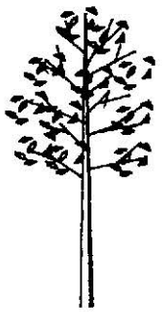
Please 4

Mitigation plans, which include integrated procedures to allow natural regrowth of vegetation as well as planned vegetation control to encourage browsing where appropriate, are utiliized to achieve benefits for wildlife inhabiting or crossing the ROW area. The use of vegetation under the transmission lines which encourages wildlife foraging by providing suitable food and protective cover is suggested where maintaining the maximum amount of line clearance is most critical. Foraging activities will help keep much of the vegetation growth in these areas to a minimum. As a result, the frequency of vegetative maintenance required to control tree heights that could interfere with the lines would be reduced. The need for such maintenance activities could potentially be reduced from annual maintenance to a 3-year maintenance program.

Effective pruning procedures to keep vegetation heights from endangering transmission lines will need to continue within the transmission ROW, utilizing the criteria established by the mitigation prescriptions as a general guide for pruning techniques. Pruning procedures include selective branch trimming, branch removal, topping or cutting back of brush or tree species without causing plant death or full plant removal. Pruning tolerances of the mitigation prescriptions allow for an optional three-year growth period beyond the fall line clearance height for trees which could potentially damage transmission lines and towers. This allowance will minimize the frequency of maintenance required to control tree height.

The incorporation of the various vegetation management prescription techniques into SCL's Integrated Vegetation Management Program will potentially reduce the need for herbicide uses. Where vegetation establishment needs to be kept to a minimum, such as maintenance access routes and around the tower bases, herbicide uses can be evaluated.

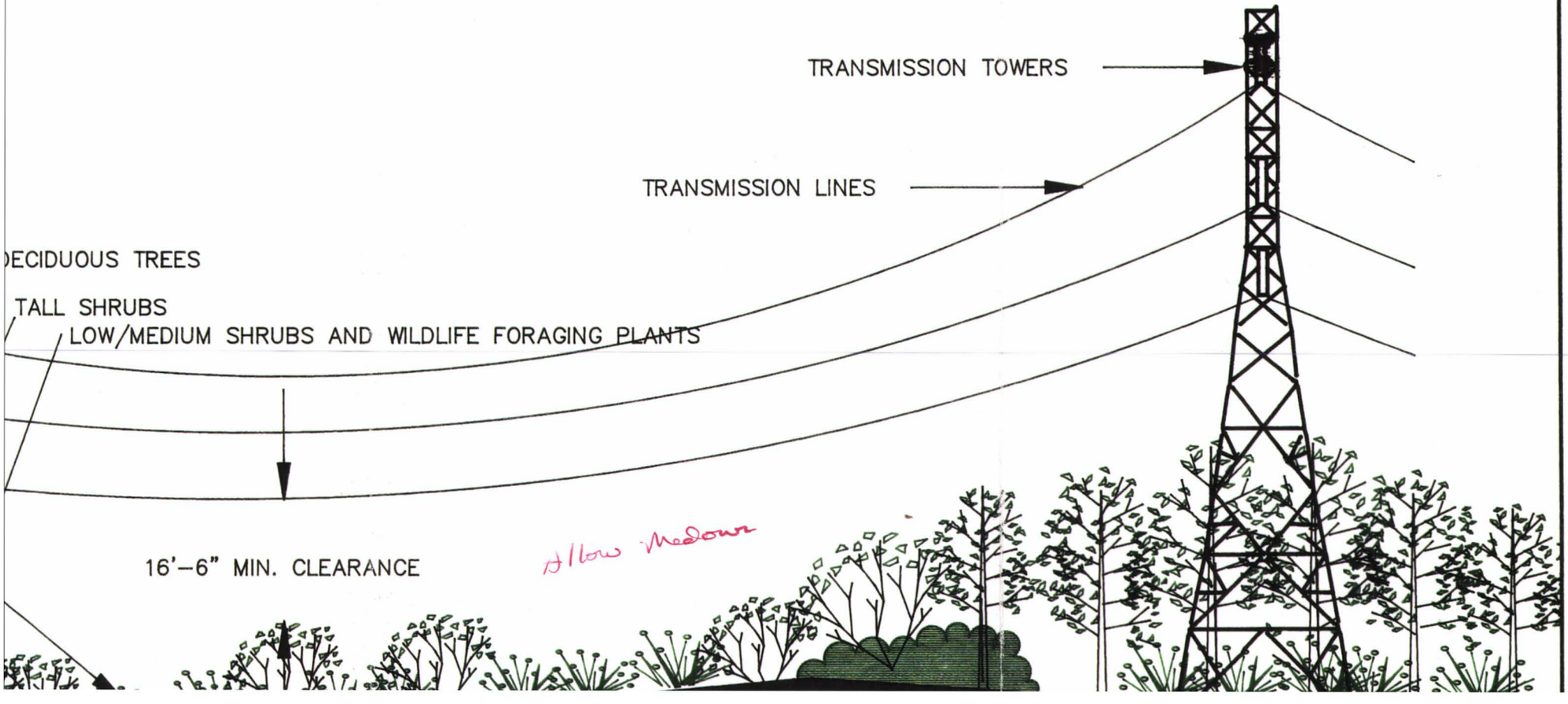
TABLE 3–2
PLANTING KEY

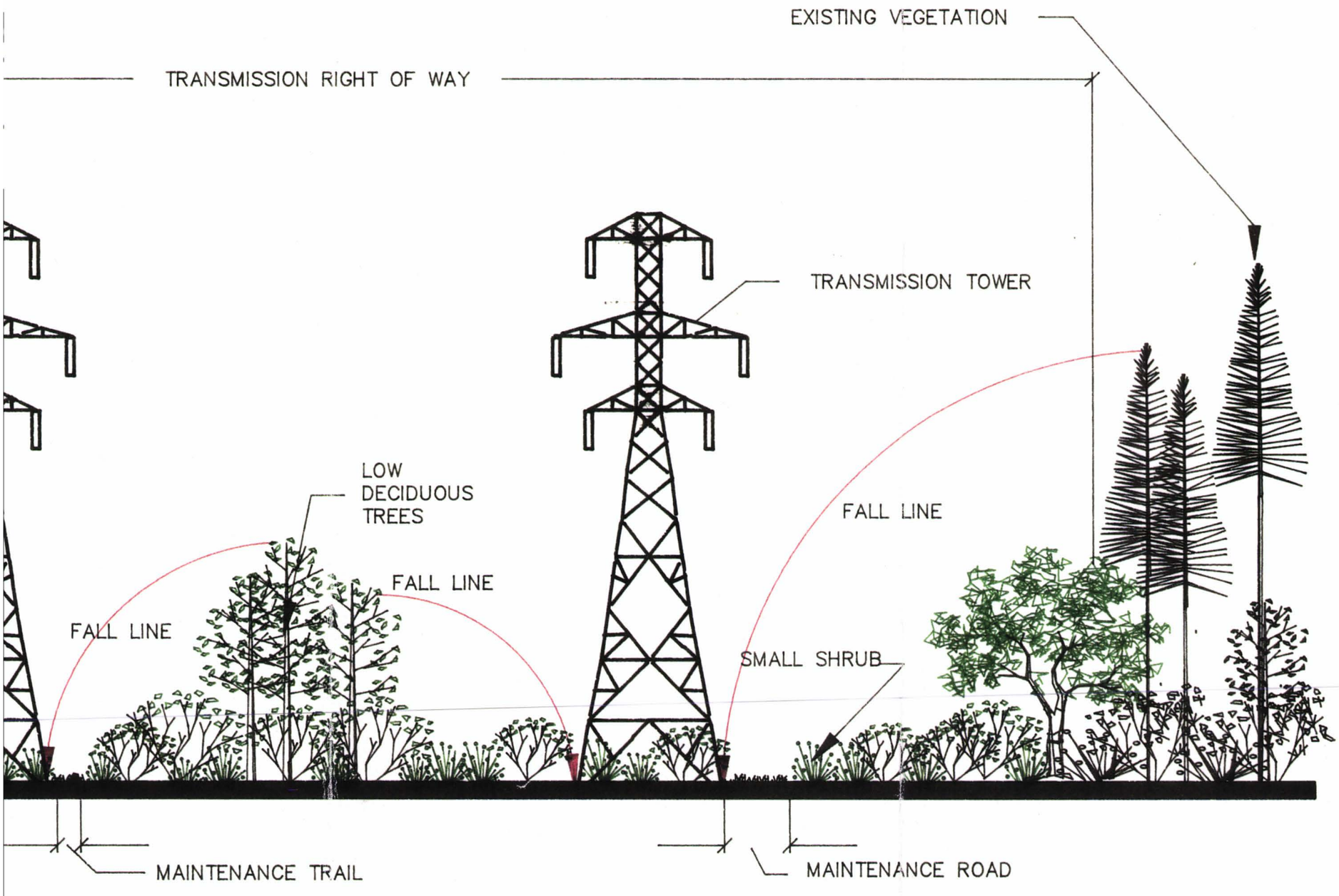
SYMBOL	TYPE/SIZE	EXAMPLE
	**EVERGREEN TREES** TALL (OVER 80') MEDIUM (40–80')	DOUGLAS FIR WESTERN HEMLOCK WESTERN RED CEDAR LODGEPOLE PINE
	**DECIDUOUS TREES** TALL (OVER 80') MEDIUM (40'–80') LOW (25'–40')	BIG LEAF MAPLE WHITE POPLAR PAPER BIRCH BLACK COTTONWOOD RED MAPLE RED ALDER VINE MAPLE ROCKY MOUNTAIN MAPLE EUROPEAN ASH WILLOWS
	**WILDLIFE FORAGING SHRUBS** TALL (8'–15') MEDIUM (3'–8')	THIMBLEBERRY HARDHACK OCEANSPRAY GOOSEBERRY WESTERN SERVICE BERRY SALMON BERRY RED OSIER DOGWOOD RED ELDERBERRY RED HUCKLEBERRY SPIREA
	**WILDLIFE FORAGING SHRUBS** LOW (1'–3')	KINNIKINNIK LONG–LEAVED OREGON GRAPE MOUNTAIN BOX

REES

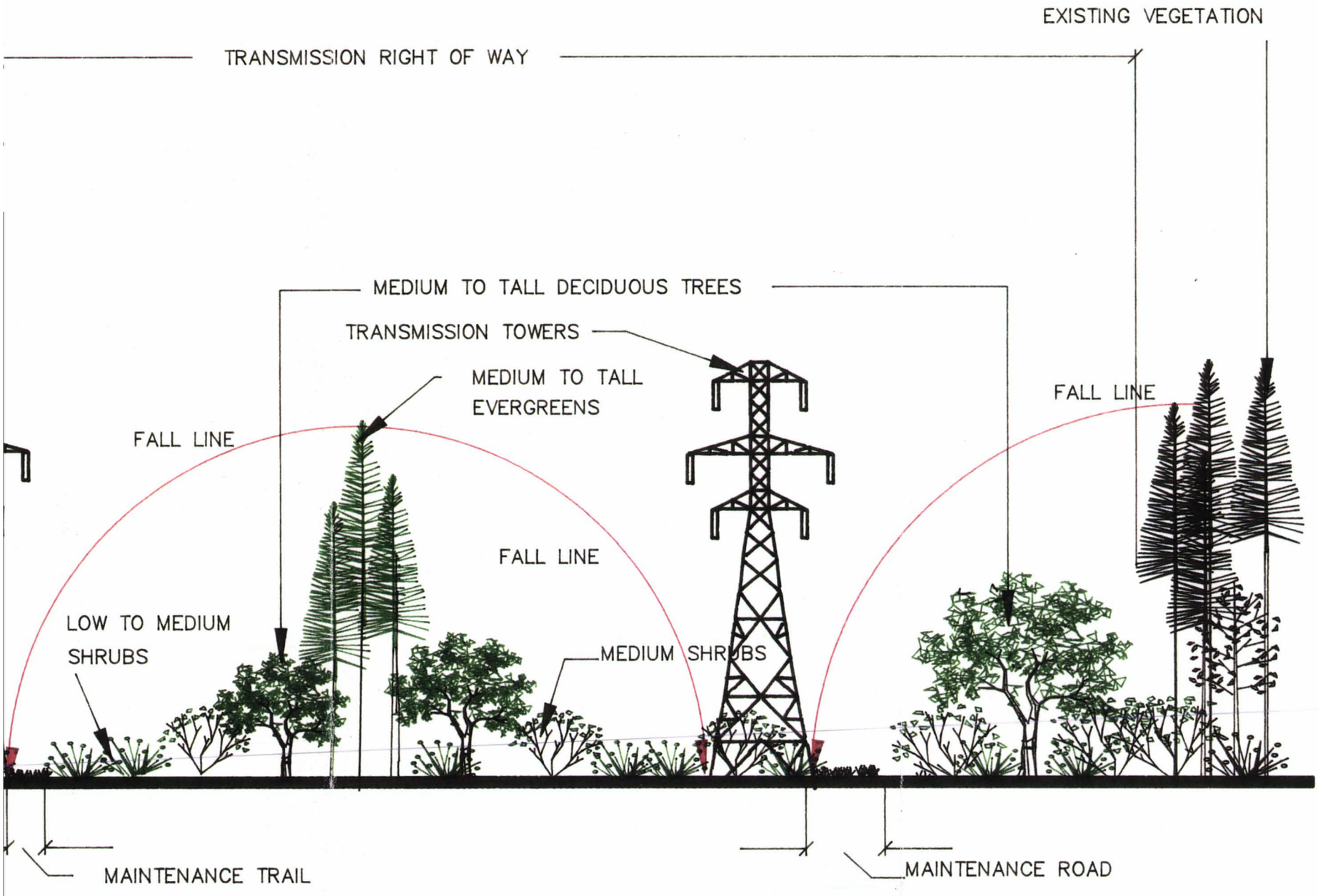
MITIGATION: PROVIDE A HEIRARCHY OF VEGETATION HEIGHTS UNDER THE TRANSMISSION LINES WHERE THEY ARE VISIBLE FROM SR 20. PLANT AND/OR ALLOW TO GROW TALLER VEGETATION AROUND THE TOWERS WHERE TRANSMISSION LINES HAVE THE GREATEST GROUND CLEARANCE. PLANT AND/OR ALLOW TO GROW VEGETATION THAT DECREASES PROGRESSIVELY IN HEIGHT TOWARDS THE CENTER WHERE TRANSMISSION LINE GROUND CLEARANCE IS AT ITS LOWEST POINT. UTILIZE WILDLIFE FORAGING VEGETATION WHERE TRANSMISSION LINE GROUND CLEARANCE IS MINIMAL.

RESULTS: VEGETATION PROVIDES PARTIAL SCREENING OF EXPOSED CORRIDOR, SOFTENS BOLD LINEAR FEATURES OF TOWER STRUCTURE, REDUCES VISUAL MAGNITUDE OF TRANSMISSION LINE FEATURES AND REDUCES CONTRAST OF CLEARED AREA WITH VEGETATION ALONG THE MARGINS OF THE CORRIDOR RIGHT OF WAY.



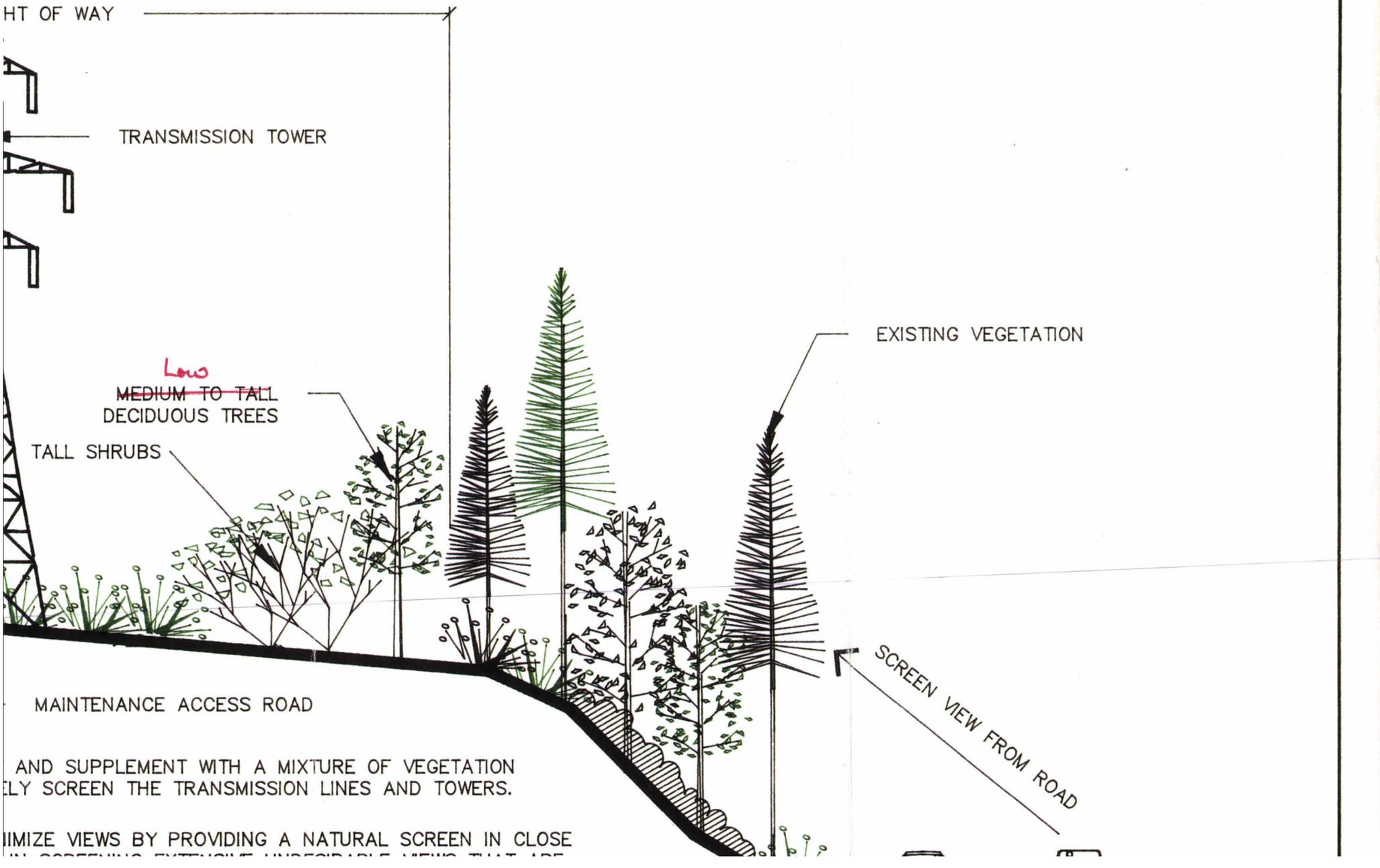


TION ALONG THE MARGINS OF THE CORRIDOR RIGHT OF WAY WITH TALLER VEGETATION ALONG THE OUTER MOST
IGHT UNDER THE TRANSMISSION LINES. CLUSTER PLANTINGS TO PROVIDE A MEANDERING EDGE TREATMENT
TILIZE WILDLIFE FORAGING VEGETATION UNDER THE TRANSMISSION LINES.



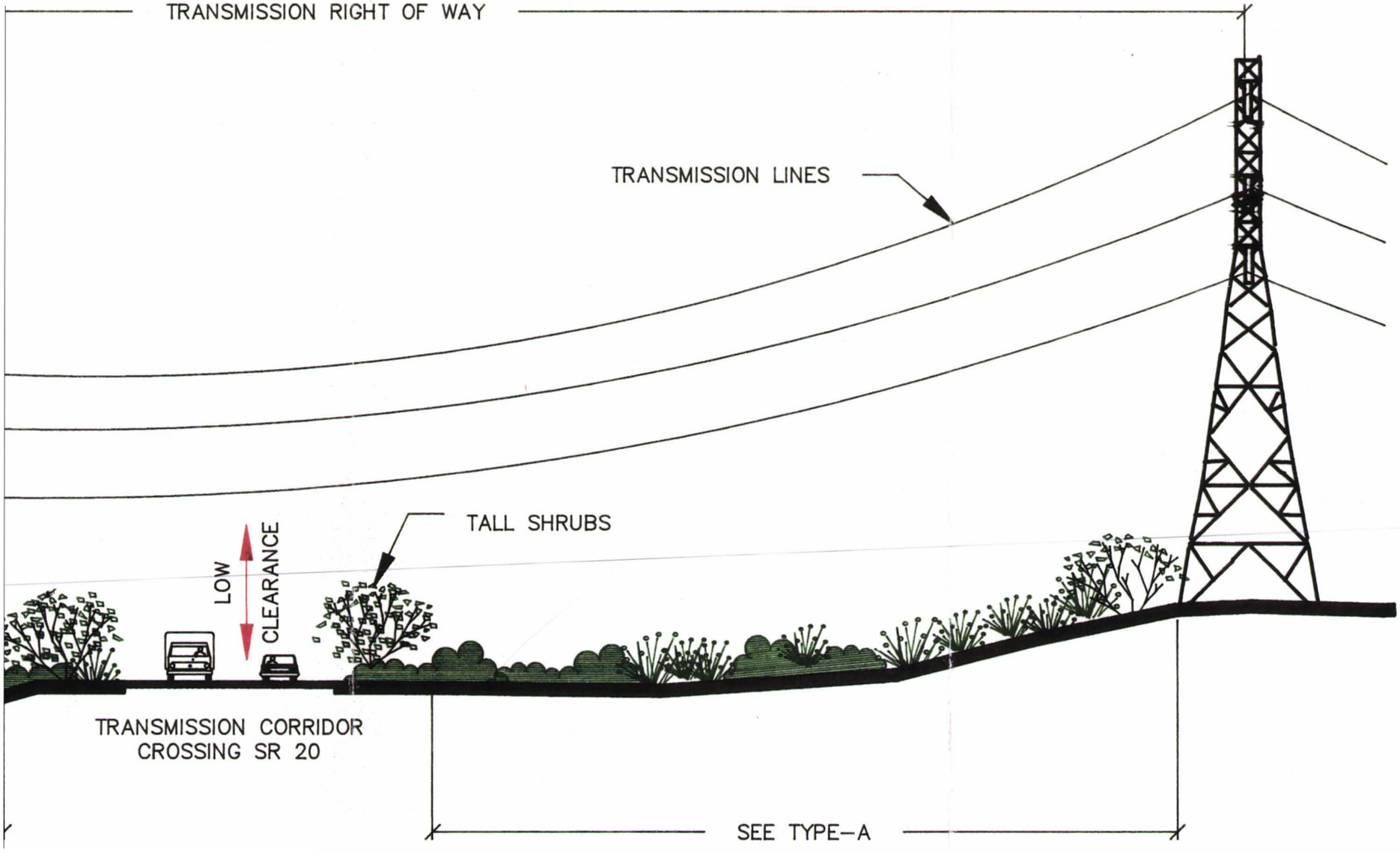
B ALONG BOTH SIDES OF CORRIDOR. PLANT AND/OR ALLOW TO GROW AREAS BETWEEN TOWERS WITH THE TALL
PROGRESSIVELY SMALLER TOWARDS THE TOWERS.

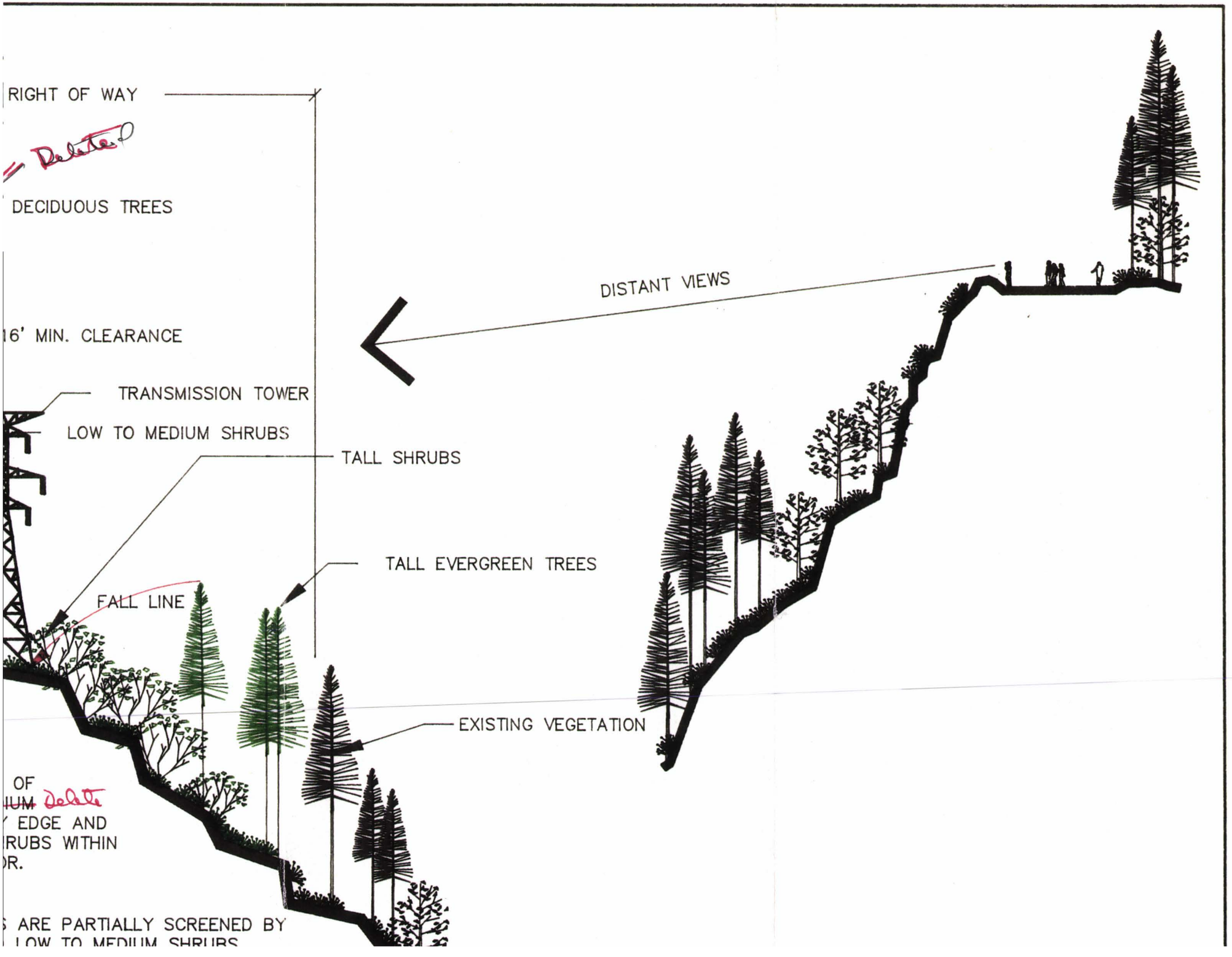
OR WILL BE SIGNIFICANTLY REDUCED AS WELL AS MINIMIZING VIEWS OF THE TOWERS AND TRANSMISSION LINES


HT OF WAY
TRANSMISSION TOWER
Low
~~MEDIUM TO TALL~~
DECIDUOUS TREES
TALL SHRUBS
EXISTING VEGETATION
SCREEN VIEW FROM ROAD
MAINTENANCE ACCESS ROAD
AND SUPPLEMENT WITH A MIXTURE OF VEGETATION
LY SCREEN THE TRANSMISSION LINES AND TOWERS.
IMIZE VIEWS BY PROVIDING A NATURAL SCREEN IN CLOSE

. PLANTINGS OF TALL SHRUBS PARALLEL TO SR 20 WHERE TRANSMISSION LINE RIGHT OF WAY CROSSES THE
TO EXISTING VEGETATION ON EITHER SIDE OF THE TRANSMISSION LINE RIGHT OF WAY.

RIDOR AND TOWERS CAN BE EFFECTIVELY SCREENED FOR THOSE WHO ARE TRAVELING THROUGH THE RIGHT OF
EGETATION ADJACENT TO SR 20.




RIGHT OF WAY
= Delete
DECIDUOUS TREES
16' MIN. CLEARANCE
TRANSMISSION TOWER
LOW TO MEDIUM SHRUBS
TALL SHRUBS
TALL EVERGREEN TREES
FALL LINE
DISTANT VIEWS
EXISTING VEGETATION
OF
IUM Delete
EDGE AND
RUBS WITHIN
R.
ARE PARTIALLY SCREENED BY
LOW TO MEDIUM SHRUBS

3.5.2 Aesthetic Target Area Prescription Plans

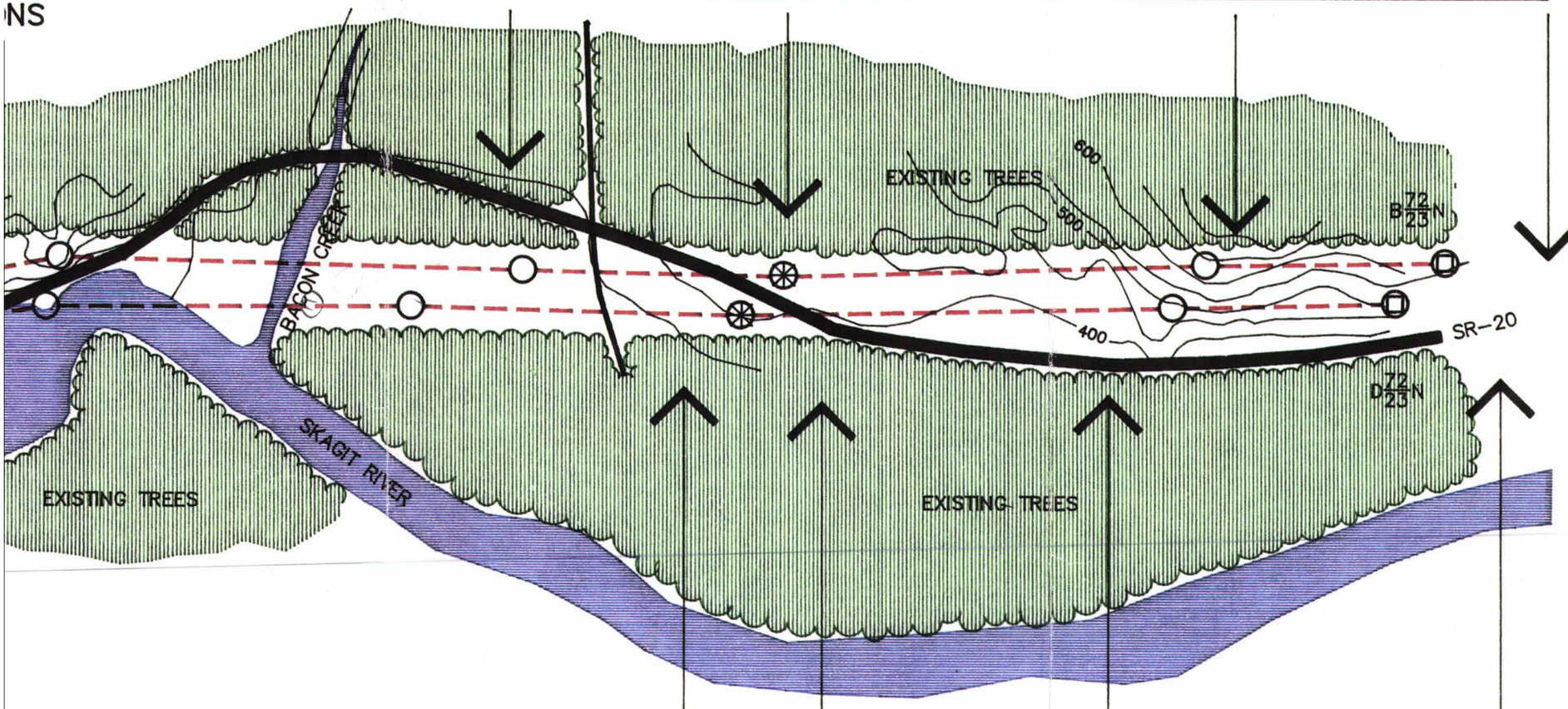
Figures 3-8 through 3-14 are vegetation management prescription plans specific to the project ATA sites. The target area plans illustrate locations of local landmarks, roads, trails, rivers and the SCL transmission lines. The plans also document which towers are visible as one travels along SR 20, or, in the case of Diablo Overlook and Gorge Dam Viewpoint, from a stationary location.

The illustration text describes how the viewer sees the corridor itself while traveling east-bound or west-bound on SR 20. Sections of the transmission corridor are broken into areas of common view characteristics with regard to slope aspect, length of exposed corridor from SR 20, at various angles, be it perpendicular to or linear/in-line with the viewer. Each view section is given a mitigation prescription applicable to the type of views possible from SR 20.

ACTERISTICS

ORRIDOR PROVIDING SOME SCREENING AT BACON CREEK. ROAD	• PARTIALLY SCREENED FROM VIEW. • SHORT DURATION.	• LONG LINEAR CORRIDOR HIGHLY VISIBLE WITH EXPOSED SLOPES AT FAR WEST END OF CORRIDOR.	• NOT SIGNIFICANT
	• TYPE: A,B,D AND E	• TYPE: A,B AND D	

NS

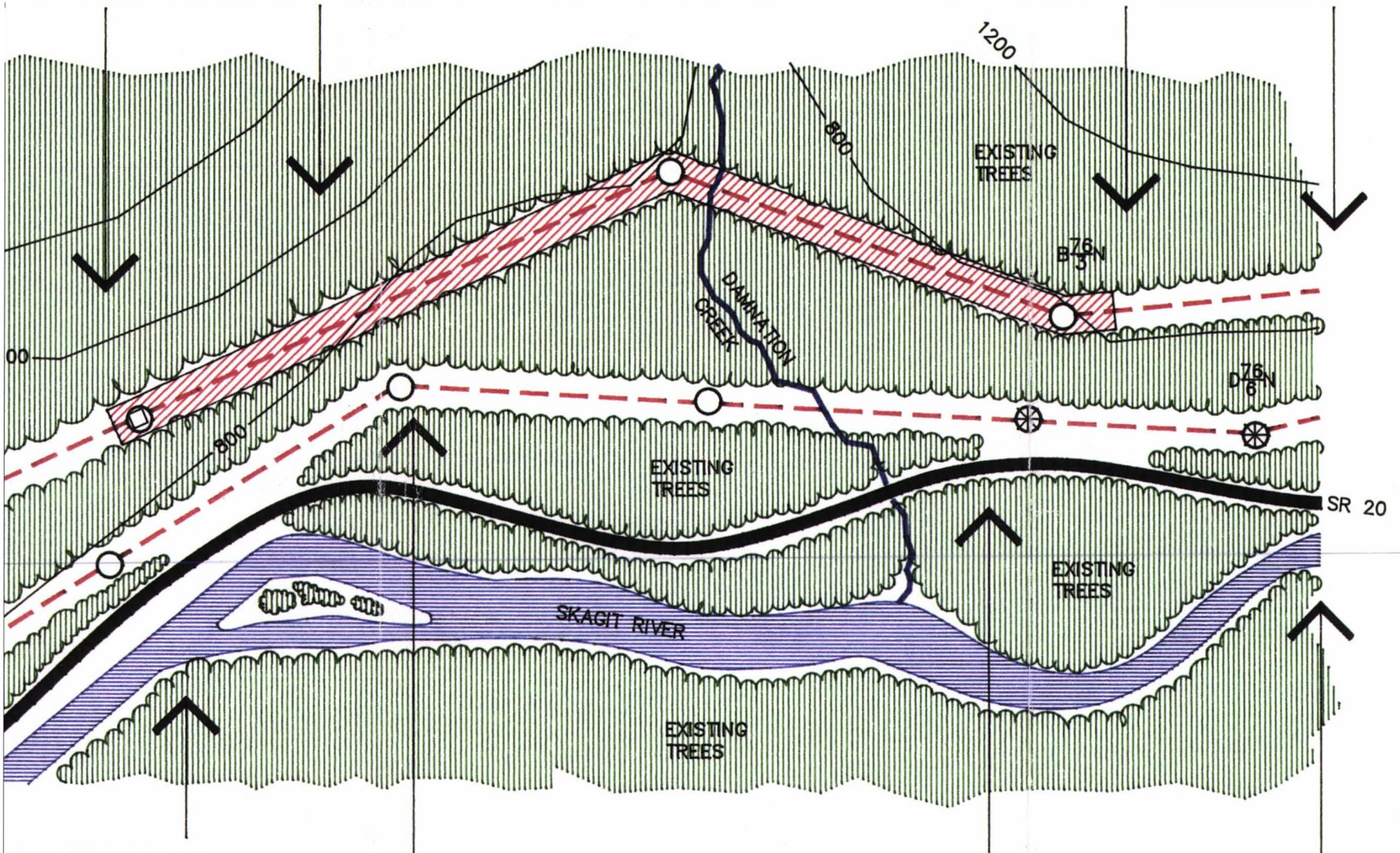


TERISTICS

SSES CORRIDOR. R PROVIDING SOME SCREENING AT BACON CREEK. R EAST END OF CORRIDOR.	• EXPOSED SLOPE	• LINEAR CORRIDOR • MED./SHORT VIEW DURATION	• EXPOSED SLOPE • LONG DURATION • HIGH VISIBILITY
	• TYPE:	• TYPE A,B AND D	• TYPE: A,B AND D

ARACTERISTICS

NT	• D–LINE VISIBLE FOR SHORT DURATION	• LONG LINEAR VIEW OF D–LINE CORRIDOR, SHORT DURATION DUE TO SCREENING BY EXISTING VEGETATION. • B–LINE NOT VISIBLE	• NOT VISIBLE
	• TYPE: A AND D	• TYPE: A AND D	N/A

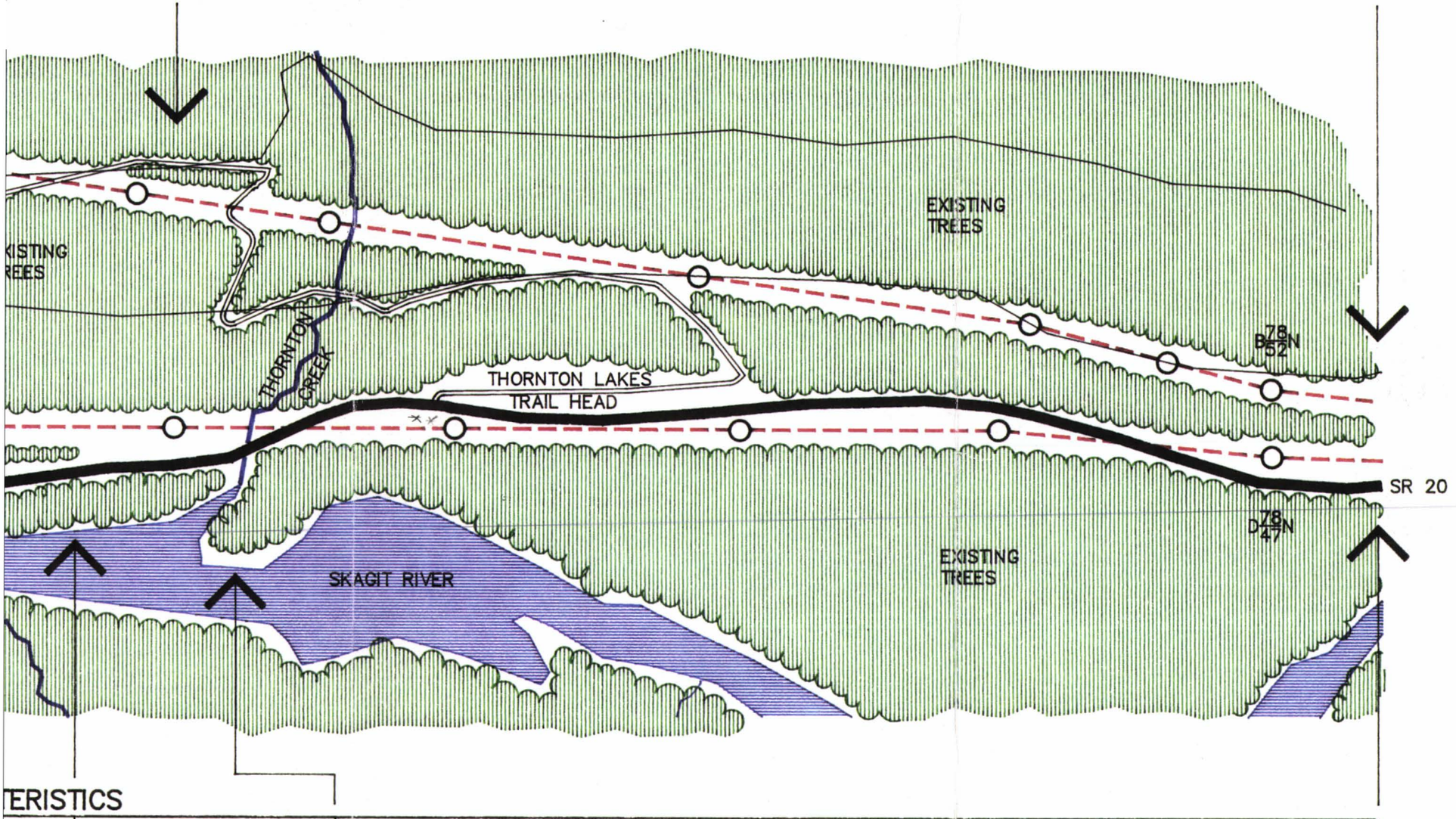


ARACTERISTICS

IFICANT	• D–CORRIDOR VISIBLE, MEDIUM DURATION	• D–CORRIDOR NOT VISIBLE • SMALL AREA AROUND TOWER B 75/38 N VISIBLE	• EXPOSED SLOPE D–LINE • B–CORRIDOR NOT VISIBLE

TERISTICS

NOT VISIBLE EXPOSED SLOPE LONG DURATION.	• B–LINE: NOT VISIBLE. • D–LINE: LONG LINEAR VIEW HIGHLY VISIBLE AS ROAD MEANDERS ALONG LENGTH OF CORRIDOR.
AND D	• TYPE: A, D AND E

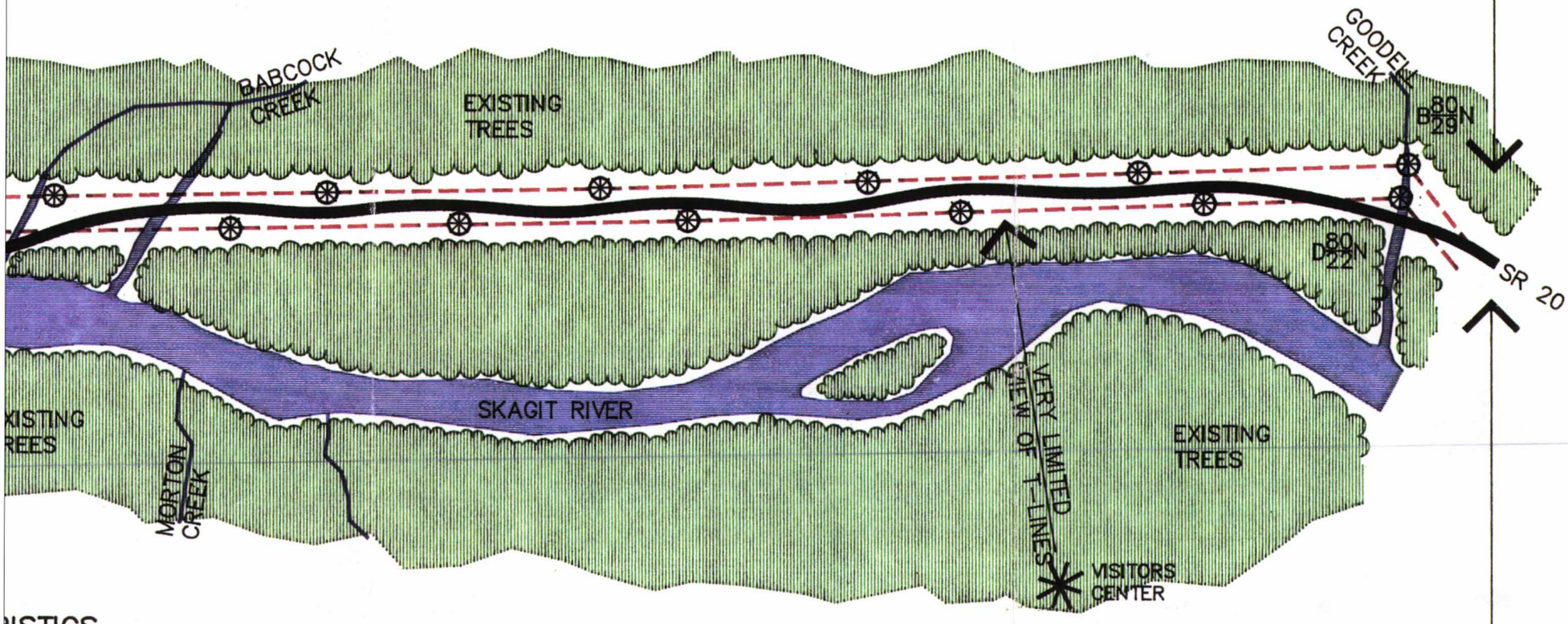


TERISTICS

• B–LINE: NOT VISIBLE • D–LINE: EXPOSED SLOPE HIGHLY VISIBLE.	• B–LINE: NOT VISIBLE. • D–LINE: LONG LINEAR VIEW HIGHLY VISIBLE AS ROAD MEANDERS ALONG LENGTH OF CORRIDOR.

ACTERISTICS

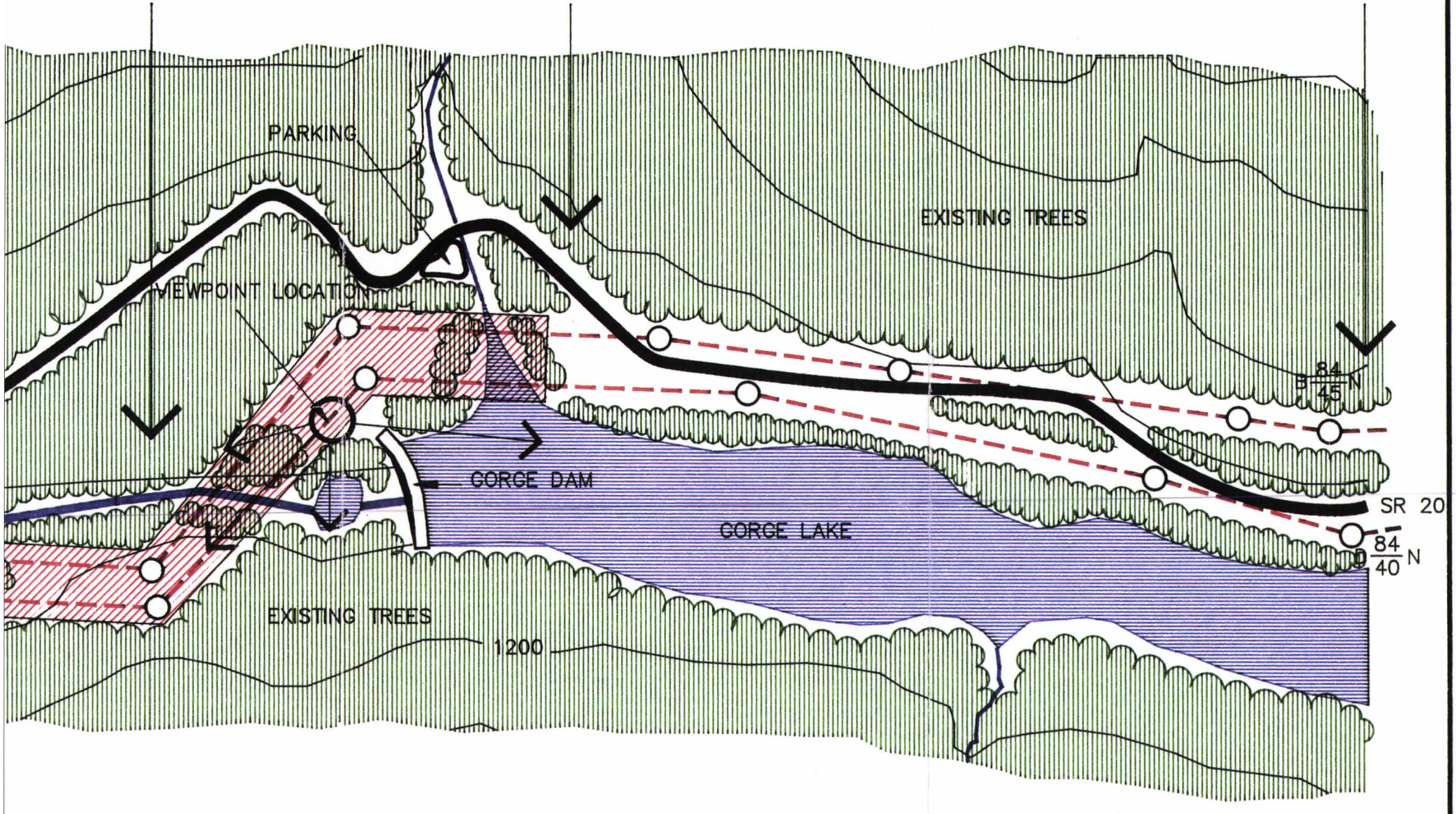
- VERY LONG LINEAR CORRIDOR, HIGHLY VISIBLE
- TYPE: A,B AND E



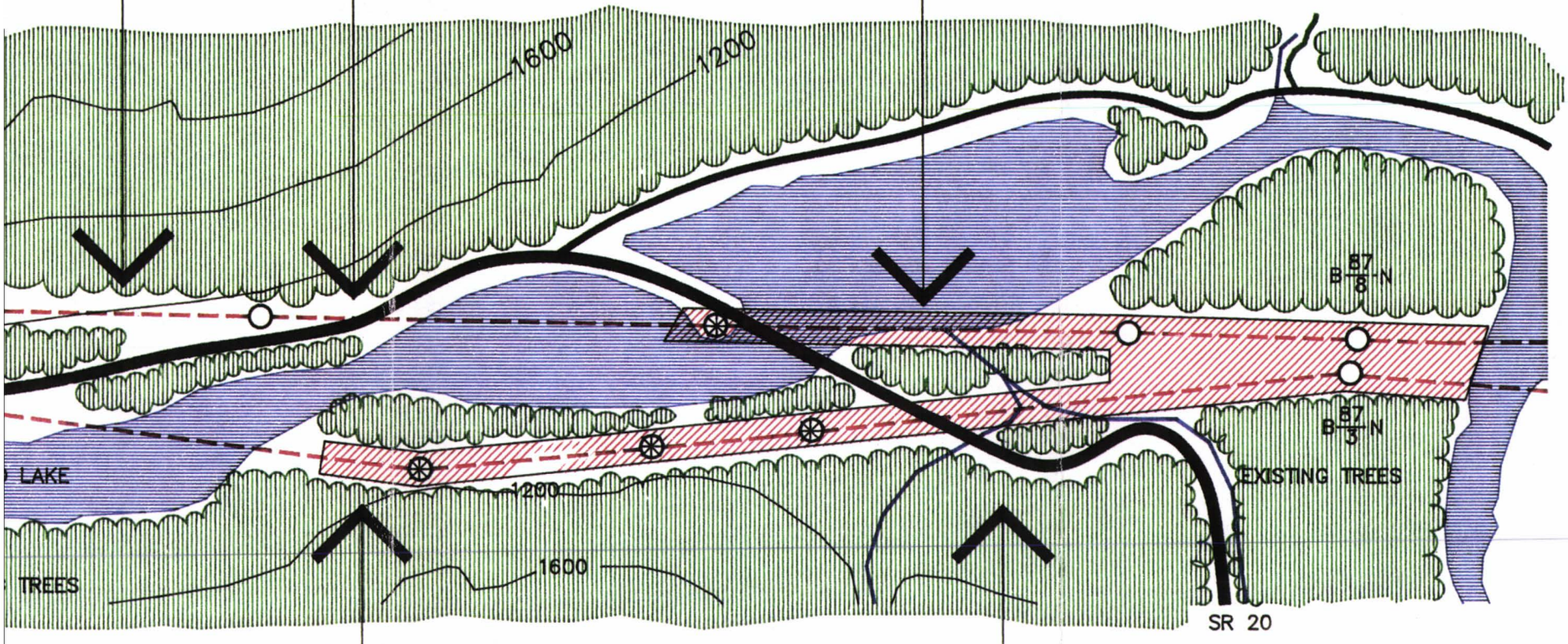
RISTICS

- VERY LONG LINEAR CORRIDOR FRAMES MOUNTAIN VIEW
- HIGHLY VISIBLE
- TYPE: A,B AND E

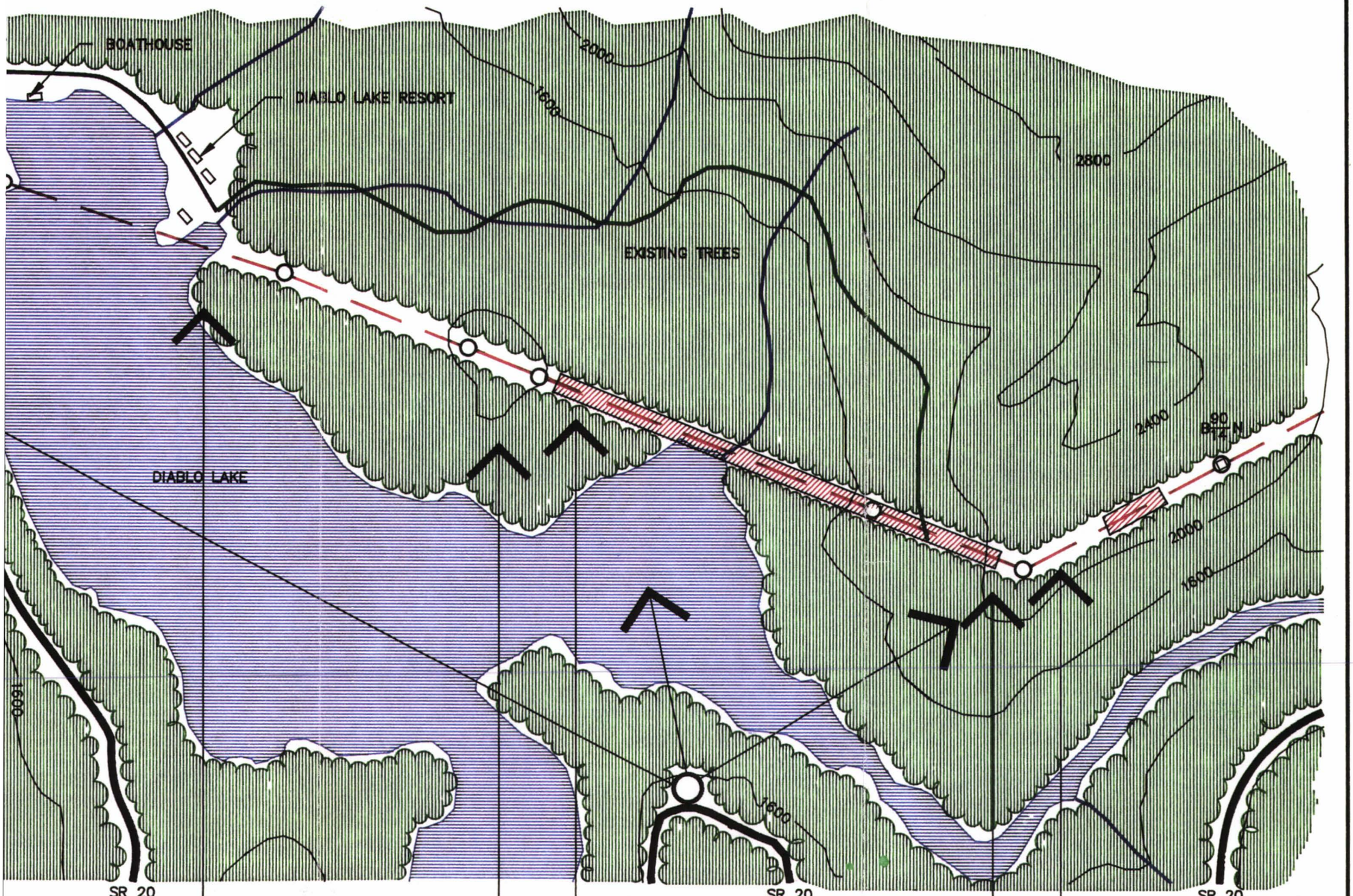
LEARED EXISTING	○ DRAMATIC VIEWS OF DAM AND CANYONS, OVERHEAD VIEWS OF T–LINE	○ LONG LINEAR VIEW OF BOTH LINES, EXPOSED CORRIDOR HAS SIMILAR APPEARANCE TO STEEP ROCK CLIFFS
	○ TYPE: F	○ TYPE: A,B AND C



	o B–LINE VISIBLE HIGH ABOVE VIEWER	o LONG LINEAR AND PERPENDICULAR VIEWS OF CORRIDOR, CLIFFS MINIMIZE IMPACTS, LINES CONTRAST WITH VEGETATION	o NOT SIGNIFICANT
	o TYPE: A,D AND E	o TYPE: D AND E	o TYPE: B



T DURATION VIEWS, D–LINE AND E ABOVE SOMEWHAT VISIBLE	o LINEAR AND PERPENDICULAR VIEWS OF CORRIDOR, CLIFFS MINIMIZE IMPACTS OF CLEARED CORRIDOR, LINES CONTRAST WITH VEGETATION	o LINEAR VIEWS OF LONG DURATION, CORRIDOR HIGHLY VISIBLE, SHARP VEGETATION CONTRAST
A,D AND E	o TYPE: D AND E	o TYPE: A AND B



	O LINES VISIBLE, CORRIDOR NOT VISIBLE	O VISIBLE CORRIDOR	O LINES VISIBLE, CORRIDOR NOT VISIBLE	O VISIBLE CORRIDOR	O NOT VISIBLE

3.6 PROGRAM IMPLEMENTATION BY SEATTLE CITY LIGHT

The viability of implementing any or all of the recommended prescriptions will depend on additional consideration of issues concerning SCL's specific concerns, as discussed under Operational Safety Constraints, and the ability to establish native vegetative communities in the ROW. Consideration of the latter requires a more detailed and site-specific analysis of slope stability, soil type and other factors that influence the establishment of native vegetation species. Information concerning species of native vegetation associated with the project ROW was compiled in 1987. The plant species list, presented for ease of reference in Appendix I, lists plants inventoried along the Skagit ROW in the project study area and along all of the SCL transmission network north of Seattle.

Of equal importance is the consideration of the SCL projected workload and maintenance forecasts which dictate the annual vegetation maintenance activity for the project study area ROW corridors. Figure 3-15 overlays the planned vegetation maintenance programs for the 1989 and 1990 season. Much of the work targeted for the 1989 season was complete by mid-summer (Stanchfield 1989).

Knowledge of planned future activity will enable SCL to evaluate the visual resource considerations of the area targeted for vegetation maintenance activity and assign a vegetation mitigation prescription to that area. The prescription would then serve as a goal for the transmission system's maintenance crew to meet. Decisions can then be reached in advance of any activity concerning the appropriateness of the mitigation prescription as well as a determination of any cost-benefit issues of concern.

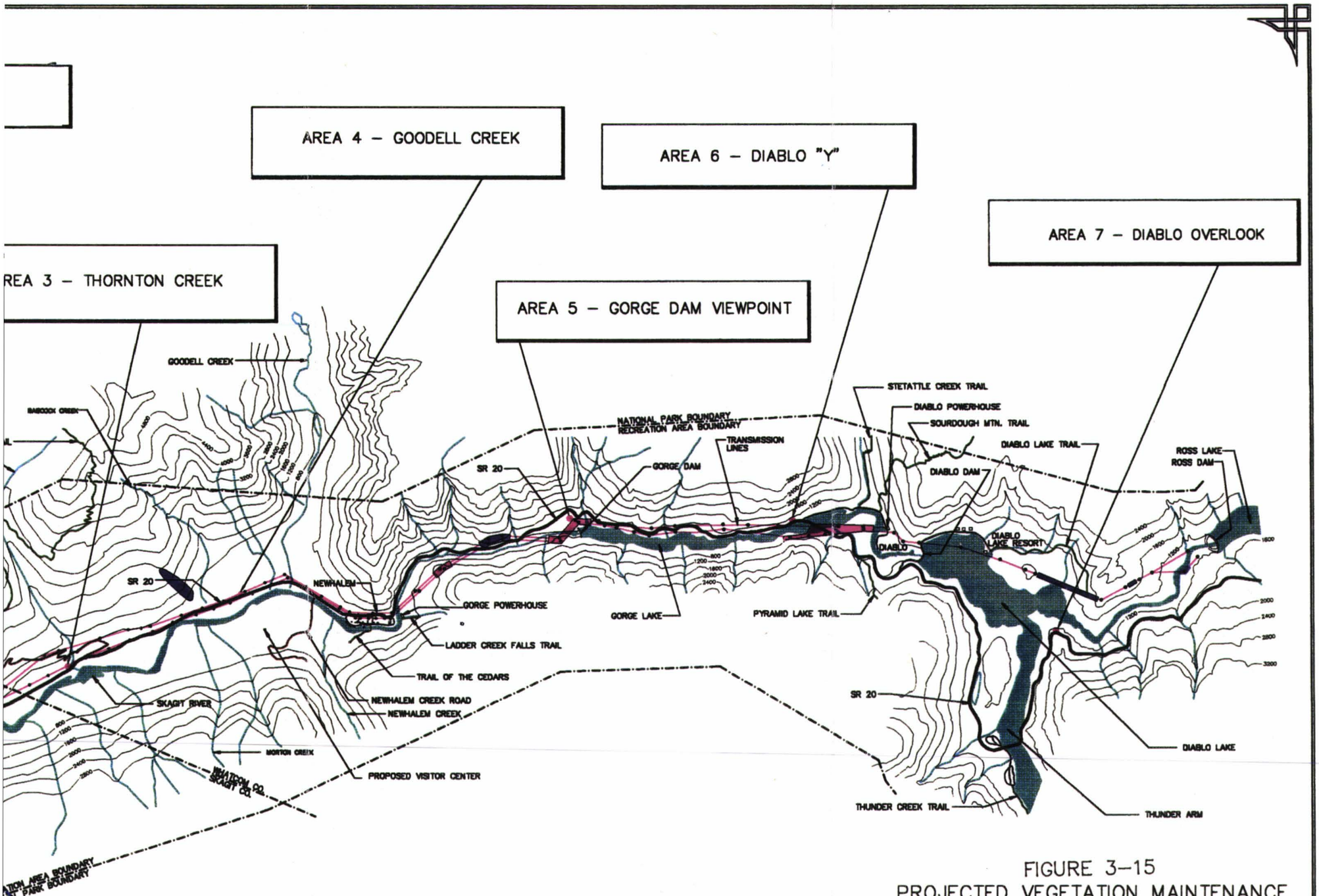


FIGURE 3–15
PROJECTED VEGETATION MAINTENANCE
PROGRAM (1989–1990)

LEGEND / NOTES

SCHEDULED FOR MAINTENANCE IN 1989

SCHEDULED FOR MAINTENANCE IN 1990

SURVEY OF RARE PLANT SPECIES

4.0 SURVEY OF RARE PLANT SPECIES

4.1 INTRODUCTION

In response to a request from the NPS, SCL evaluated the potential for threatened, endangered, and sensitive plant species to occur along the 20-mile segment of the utility's Skagit transmission line right-of-way (ROW) which crosses the Ross Lake NRA. This survey of state-listed threatened, endangered, and sensitive plant species (including candidates for federal status) is one task of a contract to study three aspects of transmission right-of-way vegetation management within this segment of the ROW.

Other aspects related to vegetation management that are under evaluation include an herbicide use evaluation and an evaluation of aesthetic impacts of the transmission line structures and ROW corridor. Within the NRA, SCL's use of herbicides is limited to the treatment of cut stumps via spot application methods. With regard to the protection of rare plant species by the governing environmental laws, the requirements of the Endangered Species Act (ESA) is implemented through the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). FIFRA labeling requirements under development will take into account herbicide use restrictions as they relate to the protection of rare plant species.

This report describes the results of rare plant surveys in transmission line ROW in the project study area. A separate report describes rare plant surveys around the three reservoirs in the project area.

The goals of this study were to:

- Locate state-listed and federal candidate plant species occurring in the study area ROW.
- Assess the potential impacts of ROW maintenance operation on rare plant populations located within the study area.
- Recommend management plans for populations potentially impacted by project operation.

4.2 STUDY AREA

Vegetation on the ROW is managed to prevent tall vegetation from contacting power lines. SCL crews regularly remove or trim trees in the ROW that can potentially grow into the safety clearance zone before the next maintenance cycle. They also use the herbicide dicamba (Banvel) to prevent regrowth of cut broadleaf shrubs of alder, birch and bigleaf maple in the ROW and to treat a noxious weed (Tansy ragwort) in areas of the ROW outside Ross Lake NRA. As a result, shrubs and young trees dominate much of the ROW, with mature trees present only in the few areas where they will not interfere with transmission lines or towers.

The study area is within the western hemlock forest zone described by Franklin and Dyrness (1973), and contains a variety of habitat types and plant communities. Extensive forests of Douglas fir and western hemlock border the ROW. ROW habitats include lodgepole pine forest, shrub and grass/forb communities, rock outcrops, wetlands, and cliffs.

4.3 METHODS

4.3.1 Identification of Rare Plant Species Potential Occurrence

Before going into the field a master list was developed of 73 rare plants reported from Whatcom and Skagit Counties, and from North Cascades National Park (Table 1). Our primary information sources were the Washington Natural Heritage Program data system (letters of June 21, 1988 and May 9, 1989, included in Appendix J) and a checklist of vascular plants reported from North Cascades National Park (Naas et al. 1989). Natural Heritage Program staff also suggested additional rare species that could potentially occur in the study area, but have not been observed in the vicinity (Gamon, personal communication).

The master list was refined by comparing habitat information reported for each species with the physical and environmental characteristics of our study area. Habitat information for species on the master list came from herbarium labels, Hitchcock et al. (1955-1969), Hitchcock and Cronquist (1973), Alverson and Arnett (1986), Vanbianchi and Wagstaff (1988) and the Washington Natural Heritage Program (1981; 1987; and letters). Habitat maps from Brueggeman et al. (1988) and a SCl Transmission Row Vegetation Inventory (Every et al. 1985), as well as direct observation provided plant community and habitat information for the study area.

TABLE 4-1

Habitats of Potential Species

Agoseris elata	alpine/subalpine
Aster sibiricus var *meritus*	subalpine
Botrychium lanceolatum	conifer & broadleaf forest understory
Botrychium lunaria	conifer & broadleaf forest understory
Botrychium minganense	broadleaf forest understory
Botrychium montanum	broadleaf forest understory
Botrychium pinnatum	conifer & broadleaf forest understory
Botrychium simplex	conifer forest understory
Calamagrostis crassiglumis	wet meadows, lake margins
Campanula lasiocarpa	alpine/subalpine
Carex atrata var *atrosquama*	subalpine meadows, forest
Carex atrata var *erecta*	subalpine/alpine
Carex buxbaumii	wetlands
Carex comosa	wetlands
Carex interrupta	wet, gravelly streambanks
Carex macrochaeta	seepage areas, waterfalls
Carex norvegica	subalpine/alpine
Carex paupercula	meadows, gravelly streambanks
Carex pluriflora	boggy lake & stream margins
Carex saxatilis var *major*	wetlands
Carex scirpoidea var *scirpoidea*	subalpine meadows & rocks
Carex scopulorum var *prionophylla*	subalpine/alpine
Carex stenophylla	gravelly & grassy sites
Carex stylosa	wetlands near coast
Castilleja levisecta	Puget lowland prairies
Cicuta bulbifera	wetlands
Coptis asplenifolia	moist conifer forest & bogs
Cryptogramma stelleri	moist limestone cliffs
Cypripedium calceolus var *parviflorum*	bogs & mossy woods
Cypripedium fasciculatum	conifer forest
Dodecatheon pulchellum var *watsonii*	subalpine/alpine
Draba aurea	alpine/subalpine
Draba lanceolata	alpine/subalpine
Epipactis gigantea	wetlands
Eretrichium nanum var *elongatum*	alpine/subalpine
Erigeron humilis	alpine/subalpine
Erythronium revolutum	moist conifer forest
Fritillaria camschatcensis	meadows
Gentiana glauca	alpine/subalpine
Githopsis specularoides	rock outcrops, grassy slopes
Habenaria chorisiana	wetland edge
Iliamna longisepala	open hillsides, open forest
Limosella acaulis	muddy shores of ponds
Listera borealis	damp spruce woods
Lobelia dortmanna	wetlands
Loiseleuria procumbens	alpine/subalpine
Lycopodium dendroideum	conifer forest
Lycopodium inundatum var *inundatum*	bogs
Mimulus pulsiferae	cliffs, rock outcrops
Mimulus suksdorfii	cliffs, rock outcrops
Mimulus washingtonensis	cliffs, rock outcrops
Nymphaea tetragona	ponds & lakes

TABLE 4-1

Habitats of Potential Species

Orthocarpus bracteosus	meadows
Parnassia kotzebuei var *kotzebuei*	damp cliffs
Parnassia kotzebuei var *pumila*	damp cliffs
Pellea brachyptera	limestone outcrops
Petrophytum cinarescens	basalt cliffs
Poa grayana	alpine/subalpine
Poa nervosa var *nervosa*	basalt cliffs
Polemonium viscosum	talus slopes
Potamogeton obtusifolius	ponds
Potentilla diversifolia var *perdissecta*	alpine
Puccinellia nutkaensis	salt marshes
Ranunculus cooleyae	damp,north-facing slopes
Rubus acaulis	mountain meadows or bogs
Salix tweedyi	wetlands & streambanks
Salix vestita var *erecta*	alpine/subalpine
Sanicula marlandica	moist woods, wetland edges
Saxifraga debilis	alpine
Saxifraga integrifolia var *apetala*	vernal wet areas
Spiranthes romanzoffiana var *porrifolia*	moist to wet meadows
Trifolium thompsonii	open sagebrush slopes

001-misc-020\habitat.tab

Although species on the master list that were reported from habitats absent from the study area were considered to have little chance of occurrence, they were searched for incidentally throughout the field surveys. Twenty species fell into this category; 17 that grow in subalpine or alpine habitats, one restricted to limestone outcrops east of the Cascade crest, and two species reported only from Puget Trough prairies or salt marshes. The remaining 53 species formed our target list, which was used to identify habitats and locations in the study area having moderate or high probability of supporting rare plants.

One drawback to targeted rare plant surveys is their focus on species whose presence is expected based on previous records. This focus may reduce the likelihood that investigators will locate and identify unexpected or previously unreported rare plants. To overcome this limitation, field methods were designed to ensure a through examination of the study area.

4.3.2 Field Surveys

Field surveys were performed April 12, May 16 - 18, June 27, July 19 and August 2, 1989 to allow the identification of plants regardless of what part of the growing season they flowered. To ensure the observation of habitats that could potentially dry out by early summer, the April and May surveys concentrated on rock outcrops and other exposed slopes. During the June, July, and August trips the survey team revisited many of the dry habitats, and searched forest, wetland, and moist cliff habitats throughout the study area. The survey team spent a total of 7 days searching for rare plants in the project area.

During the field surveys, representative search locations were chosen to include the range of microclimates in each habitat. Locations were selected that have the greatest similarities to habitats outside the study area where rare plants have been reported (i.e. wetlands). Additional habitat area was searched enroute to and from the selected locations.

A random meander search pattern was used to perform a floristic survey at each location. In a floristic survey, every species encountered is identified to a taxonomic level that allows the investigators to determine its rarity. Floristic approaches to rare plant searches ensure a more complete examination of the study area than searches targeted on individual species (Nelson 1987).

4.4 RESULTS

No rare plant populations were located in the study area. Similarly, no new populations of state or federally listed or candidate rare plants were discovered during the field surveys. All of the wetland areas in the ROW within the NRA were searched. The cliffs and sample locations that were accessible throughout the study area were searched. The majority of the forested areas on the ROW and representative locations where trees are repeatedly removed by ROW maintenance activities were searched. Selected parts of the ROW, including a large part of the Ross to Diablo lines, were also walked and searched.

A few specimens were collected for further verification. All the taxa have been previously reported from the North Cascades (Naas et al. 1989), but not necessarily from the NRA. Specimens will be deposited in the North Cascades National Park herbarium in Sedro Woolley.

4.5 DISCUSSION

4.5.1 Effects of Transmission Line Operation and ROW Maintenance

The results of the rare plant species survey indicate that the present operation and maintenance activities have no effect on rare plant populations in the study area because no species were found. However, a rare plant survey can only confirm the existence of rare plant populations. It does not deny their existence. Time and money constraints and environmental factors influencing plant growth combine to produce a degree of uncertainty in any rare plant survey. The surveys conducted in this task represent a thorough search of the most likely locations where rare plants could be found and provide general coverage of the whole study area. It is reasonable to conclude that the likelihood of having overlooked a population of rare plants is low. However, it is virtually impossible to reduce that probability to zero.

4.5.2 Management Recommendations

Because no rare plants were found that could be affected by ROW management activities, it is not necessary to recommend modifications in vegetation management practices.

REFERENCES

SECTION 2.0

REFER TO APPENDIX D

SECTION 3.0

AESTHETIC IMPACT EVALUATION

REFERENCES

Computer Augmented Plant Selector (Software Program). 1987. Terisan, third edition.

Envirosphere Company. 1985. Report to Seattle City Light, Distribution Division. Inventory of transmission right-of-way vegetation. Bellevue, Washington.

Federal Energy Regulatory Commission (FERC). October 31, 1988. Director, Division of Project Review. Letter to Randall W. Hardy, Seattle City Light. Seattle, Washington.

Green Trails Maps. 1985. 15-minute map series no. 47 and no. 48.

Seattle City Light. 1983. Department policy and procedure: maintenance of the transmission rights-of-way. DPP 500 P I-506.

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SECTION 4.0

SURVEY OF RARE PLANT SPECIES

SECTION 4.0

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APPENDICES

APPENDIX A

PACIFIC NORTHWEST WEED CONTROL MANUAL

PACIFIC NORTH WEST WEED CONTROL HANDBOOK

January 1988

(This book is revised annually)

Extension Services of Oregon State University,
Washington State University, and the University of Idaho

FORESTRY

Undesirable woody and herbaceous plants are problems in commercial forests and on fencelines and rights-of-way. Safe, dependable methods of chemical weed control have been developed for most forestry needs. Reforestation, in particular, may depend heavily on weed control. Depending upon local conditions and weed composition, the results sought differ strikingly in degree of control and composition of residual vegetation, hence in the choice of method.

The Oregon Forest Practices Act has the mandatory requirement of *successful* reforestation after logging. It also prescribes certain rules regarding uses of herbicides to protect plantations. Operators should familiarize themselves with these rules.

Forest Land Brush Control

The objective of weed or brush control on commercial forest land is to provide larger and higher-quality harvests and to reduce the length of time required to bring the crop to maturity. The weed control job alone cannot produce a harvest, but must be combined with cultural practices involving either seeding or planting, and subsequent practices that bring the crop to maturity. Growing trees is the ultimate objective, not killing brush; brush control is merely a phase of the reforestation procedure.

Chemicals

Virtually all brush and weed tree control on forest lands is done with 2,4-D, amitrole, glyphosate, picloram, triclopyr, or MSMA, as dormant or foliage sprays or injections. Atrazine and hexazinone are used for herbaceous weed control in plantations; dalapon also is used for some perennial grasses. These materials, singly or in combination, give broad-spectrum activity on forest species. The 2,4-D type compounds are relatively noninjurious to Douglas fir seedlings during the dormant season. Amitrole is more injurious to conifers, but has greater activity on certain 2,4-D-resistant plants. Picloram and dicamba are nearly always harmful when applied directly to conifers. Satisfactory reforestation brush control can be achieved with the proper formulation of these compounds applied at the proper season and with the right carrier. Dicamba has shown activity on some resistant species, but needs further testing for general recommendations in reforestation work. Soil-active herbicides are seldom suited for selective brush control in this region because of their tendency to injure conifers, but are useful for site preparation. Glyphosate is a growth inhibitor applied exclusively as a late-summer foliage treatment to brush. Glyphosate also may be used on herbs any time conifers are dormant. Triclopyr is a new arrival that has many properties similar to 2,4,5-T, and may often be used as a substitute at a higher cost. It is now registered for site preparation and release, and may be injected as the amino salt. It is highly injurious to 2 to 3 needle pines.

Hazards

The broadcast application of pesticides has received considerable attention in recent years in connection with the danger to animals and other forms of life. The known toxicity of the common brush-killing compounds used on forest lands is rather low, as is indicated in the section of this manual pertaining to the properties of herbicides.

In the Lake states, the same chemicals recommended for local use in reforestation have been used to top-kill brush to promote the proliferation of sprouts for deer browse. Local studies have shown that deer eliminate or degrade both phenoxy herbicides and atrazine with negligible accumulation, and no apparent harmful effects. Direct effects are limited to plants under normal circumstances. Meat quality has not been affected by either class of herbicide as used for reforestation.

There are numerous factors that the pesticide applicator must consider. Treatment of a forest often entails the application of large amounts of chemicals over large areas. It is difficult to delineate precisely which areas are being treated, and which areas are certain to be free of drift. It is always wise for the applicator to avoid unnecessary exposure to these chemicals. It is always wise to consult the neighboring landowners before conducting a major spray job, and to take the maximum precautions to avoid trespass. The benefits from judicious and well-planned herbicide use can be enormous and should not be jeopardized because of poor public relations.

ALWAYS FOLLOW THE DIRECTIONS ON THE LABEL. The information provided in this handbook is not intended to be a complete guide to herbicide use. Before using any chemical, you should read the label recommendations on the container. Before a chemical can be recommended for a specific use, it must be thoroughly tested. The recommendation on the manufacturer's label, when followed, can prevent many problems arising from the wrong use of a chemical.

Application Methods

The methods selected for the application of herbicides in a brush control situation depend upon the species composition, proximity of crops, degree of control required, and available equipment. Method and season of application also have a major influence on degree of selectivity.

In general, brush in which most stems are less than 2 inches in diameter, and grassy weed problems inoperable with farm equipment, are best treated by aircraft. Spot brush control is best suited for hand or tractor-mounted ground rigs. Weed trees over 1.5 to 2 inches in diameter and conifers to be thinned are most economically treated by injection. Some of the other methods are useful in special circumstances, but the above usually give the best results per dollar. The commonly used methods are described below, with special emphasis on objectives, formulations, and equipment peculiar to each.

Foliage Application: Foliage spraying is an extensively used practice that, to some extent, lacks selectivity for conifers. Nonstocked brush fields that are to be converted to conifer stands are sometimes better suited to foliage spraying than dormant spraying. Species such as vine maple and others (see Tables of Recommendations) are not satisfactorily controlled by this method. Manzanita, *Ceanothus*, and other persistent-leaved brush species lend themselves to satisfactory control with foliage treatments at any season from late dormancy until late summer. The choice of season for these species is determined, within broader limits, by the availability of spray equipment and the presence or absence of susceptible crop trees. Alder and salmonberry are especially sensitive to foliage sprays, but timing is critical. It is important to wait until foliage is mature for good control. Spraying of rapidly elongating stems will result in excessive sprouting, except in very sensitive species. The optimum season is usually midsummer in terms of target species control.

Chemical: 2,4-D, dichlorprop, triclopyr, glyphosate, dicamba, picloram, and amitrole are the herbicides used for foliage applications. For rates of application refer to the Tables of Recommendations. 2,4-D, triclopyr ester, and glyphosate are by far the most helpful herbicides of this group. The others are used largely where these fall short. Amitrole and dicamba are nonvolatile and are very promising on some resistant species. Picloram-2,4-D gives excellent control of mixed species. Picloram and dicamba are highly toxic to most conifers when applied directly, but seedlings planted 6 or more months after treatment are normally unaffected. Water is almost always used as a carrier; in late summer a small amount of diesel fuel (up to 5%) may be added.

Application: The choice of whether to spray foliage from the air or with ground equipment depends upon the size of the job and the equipment available. For most spot spray jobs, ground equipment is the most satisfactory. With ground equipment, it is necessary to completely cover the foliage of the brush being treated. It is generally necessary to apply 100 gal per acre or more of the spray solution to get adequate coverage. Aerial application involves 5 to 10 gal per acre. While the ground equipment lends itself very well to small jobs, the labor requirement is excessive on jobs of more than a few acres; and aerial application is preferred. On large jobs, aerial spraying becomes a much less expensive way to apply herbicides. The lower dosages and volumes applied by aircraft may not produce quite as complete results as a soaking ground spray, but should prove adequate for most forestry purposes with much less herbicide waste.

Make foliage treatments for most deciduous species when the plants are in full leaf. Season of application is important. Best results with foliage sprays of phenoxys, amitrole, picloram, or dicamba are achieved in late June to early August. Glyphosate should be applied only in August and September. Treatment too early in summer results in excessive sprouting or tree damage.

Foliage treatment may be used with reasonable selectivity after conifers have completed terminal elongation. Maximum selectivity is observed with glyphosate after September 1.

Dormant Application: Applications are made during the season when buds are beginning to swell, but have not actually opened. This is used in areas where Douglas fir or true firs are established and require release from brush that is susceptible at this season. In all cases, except where the brush species retain green foliage during the winter months, oil is used for the herbicide carrier. Emulsions may be as effective on the persistent-leaved brush. Pines are sensitive to dormant sprays after the end of January.

Chemical: Phenoxy herbicides and triclopyr ester are applied in low volumes by helicopter. Other types of ground apparatus are not well adapted to the requirements of this type of treatment. There are no known substitutes for oil. Except for vine maple, however, most species can be treated in summer. Vine maple is most sensitive to triclopyr only during March and April. Glyphosate is also effective on vine maple in September, and may offer an effective substitute for the dormant spray.

Basal Application: This method of application is generally used where selective treatment of plants is desirable. It is also a means of extending spraying time for brush control, since basal applications are effective from March to October. With basal treatments, the spray is mixed with oil and applied to the lower 8 to 10 inches of a tree trunk or brush stem, soaking the trunk liberally to the ground line. Even larger hardwood trees with thick bark are usually controlled effectively by basal treatments. Effectiveness and low cost of injection will probably limit general use of basal applications.

Chemical: The low volatile ester form of 2,4-D, dichlorprop, triclopyr, and dicamba, singly or in combination, may be used for basal spraying. Triclopyr is generally used when mixed brush species are involved; dicamba is excellent where residues will not harm conifers. Dichlorprop shows some utility for basal treatment of maples.

Application: Herbicides for basal sprays are always applied with oil as a carrier, using either diesel or stove oil. Rates of 10 or more pounds active ingredient of the herbicide to each 100 gal of oil are used (10 + aegh). For successful results with basal sprays, the stem must be soaked and thoroughly covered throughout the treatment area. The results from basal treatments do not become immediately apparent. Often the tree will leaf out and die back 1 or 2 years before finally dying.

Spring applications may produce best top-kill, while summer and fall sprays may give better sprout control. Winter treatments may require a higher volume of spray with higher concentration as well.

Modified Basal Application: This method of application is a combination of the foliage and basal methods of application. It is wasteful of chemical, but quite effective, especially on blackberries.

Chemical: The same chemical mixtures that are effective in basal method of application.

Application: The spray mixture is 6 pounds of the acid equivalent of the hormone chemicals in 10 to 15 gal of diesel oil, plus enough water to make 100 gal of total spray; for hard-to-kill brush, straight oil carrier should be used. Proper application requires careful wetting of the stem at the base, and at least 0.67 to 0.8 of the foliage of the plant. The application is made during the growing season. High volumes of oil and chemical may prove excessively obnoxious for settled areas.

Cut Surface Application: In the frill treatment, the trunk of the tree is hacked or frilled at intervals around the trunk at a convenient level. The cuts are made through the bark, with the chips remaining connected to the tree. The cut frill can be treated any time during the year, but the cut section should be treated with the concentrated amine-formulated herbicide immediately after the frill is completed. Few species require complete frilling. Spaced axe cuts with 0.25 teaspoon (0.25 teaspoon is about equal to one milliliter [ml] or cubic centimeter [cc] of herbicide per cut) are usually adequate.

Season is important in cut-surface applications. Certain herbicides, including 2,4-D amine, act most effectively during the upward phase of sap movement, and others, including MSMA and dicamba, are best when sap is "moving down" in the fall. Season also affects root reserves of food for recovery. Stumps may be treated with either of two methods. One method is essentially the same as for basal treatment. The only difference is that the the top is removed and the stump is treated to prevent regrowth and resprouting. Research with bigleaf maple and Oregon white oak indicates that best results require that the stump be thoroughly soaked around the ground line and cut surface with the spray solution at any time after cutting, but preferably before regrowth of sprouts. Far less costly is the application of undiluted herbicide to the perimeter of the *freshly-cut* stump surface. A teaspoonful is adequate for almost any stump when uniformly distributed around the perimeter of the live wood in a thin line. Stumps thus treated may sprout weakly in the second year if treated during the growing season or fall. Spring stump treatment has not been as successful. A delay between cutting and treatment of even an hour may reduce effectiveness.

Chemical: 2,4-D amines, triclopyr amine, picloram, dicamba, or MSMA used singly or in combination, are most effective and easiest to apply for the frill and girdle method. Esters will not work well. Do

not mix cacodylic acid or amitrole with amines or other salts of 2,4-D or picloram. Most chemicals are used undiluted. Triclopyr may be diluted to half-strength with water for hardwoods other than maples. Triclopyr is very effective on many species.

Application: When using hormone chemicals such as 2,4-D, triclopyr, or picloram, the cut area or injection should be treated with the undiluted chemical as purchased. Use ⅛ to ¼ teaspoon (= 1 ml) of the chemical for each cut. When using undiluted chemical, it is best to use amine or other salt formulations. Addition of a small amount of water may be necessary in freezing weather to reduce viscosity; the salt concentration will prevent freezing. Phenoxy herbicides should be used during late spring and early summer. MSMA should be used only during summer and fall, except on conifers. Picloram may be used any of these seasons in mixture with 2,4-D, but is best in summer. Triclopyr is best in spring and summer.

Application may be done with various types of tree injectors or with a hatchet and squeeze bottle. Tree injectors are tools designed to place chemicals into trees without frilling, girdling, or felling. The injector is jabbed into the tree at regular intervals at a convenient height and at an angle of approximately 60 degrees with the ground. On one type, a lever at the upper end of the injector is tripped and a solution is discharged into the injector hole. The object is to inject the chemical directly into the live tissue of the tree. Injector hatchets should make this a very useful and low-cost method, particularly since modern chemicals do not require injection at the base of the tree.

The "hack and squirt" method is slower than the injector and is less precise in metering of chemicals. It offers the advantage of lower investment cost for small jobs. It is not certain that results are comparable to those of injectors, but differences would not be great in any event.

Cut spacing is important. As a rule, hardwoods require closer spacing than conifers. Alder, a moderately sensitive species, should still be injected at no more than 4 inches between cut centers. Douglas fir, on the other hand, will be controlled by a single injection (1 cc) of MSMA in stems up to 12 inches in circumference (4 inches diameter). It is always a good idea to decrease spacing on larger trees, hence a 10-inch Douglas fir may receive five injections of MSMA to achieve results comparable to one injection in a 4-inch tree. Hardwoods more than 12 inches in diameter should not have more than an inch of unbroken bark between injections. Rots entering injection points hasten demise of many hardwoods, especially alder.

Injection of conifers is probably the lowest cost method of thinning. Total kill is not required, and minimal dosages will permit good development of untreated trees. Heavy dosages, particularly of picloram, offer danger of "flashback" damage to untreated trees. Organic arsenicals and MSMA appear to offer considerable protection from bark beetles in conifer trees killed by the herbicide. MSMA is more effective for killing effects on the trees, and is generally recommended; it is most effective in fall and early winter. Cutting of sprouting species without treatment of stumps often results in prolific regrowth, especially when done in winter or spring.

Special Considerations

Brush is not the only problem likely to be prevalent in brushy areas scheduled for reforestation. Brush is fine habitat for animals that feed on tree seedlings. Moreover, in heavy stands of brush, dead or alive, there is substantial shade to weaken trees, and considerable debris capable of falling and crushing small planted seedlings. An ordinary effort to establish trees in such circumstances will surely result in failure.

Trees used for reforestation in the brush need to be substantially larger than those used for Christmas trees and old field plantings. They should also be repellent treated, or, preferably, of a species unpalatable to animals. Finally, the seedlings should be able to persist in shade. If Douglas fir is used, it must be recognized that it is attractive to animals and cannot tolerate heavy shade. Douglas fir seedlings should be a minimum of 24" tall for such areas; 30" is preferable. Normal 2- or 3-year-old nursery seedlings are inadequate because of rabbit damage and inability to stand up under litterfall.

Pernads better suited to chemical site preparation than Douglas fir is grand fir for areas of less than 60" rainfall, and western hemlock in the moister areas. Both species are quite unattractive to animals even without repellants, and are capable of tolerating a substantial degree of reencroachment by brush. Seedlings 10" to 24" are adequate in size. Markets are improving rapidly for timber of these species, and they may well prove economically more attractive than Douglas fir, for which planting success may be uncertain in brush.

Experience is showing that two applications of herbicide or even more may be necessary for full establishment of plantations. These should be scheduled so that most species are controlled immediately before planting. After planting, a spring dormant spray is a good means of prolonging relief from brush with a minimum of damage to conifers. The spring dormant sprays are damaging to some pines, however, and release of these should be done during late summer. In general, the pines are poor pets in brushfields, and this will seldom be a consideration.

Special Registration for Forestry

Herbicides should carry on their labels specific recommendations for a particular use. Forests are not included under noncrop labeling according to recent interpretation of labeling laws. Herbicide dealers and distributors are required under the Federal Pesticide Control Act of 1972 to insure that their products are properly labeled, and sold only for purposes described on the label. The major herbicides registered for forestry use in Oregon are listed in the Grass Control for Plantation Establishment section, with a rating of effectiveness on some important forest species.

General Use Formulations

Some herbicides are registered for general woody species control for such areas as pastures, fencelines, and ditchbanks. Some are nonselective, such as the dicamba, amitrole, and picloram formulations; others are nonselective only at certain times, such as glyphosate, 2,4-D brushkiller, and other phenoxy formulations. These materials may be useful for site preparation or stand cleanup. Many of these products have been used traditionally on forest lands, but prospective users are warned to verify current label status and interpretation before proceeding.

Season of Use

Chemicals are used in all seasons for forest weed control, but each chemical produces a particular set of results in each season. Some are effective for only a few weeks out of the year; others are selective at certain times and nonselective at others. Dosages and results change with season. Follow the label carefully for safety, economy, and good results.

Effectiveness of Major Forestry-Registered Herbicides During Seasons of Optimum Usage

Species	Herbicide								
	amitrole	atrazine	dalapon	glyphosate	picloram	2,4-D	hexazinone	asulam	triclopyr
Conifers—									
Pines	I	R	I-R	I-R	I-S	S-I	R	R	S
Douglas-fir	I	R	I-R	R	S	I-R	R	R	I
True firs	I	I-R	I-R	R	S	S-I	I	R	I
Hemlock	I	I-R	I-R	I	S	I-R	?	R	I
Woody Weed Spp.—									
Alder	R			I	S	I-S			S
Bigleaf maple	I			I	I-R	R			I-S
Blackberries	S			S	S	R	I		S
Cascara	I			S	I	I			S
Ceanothus spp.	–			R	–	S			S
Cherry	I			S	S	S			I
Chinquapin	–			R	–	I			S
Elderberry	S			S	S	R			S
Hazel	I			S	I	I			I
Madrone	R			R	–	I			S
Manzanita spp.	R			R	S	S			I
Poison-oak	S			I	S	R			I
Salmonberry	S			S	I	R			I
Snowberry	–			S	–	I-S			
Tanoak	–			R	–	I			I-S
Thimbleberry	R			S	I	I			I
Vine maple	I			S	I-S	R			I-S
Willow spp.	–			–	I-S	R-S			I-S
Herbs—									
Annual grasses	S	S	S	S	R	R	S	R	R
Perennial grasses	S	S-R	S-I	S	R	R	S	R	R
Bracken fern	I	I	R	S	I	R	I	S	R
Broad-leaved herbs	S	I	R	S	S-I	S	S-I	R	S
Sword fern	R	R	R	I	R	R	R	R	R

R = Resistant to highest rates.
I = Intermediate or variable; highest rates effective.
S = Sensitive; killed by medium or lower rates.

Recommendations for Directed Spot Spray, Tree Injection, and Basal Bark Treatment

Name	Chemical[1]	Active chemical per 100 gal of solution	Carrier	Expected control	Application
Alder, Red *(Alnus rubra)*	2,4-D	2 lb	Water	Excellent	Foliage spray. See label for release timing.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Excellent	Foliage spray. Site prep. only
	dicamba + 2,4-D	1 lb + 2 lb	Water	Excellent	Site prep. only
	2,4-D amine	undiluted	None	Good	Injection—3" between centers.
	picloram + 2,4-D	undiluted	None	Good	Injection—3" between centers
	picloram pellets		None	Excellent	Spring. Site prep only
	2,4-D + dichlorprop	1.5 gal (3 + 3 lb ai)	Water		Foliage spray. Not recommended in WA and ID
	2,4-D + dichlorprop	3 to 4 gal (6 to 8 + 6 to 8 lb ai)	Oil		Basal treatment.
	triclopyr ester or triclopyr amine	0.75 gal 3 lb	Water Water		Midsummer directed foliage spray. Not for conifer release
	triclopyr amine	Half strength	Water	Excellent	Injection, 3-4" between centers.
	triclopyr ester	4 to 8 lb undiluted	Oil	Excellent	Basal treatment, any season. Thin-line basal bark treatment.
	glyphosate	3 lb ae	Water	Good to excellent	Foliage spray, July.
Ash, Oregon *(Fraxinus latifolia)*	triclopyr amine	3 lb	Water	Excellent	Foliage spray. Not for conifer release.
	triclopyr ester	3 lb	Water	Excellent	Directed foliage spray.
Blackberry Himalaya *(Rubus procerus)*	glyphosate	3 lb ae	Water	Excellent	Sept.-Oct., as long as most of the foliage is still green.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Good to excellent	Foliage spray. Aug.-Sept. Site prep. only.
	triclopyr ester	3 lb	Water	Excellent	Midsummer directed foliage spray.

[1] Herbicides listed in these recommendations generally have broadly inclusive labels, in terms of effectiveness at concentrations given. Concentrations and dosages suggested here are not necessarily listed on product labels for each species. The recommendations here are based on the best experience available, and do not exceed rates recommended for various uses on the labels. Deviations from specific labels are primarily to include species other than those for which product data were available at the time latest labels were issued. New regulations regarding use and current label coverage should be consulted before purchasing a particular product.

DIRECTED SPOT SPRAY, TREE INJECTION, AND BASAL BARK TREATMENT—continued

Name	Chemical[1]	Active chemical per 100 gal of solution	Carrier	Expected control	Application
Blackberry (Continued)					
Himalaya *(Rubus procerus)*	*triclopyr amine*	*2 to 3 lb*	*Water*	*Good*	*Midsummer foliage spray. Not for conifer release.*
Evergreen *(Rubus laciniatus)*	glyphosate	3 lb ae	Water	Excellent	Sept.-Oct., as long as most of the foliage is still green.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Good	Foliage spray. Site prep. only.
	triclopyr amine	2 to 3 lb	Water	Good	Midsummer foliage spray. Not for conifer release.
Trailing *(Rubus vitifolius)*	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Good	Foliage spray
	triclopyr amine	2 to 3 lb	Water	Good	Midsummer foliage spray. Not for conifer release.
	triclopyr ester	3 lb	Water	Fair to good	Midsummer directed foliage spray.
	glyphosate	3 lb ae	Water	Excellent	Aug.-Sept.
Broom, scotch *(Cytisus scoparius)*	2,4-D	2 lb	Water	Excellent	Foliage spray. See label for release timing.
	triclopyr ester	4 to 8 lb	Oil	Good	Basal/foliage spray July to Aug. Not for conifer release.
Cascara, buckthorn *(Rhamnus purshiana)*					
	glyphosate	3 to 4.5 lb ae	Water	Good	Late summer.
	MSMA	5 to 6 lb/gal (undiluted)	None	Good	Injection, late summer.
Ceanothus[2]					
Mountain whitethorn *(Ceanothus cordulatus)*, Blue blossom *(Ceanothus thyrsiflorus)*, or Snowbrush *(Ceanothus velutinus)*	triclopyr ester	3 lb	Water		Midsummer directed foliage spray.
Deerbrush *(Ceanothus integerrimus)*	2,4-D	2 lb	Water	Excellent	Foliage spray. See label for release timing.
	glyphosate	3 lb ae	Water	Excellent	Sept., foliage spray.
Cherry					
Bitter *(Prunus emarginata)*	picloram + 2,4-D	1 gal (0.54 to 2 lb ai)	Water	Good to excellent	Foliage spray. Site prep. only.
	glyphosate	3 lb ae	Water	Excellent	Sept., foliage spray.

[2] Based on results in southwestern Oregon.

DIRECTED SPOT SPRAY, TREE INJECTION, AND BASAL BARK TREATMENT—continued

Name	Chemical[1]	Active chemical per 100 gal of solution	Carrier	Expected control	Application
Cherry, Bitter (*Prunus emarginata*) (Continued)					
Himalaya (*Prunus procerus*)	dicamba + 2,4-D	1 lb + 2 lb	Water	Excellent	Foliage spray. Site prep. only
	2,4-D amine	undiluted	None	Excellent	Injection or frill June-Aug.
	triclopyr ester	4 to 8 lb	Oil	Excellent	Basal spray. Nov - Feb.
	triclopyr ester	undiluted	None	—	Thinline basal bark treatment.
Chokecherry (*Prunus virginiana*)	2,4-D amine	undiluted	None	Excellent	Injection or frill June-Aug.
Chinquapin (*Castanopsis* sp.)	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Good	Foliage spray Site prep. only
	2,4-D amine	undiluted	None	Good	Frill treatment.
	triclopyr ester	4 lb	Water	Excellent	Foliage spray. Not for conifer release
		4 to 8 lb	Oil	Excellent	Basal spray
Coffeeberry (*Rhamnus californica*)	2,4-D	4 lb	Water[1]	Poor	Directed foliage spray or site prep
	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Good	Foliage spray. Site prep. only
Cottonwood (*Populus trichocarpa*)	dicamba + 2,4-D	1 lb + 2 lb	Water	Excellent	Foliage spray
	2,4-D amine	undiluted	None	Good	Frill treatment or injection.
	triclopyr ester	4 to 8 lb	Oil	Excellent	Basal spray.
	glyphosate	3 lb ae	Water	Excellent	Foliage spray, July to Aug. Not recommended in Idaho.
Currants & Gooseberries (*Ribes* sp.)					
Douglas-fir (*Pseudotsuga menziesii*)	picloram + 2,4-D	2 gal (1.08 + 4 lb ai)	Water	Good	Roadside spray.
	dicamba + 2,4-D	1 lb + 2 lb	Water	Good	Roadside spray.
	MSMA	6.0 lb/gal (undiluted)	None	Excellent	Injection (thinning).
	picloram + 2,4-D	undiluted	None	Excellent	Injection (thinning) fall-winter.
Elderberry, Red (*Sambucus callicarpa*)	dicamba + 2,4-D	1 lb + 2 lb	Water	Excellent	Foliage spray. Site prep. only
	glyphosate	3 lb ae	Water	Excellent	Late summer.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water		Foliage spray. Site prep only.
Gorse (*Ulex eurooaeus*)	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Excellent	Foliage spray. Best on younger plants. Site prep. only.
Hazel (*Corylus cornuta* var. *californica*)	glyphosate	3 lb ae	Water		Late summer foliage spray.
	triclopyr ester	4 to 8 lb	Oil	Excellent	Basal spray.

DIRECTED SPOT SPRAY, TREE INJECTION, AND BASAL BARK TREATMENT—continued

Name	Chemical[1]	Active chemical per 100 gal of solution	Carrier	Expected control	Application
Lodgepole pine *(Pinus contorta)*	MSMA	5 to 6 lb/gal (undiluted)	None	Excellent	Injection—1 cut per 5" circumference.
Madrone *(Arbutus menziesii)*	2,4-D	4 lb	Water	Good	Directed foliage spray or site prep.
	picloram	pellets	None	Excellent	Spring treatment. Site prep. only.
	triclopyr ester	3 lb	Water	Good	Midsummer directed foliage spray.
		4 to 8 lb	Oil	Excellent	Basal spray.
Manzanita[2]					
Hairy *(Arctostaphylos columbiana)*	2,4-D	2 lb	Water[3]	Good	Foliage spray. See label for release timing
Hoary *(Arctostaphylos canescens)*	2,4-D	2 lb	Water	Good	Foliage spray. See label for release timing.
Pine *(Arctostaphylos parryana)*	2,4-D	2 lb	Water[3]	Good	Foliage spray. See label for release timing.
Whiteleaf *(Arctostaphylos viscida)*	2,4-D	2 lb	Water[3]	Good	Foliage spray. See label for release timing.
Greenleaf *(Arctostaphylos patula)*	2,4-D	2 lb	Water[3]	Poor to fair	Retreatment of sprouts necessary; foliage spray. See label for release timing.
	triclopyr ester	3 lb	Water	Fair	Midsummer directed foliage spray. Not recommended in Idaho.
		4 to 8 lb	Oil	Excellent	Basal spray.
Howell's *(Arctostaphylos hispidula)*	2,4-D	2 lb	Water	Good	Foliage spray. See label for release timing.
Maple					
Bigleaf *(Acer macrophyllum)*	dichlorprop	20 lb	Oil or Water	Good	Invert aerial clump spray. WA and OR only.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Fair	Site prep. only.
	dicamba + 2,4-D	1 lb + 2 lb	Water	Fair to good	Foliage spray.
	2,4-D + dichlorprop	1.5 gal (3 + 3 lb ai)	Water		Foliage spray. Not recommended in WA and ID.
	2,4-D + dichlorprop	3 to 4 gal (6 to 8 + 6 to 8 lb ai)	Oil		Basal treatment.

[2] Based on results in southwestern Oregon.

[3] Addition of 2% to 5% oil as an emulsion gives best results.

DIRECTED SPOT SPRAY, TREE INJECTION, AND BASAL BARK TREATMENT—continued

Name	Chemical[1]	Active chemical per 100 gal of solution	Carrier	Expected control	Application
Maple, Bigleaf *(Acer macrophyllum)* (Continued)	MSMA	6.0 lb/gal (undiluted)	None	Good	Injection; trees up to 16" diameter. Aug.-Dec.
	triclopyr amine	Undiluted		Excellent	Injection, half-strength for trees less than 12" or stump treatment.
	triclopyr ester	4 lb	Water	Fair	Foliage spray or sprout clumps. Not for conifer release
	triclopyr ester	4 to 8 lb	Oil	Good	Basal treatment.
	picloram	pellets	None	Fair	Pellets around base in spring. Site prep only
	picloram + 2,4-D	undiluted	None	Excellent	Frill, injection, or stump
Vine *(Acer circinatum)*	glyphosate	3 lb ae	Water	Good	Foliage spray, late summer
	picloram + 2,4-D	1 gal (0.54 – 2 lb ai)	Water	Good	Foliage spray. Site prep only
	dicamba + 2,4-D	1 lb – 2 lb	Water	Good	Foliage spray. Site prep only
	triclopyr ester	12 lb	Oil	Good to excellent	Basal treatment
		undiluted	None	Good to excellent	Thinline basal bark treatment.
Oak					
Oregon *(Quercus garryana)*	glyphosate	3 lb ae	Water	Excellent	Foliage spray
	picloram + 2,4-D	1 gal (0.54 – 2 lb ai)	Water	Excellent	Foliage spray. Site prep. only
	2,4-D amine	undiluted	None	Excellent	Frill—good on all oaks.
	triclopyr ester	2 to 3 lb	Water	Good	Directed foliage spray. Good on all oaks.
		4 to 8 lb	Oil		Basal treatment. Good on all oaks.
	2,4-D + dichlorprop	1.5 gal (3 – 3 lb ai)	Water	Good	Foliage spray. Not recommended in WA and ID.
	2,4-D + dichlorprop	3 to 4 gal (6 to 8 – 6 to 8 lb ai)	Oil	Good	Basal treatment.
Canyon Live *(Quercus chrysolepis)*	2,4-D	4 lb	Water[2]	Fair to good	Directed foliage spray or site prep. Retreatment may be necessary.
	triclopyr ester	4 to 8 lb	Oil	Excellent	Basal spray.

[2] Addition of 2% to 5% oil as an emulsion gives best results.

DIRECTED SPOT SPRAY, TREE INJECTION, AND BASAL BARK TREATMENT—continued

Name	Chemical[1]	Active chemical per 100 gal of solution	Carrier	Expected control	Application
Oak (Continued)					
Poison-Oak *(Rhus diversiloba)*	triclopyr ester	2 to 3 lb	Water	Good	Directed foliage spray.
	glyphosate	6 lb ae	Water	Excellent	Foliage spray July-Aug.
	2,4-D	4 lb	Water	Fair	Directed foliage spray or site prep. Retreat sprouts
	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Fair	Foliage spray. Site prep. only
	picloram	2 lb	Water	Good	Foliage spray. Site prep. only
Ponderosa Pine *(Pinus ponderosa)*	MSMA	6.0 lb/gal (undiluted)	None	Excellent, especially in winter	Injection. One cut per 5" circumference. Has some beetle repellancy. Wider spacing gives good kill of trees.
	triclopyr ester	4 lb	Water or Oil	Excellent	Foliage spray May-Aug. Site prep only
Rhododendron *(Rhododendron macrophyllum)*	triclopyr ester	4 lb	Water or Oil	Fair to good	Spring foliage spray. Site prep only
Salal *(Gaultheria shallon)*	triclopyr ester	4 lb	Water	Good	Summer foliage spray. Site prep. only.
	picloram	2 lb	Water	Good	Summer foliage spray. Site prep only.
	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Fair	Foliage spray. Site prep. only.
Salmonberry *(Rubus spectabilis)* (See Blackberry—Salmonberry)					
Serviceberry *(Amelanchier* spp.)	2,4-D[4]	2 lb	Water[3]	Poor to fair	Foliage spray. Several treatments required. See label for release timing.
	triclopyr ester	2 to 3 lb	Water	Good	Directed foliage spray.
Snowberry *(Symphoricarpos albus)*	glyphosate	4 lb ae	Water	Excellent	Foliage spray July-Sept. Not recommended in Idaho.
	triclopyr ester	2 to 3 lb	Water	Good	Foliage spray.

[3] Addition of 2% to 5% oil as an emulsion gives best results.

[4] One pound MSMA per 100 gal spray should improve effectiveness. Check label for current registration. Some labels may specify that this treatment should be used in areas where conifers are less than 4 feet tall because of potential injury through root uptake.

DIRECTED SPOT SPRAY, TREE INJECTION, AND BASAL BARK TREATMENT—continued

Name	Chemical[1]	Active chemical per 100 gal of solution	Carrier	Expected control	Application
Sweetbriar rose *(Rosa eglanteria)*	picloram + 2,4-D	1 gal (0.5 + 2 lb ai)	Water	Good	Good initial kill, some retreatment on sprouts. Site prep. only.
	triclopyr ester	2 to 3 lb	Water	Good	Directed foliage spray
Tanoak[2] *(Lithocarpus densiflora)*	2,4-D[4]	4 lb	Water[3]	Poor	Directed foliage spray. Several treatments required.
	triclopyr ester	4 to 8 lb	Oil		Basal treatment.
Thimbleberry *(Rubus parviflorus)*	picloram + 2,4-D	1 gal (0.54 + 2 lb ai)	Water	Good	Foliage spray. Retreatment may be required. Site prep. only
	glyphosate	3 lb ae	Water	Excellent	Foliage spray, July-Sept.
	dicamba + 2,4-D	1 lb + 2 lb	Water	Fair to good	Foliage spray. Site prep. only
Willow *(Salix spp.)*	2,4-D	2 lb	Water	Good	Foliage spray. May need to retreat sprouts. See label for release timing.
	2,4-D + dichlorprop	1.5 gal (3 + 3 lb ai)	Water		Foliage spray. Not recommended in WA and ID
	2,4-D + dichlorprop	3 to 4 gal (6 to 8 + 6 to 8 lb ai)	Oil		Basal treatment.
	triclopyr ester	2 to 3 lb	Water	Good	Directed foliage spray.
		4 to 8 lb	Oil		Basal treatment.
	glyphosate	3 lb ae	Water	Good	Foliage spray, July-Sept.

[1] Herbicides listed in these recommendations generally have broadly inclusive labels, in terms of effectiveness at concentrations given. Concentrations and dosages suggested here are not necessarily listed on product labels for each species. The recommendations here are based on the best experience available, and do not exceed rates recommended for various uses on the labels. Deviations from specific labels are primarily to include species other than those for which product data were available at the time latest labels were issued. New regulations regarding use and current label coverage should be consulted before purchasing a particular product.

[2] Based on results in southwestern Oregon.

[3] Addition of 2% to 5% oil as an emulsion gives best results.

[4] One pound MSMA per 100 gal spray should improve effectiveness. Check label for current registration. Some labels may specify that this treatment should be used in areas where conifers are less than 4 feet tall because of potential injury through root uptake.

Herbicide		Application and Remarks
Scotch thistle (*Onopordum acanthium*)—continued **musk thistle (*Carduus nutans*)—continued**		
• dicamba Banvel	**Rate:**	0.5 to 1.0 lb ae/A
	Time:	Apply before lengthening of flower stalk on established plants and for seedling control. Fall applications should be sprayed to control rosettes.
	Remarks:	Repeat applications for several years after initial treatments to control new seedlings.
	Caution:	Soil residuals may be present for 12 to 18 months following application of dicamba. Grass is tolerant of dicamba at these rates.
• picloram Tordon	**Rate:**	0.25 lb ae/A
	Time:	Apply in the fall before scotch or musk thistle bolts.
	Remarks:	Do not use on diversified cropland west of the Cascades. Follow-up applications will be necessary to control new seedlings and escaped plants.
	Caution:	A restricted-use herbicide. Soil residuals may last over 1 year following a 0.25 lb ai/A application. Do not use near water. Potatoes, beans, and many other broadleaf crops are sensitive to picloram. Do not use in diversified cropping areas.
• chlorsulfuron Telar	**Rate:**	1 to 3 oz product/A 0.75 to 2.25 oz ai/A
	Time:	Apply to young, actively growing weeds.
	Remarks:	Do not apply to frozen ground. Maintain constant agitation while mixing product with water. Add 0.25% by volume of nonionic surfactant to spray mixture. Apply with ground equipment in a minimum of 10 gpa carrier.
	Caution:	Avoid contact with sensitive crops. Chlorsulfuron can persist in soil; if land is to be returned to cropland, allow sufficient time for product to dissipate. Powdery, dry soils and light, sandy soils should not be treated when there is little likelihood of rainfall after treatment.
St. Johnswort (*Hypericum perforatum*)		
• 2,4-D	**Rate:**	2.0 lb ae/A in 50 gal of water
	Time:	Apply before any blossoms open, preferably on new seedlings after germination.
	Remarks:	2,4-D is not very effective in completely killing St. Johnswort in 1 application, so repeated applications are necessary. Klamath beetles are preferred for controlling large infestations.
	Caution:	Avoid drift to sensitive crops.
swainsonpea or Austrian peaweed (*Swainsona salsula*)		
• 2,4-D LV ester	**Rate:**	2.0 lb ae/A
	Time:	Apply in the early bloom stage of growth.
	Remarks:	Repeat treatment may be required.
	Caution:	Avoid drift to sensitive crops.
tansy ragwort (*Senecio jacobaea*)		
• 2,4-D • picloram Tordon • dicamba Banvel • 2,4-D + dicamba Weedmaster	**Rate:**	1.0 to 2.0 lb ae/A 2,4-D, LV ester, or amine 0.25 lb ae/A picloram 1.0 lb ae/A dicamba 2.0 qt/A Weedmaster
	Time:	When using 2,4-D, apply in the spring before any flowers appear. The earlier the application in relation to plant growth, the better the control. Picloram and dicamba can be used at the flowering stage with good results. Fall applications after rains have initiated seed germination have proven effective also.

Herbicide		Application and Remarks
tansy ragwort (*Senecio jacobaea*)—continued		
• 2,4-D (cont.) • picloram Tordon (cont.) • dicamba Banvel (cont.) • 2,4-D + dicamba Weedmaster (cont.)	**Remarks:**	Respraying for more than 1 year is necessary to control late-germinating seeds. Consult herbicide labels for grazing restrictions. See also pasture and rangeland section for broadcast spray
	Caution:	**Picloram is a restricted-use herbicide.** Picloram is registered for use on rangeland and permanent pastures. Avoid drift to sensitive crops. Do not use picloram near water. Potatoes, beans, and many other broadleaf crops are sensitive to picloram. Do not use picloram in diversified cropping areas. Do not graze dairy animals within 2 weeks after application.
western bracken fern (*Pteridium aquilinum*)		
• asulam Asulox	**Rate:**	1.6 to 3.34 lb ai/A
	Time:	When bracken is in full frond.
	Remarks:	Apply on uncultivated land, reforestation sites, and Christmas tree plantations only. Asulam has a half life of 6 to 14 days in the soil.
	Caution:	See label for precautions.
• picloram Tordon	**Rate:**	4.0 lb ae/A
	Time:	Spring application during frond growth.
	Remarks:	Will control broadleaf plants for up to 2 years. Granular formulations have more control than liquid formulations. Registered for use on grazing and noncropland.
	Caution:	A restricted-use herbicide. Do not use near water since picloram is very water soluble. Potatoes, beans, and many other broadleaf crops are very sensitive to picloram. Do not use in diversified cropping areas. Do not graze dairy animals on treated areas within 2 weeks after application. Use no more than 25 gal of Tordon 22K on any 100 acre block in a single season.
• dicamba Banvel	**Rate:**	4.0 to 8.0 lb ae/A
	Time:	Apply in late winter before frond emergence.
	Remarks:	Proper management for maximum crop competition will aid in control. Will not control grasses.
	Caution:	Avoid drift to sensitive crops. Clover stands may be reduced or eliminated in pastures.
• glyphosate Roundup	**Rate:**	2.25 to 3.0 lb ae/A or use a 1.0% to 1.5% solution when using hand-held equipment.
	Time:	When bracken fronds are at least 18 inches long.
	Remarks:	Adequate foliar coverage is necessary.
	Caution:	Glyphosate will control grasses in the treated area as well as other vegetation.
wild blackberry vines (*Rubus* spp.)		
• picloram Tordon	**Rate:**	1.0 lb ae with 50 gal of water for spot treatment sprays.
	Time:	Apply in late spring after leaves are fully developed.
	Remarks:	A thorough wetting of foliage is necessary. Reapplication will be required as regrowth occurs.
	Caution:	A restricted-use herbicide. Do not use near water. Potatoes, beans, and many other broadleaf crops are sensitive to picloram. Do not use picloram in diversified cropping areas.
• glyphosate Roundup	**Rate:**	Broadcast treatment, 2.25 to 3.0 lb ae/A. Spot treatment, 1.0% to 1.5% solutions.
	Time:	Apply in September to October when canes are actively growing and after berries are formed. Fall treatments must be made before a killing frost.
	Remarks:	Symptoms of the fall spray treatment may not occur before frost. Repeat treatments may be necessary for complete control. Trailing blackberries are more difficult to control.
	Caution:	Glyphosate will control grasses in the treated area as well as other vegetation.

APPENDIX B

SPECIMEN LABELS FOR COMPOUNDS OF INTEREST

BANVEL

(DICAMBA)

Banvel®
HERBICIDE

SPECIMEN LABEL

ACTIVE INGREDIENTS:

Dimethylamine salt of dicamba (3,6-dichloro-o-anisic acid)*	48.2%
Dimethylamine salts of related acids	12.0%
INERT INGREDIENTS:	39.8%
TOTAL ...	100.0%

* This product contains 40.0% 3,6-dichloro-o-anisic acid (dicamba) or 4 pounds per gallon.

EPA Reg. No. 55947-1
EPA Est. No. 55947-TX-1

KEEP OUT OF REACH OF CHILDREN

WARNING

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS WARNING

Causes eye irritation. Do not get in eyes, on skin, or on clothing. Harmful if swallowed. Avoid breathing spray mist. Wash thoroughly after handling. In case of contact, wash skin with soap and water; for eyes, flush with water for 15 minutes and get medical attention.

ENVIRONMENTAL HAZARDS

Keep out of lakes, streams or ponds. Do not contaminate water by cleaning of equipment or disposal of wastes. Apply this product only as directed on label.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

For additional copies of the Specimen Label, write to the manufacturer.

BEFORE USING BANVEL HERBICIDE READ AND FOLLOW THE PRECAUTIONS

IMPORTANT

The following directions apply to all uses of BANVEL® Herbicide. Additional precautions and restrictions will be found in each specific use section.

Do not contaminate irrigation ditches or water used for domestic purposes.

SENSITIVE CROP PRECAUTIONS: BANVEL Herbicide may cause injury to desirable trees and plants, particularly beans, cotton, flowers, fruit trees, grapes, ornamentals, peas, potatoes, soybeans, sunflowers, tobacco, tomatoes and other broadleaf plants when contacting their roots, stems or foliage. These plants are most sensitive to BANVEL Herbicide during their development or growing stage. FOLLOW THE PRECAUTIONS LISTED BELOW WHEN USING BANVEL HERBICIDE.

- Do not treat areas where either possible downward movement into the soil or surface washing may cause contact of BANVEL Herbicide with the roots of desirable plants such as trees and shrubs.
- Avoid making applications when spray particles may be carried by air currents to areas where sensitive crops and plants are growing. Do not spray near sensitive plants if wind is gusty or in excess of 5 mph and moving in the direction of nearby sensitive crops. However, always make applications when there is some air movement to determine the direction and distance of possible spray drift. Leave an adequate buffer zone between area to be treated and sensitive plants. Coarse sprays are less likely to drift out of the target area than fine sprays. Agriculturally approved drift-reducing additives may be used.

Continued on next page...

- Do not apply BANVEL Herbicide in the vicinity of sensitive crops when the temperature on the day of application is expected to exceed 85° F as drift is more likely to occur.
- Do not use aerial equipment to apply BANVEL Herbicide when sensitive crops and plants are growing in the vicinity of area to be treated.
- To avoid injury to desirable plants, equipment used to apply BANVEL Herbicide should be thoroughly cleaned (see PROCEDURE FOR CLEANING SPRAY EQUIPMENT on page 12) before reusing to apply any other chemicals.

All crop uses of BANVEL Herbicide are intended for a normal growing interval between planting and harvest. No crop rotation restrictions exist if normal harvest of treated crop has occurred. If this interval is shortened, such as in cover crops that will be plowed under, do not follow up with the planting of a sensitive crop.

Crops growing under stress conditions such as drought, poor fertility, or foliar damage due to hail, wind or insects, can exhibit various injury symptoms that may be more pronounced if herbicides are applied.

Consult your local or state authorities for possible application restrictions and advice concerning these and other special local use situations. Tank mix recommendations are for use only in states where the tank mix product and application site are registered.

Do not apply this product through any type of irrigation system.

PROCEDURE FOR CLEANING SPRAY EQUIPMENT

The steps listed below are suggested for thorough cleaning of spray equipment following applications of BANVEL Herbicide or tank mixes of BANVEL Herbicide plus 2,4-D amine.

1) Hose down thoroughly the inside as well as outside surfaces of equipment while filling the spray tank half full of water. Flush by operating sprayer until the system is purged of the rinse water.
2) Fill tank with water while adding 1 quart of household ammonia for every 25 gallons of water. Operate the pump to circulate the ammonia solution through the sprayer system for 15 to 20 minutes and discharge a small amount of the ammonia solution through the boom and nozzles. Let the solution stand for several hours, preferably overnight.
3) Flush the solution out of the spray tank through the boom.
4) Remove the nozzles and screens and flush the system with two full tanks of water.

The steps listed below are suggested for thorough cleaning of spray equipment used to apply BANVEL Herbicide as a tank mix with wettable powders (WP), emulsifiable concentrates (EC), or other types of water-dispersible formulations. BANVEL Herbicide tank mixes with water-dispersible formulations require the use of a water/detergent rinse.

5) Complete step 1.
6) Fill tank with water while adding 2 lbs. of detergent for every 40 gallons of water. Operate the pump to circulate the detergent solution through the sprayer system for 5 to 10 minutes and discharge a small amount of the solution through the boom and nozzles. Let the solution stand for several hours, preferably overnight.
7) Flush the detergent solution out of the spray tank through the boom.
8) Repeat step 1, and follow with steps 2, 3, and 4.

MIXING AND APPLICATION

UNLESS OTHERWISE SPECIFIED UNDER THE INDIVIDUAL USE HEADINGS OF THIS BOOKLET, THE FOLLOWING DIRECTIONS APPLY TO ALL CROP AND NON-CROP USES OF BANVEL HERBICIDE. REFER TO INDIVIDUAL USE SECTIONS FOR ADDITIONAL PRECAUTIONS, RESTRICTIONS, APPLICATION RATES AND TIMINGS.

BANVEL Herbicide is a water-soluble formulation that can be applied using water or sprayable fluid fertilizer as the carrier. If a fluid fertilizer is to be used, a compatibility test (see COMPATIBILITY TEST on pages 12-13) should be made prior to tank mixing.

Ground or aerial application equipment which will give good spray coverage of weed foliage should be used. HOWEVER, DO NOT USE AERIAL APPLICATION EQUIPMENT IF SENSITIVE CROPS ARE GROWING IN THE VICINITY OF THE AREA TO BE TREATED.

Apply 5 to 50 gallons of diluted spray per treated acre when using ground application equipment, or 3 to 10 gallons of diluted spray per treated acre when using aerial application equipment. Use the higher level of the listed spray volumes when treating dense or tall vegetation. Use coarse sprays.

Select nozzles designed to produce minimal amounts of fine spray particles. Spray with nozzles as close to the weeds as is practical for good weed coverage.

BANVEL Herbicide should not be applied during periods of gusty wind or when wind is in excess of 15 mph as uneven spray coverage may occur.

Avoid disturbing (e.g. cultivating or mowing) treated areas for at least 7 days following application.

BAND TREATMENTS

BANVEL Herbicide may be applied as a band treatment. Use the formulas below to determine the appropriate rate and volume per treated acre.

$$\frac{\text{Band width in inches}}{\text{Row width in inches}} \times \text{Broadcast RATE per treated acre} = \text{Band RATE per treated acre}$$

$$\frac{\text{Band width in inches}}{\text{Row width in inches}} \times \text{Broadcast VOLUME per treated acre} = \text{Band VOLUME per treated acre}$$

COMPATIBILITY TEST

Before mixing in the spray tank, it is advisable to test compatibility by mixing all components in a small container in proportionate quantities (see following table).

Amount of Herbicide to Add to One Pint of Spray Carrier
(Assuming Volume is 25 Gallons per Acre)

HERBICIDE FORMULATIONS	RATE PER ACRE	LEVEL TEASPOONS
Dry	1 lb.	1½
Liquid	1 pt.	½

If herbicide(s) do not ball-up or form flakes, sludge, gels, oily films or layers, or other precipitates, then the tested spray mix is compatible. Usually, incompatibility in any of the above described forms will occur within 5 minutes after mixing.

If components are incompatible, the use of a compatibility agent is recommended. Rerun the above COMPATIBILITY TEST with a suitable compatibility agent (1/4 teaspoon is equivalent to 2 pints per 100 gallons of fluid fertilizer).

GENERAL WEED LIST

This is a general list of weeds which may be treated with BANVEL Herbicide in accordance with this label as recommended under the rates and timing sections of the Individual Use Headings. Proper usage of this product will give control or growth suppression of many ANNUAL, BIENNIAL, and PERENNIAL broadleaf weeds, and many WOODY brush and vine species including:

ANNUALS

Amaranth, Spiny (Spiny Pigweed)
Aster, Slender
Bedstraw
Beggarweed, Florida
Broomweed, Common
Buckwheat, Wild
Buffalobur
Burclover, California
Burcucumber
Buttercup, Roughseed
Carpetweed
Catchfly, Nightflowering
Chamomile, Corn
Chickweed, Common
Clovers (Annual)
Cockle, Corn
Cockle, Cow
Cocklebur, Common
Croton, Tropic
Croton, Woolly
Cucumber, Wild
Daisy, English
Eveningprimrose, Cutleaf
Fleabane, Annual
Goosefoot, Nettleleaf
Henbit
Jimsonweed
Knotweed
Kochia
Ladysthumb
Lambsquarters, Common
Lambsquarters (triazine resistant)
Lettuce, Prickly
Mallow, Common
Mallow, Venice
Mayweed
Morningglory, Ivyleaf
Morningglory, Tall
Mustard, Tansy
Mustard, Wild
Mustard (Yellowtops)
Nightshade, Black
Pennycress, Field (Fanweed, Frenchweed, Stinkweed)
Pepperweed, Virginia (Peppergrass)
Pigweed, Prostrate
Pigweed, Redroot (Carelessweed)
Pigweed, Rough
Pigweed, Smooth
Pigweed (triazine resistant)
Pigweed, Tumble
Poorjoe
Puncturevine
Purslane, Common
Pusley, Florida
Radish, Wild
Ragweed, Common
Ragweed, Giant Buffaloweed)
Rubberweed, Bitter (Bitterweed)
Sesbania, Hemp
Shepherdspurse
Sicklepod
Sida, Prickly (Teaweed)
Smartweed, Green
Smartweed, Pennsylvania
Sneezeweed, Bitter
Sowthistle, Annual
Sowthistle, Spiny
Spikeweed, Common
Spurge, Prostrate
Spurry, Corn
Starbur, Bristly
Sumpweed, Rough
Sunflower, Common (Wild)
Sunflower, Volunteer
Thistle, Russian
Velvetleaf
Waterhemp
Waterprimrose, Winged
Wormwood, Annual

BIENNIALS

Burdock, Common
Carrot, Wild (Queen Anne's Lace)
Cockle, White
Eveningprimrose, Common
Geranium, Carolina
Gromwell
Knapweed, Diffuse
Knapweed, Spotted
Mallow, Dwarf
Plantain, Bracted
Ragwort, Tansy
Starthistle, Yellow
Sweetclover
Teasel
Thistle, Bull
Thistle, Milk
Thistle, Musk
Thistle, Plumeless

PERENNIALS

*Alfalfa
Artichoke, Jerusalem
Aster, Spiny
Aster, Whiteheath
Bedstraw, Smooth
Bindweed, Field
Bindweed, Hedge
Blueweed, Texas
*Bursage (Bur Ragweed) (Lakeweed) (Povertyweed)
Bursage, Woolyleaf (Lakeweed)
*Buttercup, Tall
Campion Bladder
Chickweed, Field
Chickweed, Mouseear
Chicory
*Clover, Hop
*Dandelion, Common
*Dock, Broadleaf (Bitterdock)
Dock, Curly
Dogbane, Hemp
*Dogfennel (Cypressweed)
Fern, Bracken
Garlic, Wild
Goldenrod, Canada
Goldenrod, Missouri
Goldenweed, Common
Hawkweed
Horsenettle, Carolina
Ironweed
Knapweed, Black
Knapweed, Russian
Mare's Tail (Horseweed)
Milkweed, Climbing
Milkweed, Common
Milkweed, Honeyvine
Milkweed, Western Whorled
Nettle, Stinging
Nightshade, Silverleaf (White Horsenettle)
Onion, Wild
*Plantain, Broadleaf
*Plantain, Buckhorn
Pokeweed
Ragweed, Western
Redvine
Smartweed, Swamp
Snakeweed, Broom
*Sorrel, Red (Sheep Sorrel)
Sowthistle
Sowthistle, Perennial
Spurge, Leafy
Sundrop, Halfshrub (Eveningprimrose)
Thistle, Canada
Toadflax, Dalmatian
Trumpetcreeper (Buckvine)
Vetch
Waterhemlock
Waterprimrose, Creeping
*Woodsorrel, Common Yellow
Wormwood, Common
Wormwood, Louisiana
*Yankeeweed
Yarrow, Common

* Noted perennials may be controlled using BANVEL Herbicide at rate lower than those recommended for other listed perennial weeds. (See application rates and timing on pages 14, 15, 17, 18, 20, 21, 23, 24, and 25.)

WOODY

Alder
Ash
Aspen
Basswood
Beech
Birch
Blackberry
Blackgum
Cedar
Cherry
Chinquapin
Cottonwood
Creosotebush
Cucumbertree
Dewberry
Dogwood
Elm
Grape
Hawthorn (Thornapple)
Hemlock
Hickory
Honeylocust
Honeysuckle
Hornbeam
Huckleberry
Huisache
Ivy, Poison
Kudzu
Locust, Black
Maple
Mesquite
Oak
Oak, Poison
Olive, Russian
Persimmon, Eastern
Pine
Plum, Sand (Wild Plum)
Poplar
Rabbitbrush
Redcedar, Eastern
Rose, McCartney
Rose, Multiflora
Sagebrush, Fringed
Sassafras
Serviceberry
Spicebush
Spruce
Sumac
Sweetgum
Sycamore
Tarbush
Willow
Witchhazel
Yaupon
Yucca

FIELD, SEED*, AND SILAGE CORN IMPORTANT

Observe all precautions, mixing and application instructions on pages 12-13 as well as the following:

* Do not apply BANVEL Herbicide to seed corn without first verifying with your local seed corn company (supplier) the Banvel selectivity on your inbred line. This precaution will help avoid potential injury of sensitive varieties.

BANVEL is not registered for use on sweet corn and popcorn.

Direct chemical contact with corn seed must be avoided. If corn seeds are less than 1½ inches below the surface, delay application until corn has emerged.

Up to 2 applications of BANVEL Herbicide may be made during a growing season. Do not exceed a total of 1½ pints of BANVEL Herbicide per treated acre per crop year. Allow two weeks between applications of BANVEL Herbicide. See appropriate section for rate information. For combination options or sequential treatments, refer to appropriate section.

Applications of BANVEL Herbicide to corn during periods of rapid growth may result in temporary leaning. Corn will usually become erect within 3 to 7 days. Cultivation should be delayed until after corn is growing normally to avoid breakage.

Do not use adjuvants containing penetrants such as petroleum and crop oils after crop emergence.

Prior to the ensilage (milk) stage of the crop, do not harvest or graze corn for dairy or beef feed.

Use coarse sprays to avoid potential herbicide drift. Select nozzles which are designed to produce minimal amounts of fine spray particles such as raindrops, LP flat fans or large capacity flood nozzles such as D10, TK10 or greater capacity tips. Keep the spray pressure at or below 20 psi and the spray volume at or above 20 gpa, unless otherwise required by the manufacturer of drift-reducing nozzles. An agriculturally approved drift control agent may be added to further reduce the potential for drift.

Several synthetic pyrethroid insecticides are labeled for tankmix applications of BANVEL. Refer to their label for specific recommendations.

WEEDS CONTROLLED

BANVEL Herbicide will control many ANNUAL broadleaf weeds or give growth suppression of many PERENNIAL broadleaf weeds commonly found in corn. (Refer to the GENERAL WEED LIST on pages 13-14.)

For best performance, make application when weeds have emerged and are actively growing.

Preemergence control of cocklebur, velvetleaf, and jimsonweed may be reduced if conditions such as low temperature or lack of soil moisture cause delayed or deep germination of weeds.

Adding an agriculturally approved surfactant to BANVEL Herbicide will improve wild mustard, common sunflower, or velvetleaf control when weeds are over 5 inches tall or growing under drought stress at time of application. Tank mixing BANVEL Herbicide plus 2,4-D will improve control from a late postemergence application, but 2,4-D may cause brittleness to corn. Refer to tank mix treatments on pages 15-16.

PREPLANT/PREEMERGENCE IN NO TILLAGE CORN

Applications of BANVEL Herbicide may be made before, during, or after planting to emerged and actively growing broadleaf weeds. Apply BANVEL Herbicide at 1 pint per treated acre on medium or fine textured soils containing 2% or greater organic matter. This rate also applies to soils containing greater than 8% organic matter. Use ½ pint per treated acre on coarse textured soils (sand, sandy loam, and loamy sand).

When planting into a legume sod (e.g., alfalfa or clover), apply BANVEL Herbicide after 4-6 inches of regrowth has occurred.

PREEMERGENCE IN CONVENTIONAL OR REDUCED TILLAGE CORN

BANVEL Herbicide may be applied after planting and prior to corn emergence. Application at 1 pint per treated acre may be made to medium or fine textured soils which contain 2% or greater organic matter. DO NOT apply to coarse textured soils.

Preemergence application of BANVEL Herbicide does not require mechanical incorporation to become active. A shallow mechanical incorporation is recommended if application is not followed by adequate rainfall or sprinkler irrigation. Avoid tillage equipment (e.g., drags, harrows) which concentrate treated soil over seed furrow.

EARLY POSTEMERGENCE (ALL TILLAGE SYSTEMS) (Spike to 5th true leaf stage)

BANVEL Herbicide at 1 pint per treated acre may be applied during the period from corn emergence through the 5th true leaf stage or 8 inches tall, whichever comes first. Reduce the rate to ½ pint per treated acre if the crop is beyond the 8 inch stage or growing on coarse textured soils (sand, sandy loam, loamy sand).

LATE POSTEMERGENCE (ALL TILLAGE SYSTEMS) (8" to 36" tall corn)

Application of BANVEL Herbicide at ½ pint per treated acre may be made from 8 to 36 inch tall corn or 15 days before tassel emergence, whichever comes first.

Make directed spray application when: (1) corn leaves prevent proper spray coverage; (2) sensitive crops are growing nearby; (3) tank mixing with 2,4-D; or (4) surfactants are added to the spray mixture.

DO NOT apply BANVEL Herbicide when soybeans are growing nearby if any of these conditions exist:
- corn is more than 24 inches tall
- soybeans are more than 10 inches tall
- soybeans have begun to bloom

OVERLAY (SEQUENTIAL) TREATMENTS

BANVEL Herbicide may be applied to ground previously treated with one or more of the following herbicides.

atrazine
Bexton®/Ramrod (propachlor)
Bicep®
Bladex® (cyanazine)
Bronco®
Dual® (metolachlor)
Eradicane® (EPTC)
Extrazine®
Gramoxone® (paraquat)
Lasso® (alachor)
Marksman®
Princep® (simazine)
Prowl® (pendimethalin)
Roundup® (glyphosate
Sutan + ®/Genate® (butylate)

READ AND FOLLOW LABEL DIRECTIONS FOR EACH OF THE ABOVE PRODUCTS.

TANK MIX TREATMENTS FOR CORN

BANVEL Herbicide may be tank mixed with one or more of the following herbicides for control of grasses or additional broadleaf weeds. Read and follow the label of each tank mix product used for precautionary statement, directions for use, rates and timings, and other restrictions.

RATES AND TIMINGS

BANVEL PLUS	PREPLANT/ PREEMERGENT (NO TILLAGE CORN)	PREEMERGENT (CONVENTIONAL OR REDUCED TILLAGE CORN)	EARLY POST-EMERGENT (ALL TILLAGE SYSTEMS)	LATE POSTEMER-GENT (ALL TILLAGE SYS-TEMS)	ADDITIONAL DIRECTIONS
Atrazine	1¼-4 lbs. ai/A	1¼-4 lbs. ai/A	1¼-4 lbs. ai/A	1¼-4 lbs. ai/A	Application may be made before grasses are 1½ inches tall.
BLADEX®	1¼-4 lbs. ai/A	1¼-4 lbs. ai/A	1¼-2 lbs. ai/A (use the 80W, 90DF formula-tions only.)	-	Application may be made before grasses are 1½ inches tall, and before corn is beyond the 4 true leaf stage.
DUAL®	-	1½-3 lbs. ai/A (use only on fine or medium textured soils with 2½% or greater organic matter)	1½-3 lbs. ai/A	-	Application may be made after planting and until grasses reach the 2 leaf stage and before corn is greater than 3 inches tall.

RATES AND TIMINGS

BANVEL® PLUS	PREPLANT/ PREEMERGENT (NO TILLAGE CORN)	PREEMERGENT (CONVENTIONAL OR REDUCED TILLAGE CORN)	EARLY POST-EMERGENT (ALL TILLAGE SYSTEMS)	LATE POSTEMER-GENT (ALL TILLAGE SYS-TEMS)	ADDITIONAL DIRECTIONS
LASSO®	1½-4 lbs. ai/A (use only on fine textured soils greater than 2½% organic matter)	1½-4 lbs. ai/A (use only on fine textured soils with greater than 2½% or-ganic matter)	1½-4 lbs. ai/A	-	Application may be made before grasses reach the 2 leaf stage and before corn is greater than 3 inches tall.
PARAQUAT	¼-1 lb. ai/A	¼-1 lb ai/A	-	-	Application may be made to emerged weeds but prior to corn emergence.
PRINCEP®	2.0-3.0 lbs. ai/A	2.0-3.0 lbs. ai/A	-	-	Application may be made prior to weed and corn emergence.
PROWL®	-	1.0-2.0 lbs. ai/A	-	-	Application may be made immed-iately after planting but prior to weed and corn emergence
ROUNDUP®	1.0-3.0 lbs. ai/A	1.0-3.0 lbs. ai/A	-	-	Application may be made to emerged weeds but prior to corn emergence.
2,4-D	¼-½ lbs. ai/A	¼-½ lbs. ai/A	Not recom-mended	1/8 lb. ai/A	Drop pipes are to be used when corn reaches the 8" growth stage. Keeping the spray off the corn leaves and out of the whorl will reduce the likelihood of crop injury and improve spray coverage of weed foilage.

GRAIN SORGHUM (Milo)

IMPORTANT

Observe all precautions on pages 11-12, including the reference to crops growing under stress.

Read and follow mixing and application instructions on page 12.

Applications of BANVEL Herbicide to sorghum during periods of rapid growth may result in temporary leaning of plants or rolling of leaves. These effects are usually outgrown within 10 to 14 days.

Do not graze or feed treated sorghum forage or silage prior to mature grain stage.

Do not apply BANVEL Herbicide to sorghum grown for seed production.

Make no more than one application per growing season.

Delay harvest until 30 days after treatment.

WEEDS CONTROLLED

BANVEL Herbicide, when applied at the recommended rate for grain sorghum, will control many actively growing ANNUAL broadleaf weeds and will reduce competition from established PERENNIAL broadleaf weeds as well as control their seedlings. (Refer to GENERAL WEED LIST on pages 13-14.)

RATES AND TIMINGS

BANVEL Herbicide may be applied to emerged and actively growing weeds at least 15 days prior to planting. Postemergence application of BANVEL Herbicide must be made after sorghum is in the 3 leaf stage but before sorghum is 15 inches tall. For best performance, make applications when sorghum is in the 3-5 leaf stage and weeds are small (less than 3 inches tall). Use drop pipes (drop nozzles) if crop is taller than 8 inches. Keeping the spray off the sorghum leaves and out of the whorl will reduce the likelihood of crop injury and improve spray coverage of weed foliage.

BROADCAST RATE PER TREATED ACRE:
½ pint (¼ lb. a.i.)

TANK MIX TREATMENT

BANVEL plus Atrazine

For improved control of emerged, actively growing broadleaf weeds including triazine resistant species and added supression of perennial broadleaf weeds, tank mix ½ pint BANVEL Herbicide with 0.5 to 1.25 lbs. a.i. atrazine per treated acre. For control of grasses (less than 1.5 inches tall), tank mix ½ pint BANVEL Herbicide with 2-3 lbs. a.i. atrazine per treated acre. For best performance and minimal crop injury, make application when sorghum is 3-8" tall and when broadleaf weeds are small (less than 6 inches tall). The atrazine rate will depend upon soil texture and length of residual weed control desired.

READ AND FOLLOW THE LABEL OF EACH TANK MIX PRODUCT USED FOR PRECAUTIONARY STATEMENTS, DIRECTIONS FOR USE, APPLICATION RATES AND TIMINGS AND OTHER RESTRICTIONS.

OVERLAY (SEQUENTIAL) TREATMENTS

BANVEL Herbicide may be applied to ground previously treated with one or more of the following herbicides:

Herbicide	Maximum rate per treated acre (lbs. a.i.)
alachlor (Lasso®) (Screen®-treated seed)	4
atrazine	3
metolachlor (Dual®) (Concep®-treated seed)	2.5
propachlor (Ramrod®)	5
propazine (Milogard®)	3.2

PREHARVEST USES

For Use Only in the States of Texas and Oklahoma

Application of BANVEL Herbicide may be made any time after the sorghum has reached the soft dough stage of development for suppression of weeds. An agriculturally approved surfactant may be used to improve performance.

BROADCAST RATE PER TREATED ACRE:
½ pint (¼ lb. a.i.)

SMALL GRAINS (NOT UNDERSEEDED TO LEGUMES)

IMPORTANT

Observe all precautions on pages 11-12. Read and follow mixing and application instructions on pages 12-13.

If small grains are grown for pasture only, refer to the PASTURE, RANGELAND and NON-CROPLAND section pages 20-21.

Do not graze or harvest for livestock feed prior to crop maturity.

WEEDS CONTROLLED

BANVEL Herbicide, when applied at recommended rates, will controll ANNUAL broadleaf weeds commonly found in small grains, such as:

Buckwheat, Wild
Chamomile, Corn
Cockle, Corn
Cockle, Cow
Cocklebur, Common
Henbit
Knotweed
Kochia
Ladysthumb
Lambsquarters, Common
Mallow, Common
Nightshade, Black
Pennycress, Field
Pigweed, Redroot (Carelessweed)
Pigweed, Rough
Pigweed, Tumble
Ragweed, Common
Ragweed, Giant (Buffaloweed)
Smartweed, Green
Smartweed, Pennsylvania
Sowthistle, Annual
Sunflower, Common (Wild)
Sunflower, Volunteer
Thistle, Russian
Velvetleaf

BANVEL Herbicide and BANVEL Herbicide tank mixes will reduce competition from established PERENNIAL broadleaf weeds and control their seedlings. (Refer to GENERAL WEED LIST on pages 13-14.)

THE SPECIAL USE TANK MIX FOR FALL SEEDED WHEAT ONLY allows a higher rate of 2,4-D to be used in combination with BANVEL Herbicide. This tank mix treatment may be used for improved performance of difficult-to-control weeds including:

* Fiddleneck (Tarweed)	Gromwell
Garlic, Wild	* Onion, Wild

* Spring applications may not control weeds that develop in the fall. For fall applications, refer to the BETWEEN CROPPING APPLICATIONS section, pages 23, 24, and 25.

RATES AND TIMINGS

Application of BANVEL Herbicide may be made before, during or after planting to emerged and actively growing weeds. See specific crop for timing restrictions. For best performance, make application when weeds are in the 2-3 leaf stage and rosettes are less than 2 inches across. Use the higher level of listed rate ranges when treating more mature weeds or dense vegetative growth. Surfactant should not be used when applying BANVEL Herbicide alone or in a tank mix on small grains except when tank mixing with chlorsulfuron (Glean), metsulfuron (Ally) or Finesse.

FALL SEEDED WHEAT

BANVEL HERBICIDE MUST BE APPLIED TO FALL SEEDED WHEAT PRIOR TO THE JOINTING STAGE.

BROADCAST RATE PER TREATED ACRE:
¼ pint (⅛ lb. a.i.)

TANK MIX TREATMENTS

For control of grasses or additional broadleaf weeds, BANVEL Herbicide may be tank mixed with the following herbicides. Read and follow the label of each tank mix product used for precautionary statements, directions for use, weeds controlled and geographic and other restrictions.

BROADCAST RATE PER TREATED ACRE:
Apply ⅛-¼ pint (1/16-⅛ lb. a.i.) BANVEL Herbicide with:

	amount product*	lb. a.i.
2,4-D	½-¾ pint	¼-⅜
MCPA	½-¾ pint	¼-⅜
bromoxynil (Braminal ME4, Buctril)	½-¾ pint 1-1½ pint	¼-⅜ ⅓-⅜
bromoxynil + MCPA (Bronate, Brominal Plus)	1 pint 1 pint	¼ + ¼ ¼ + ¼
metsulfuron (Ally®)****	1/10 wt.oz.	0.0038
metribuzin (Sencor® 75 DF**, Lexone® DF™)	⅙-⅓ lb.	⅛-¼
(Sencor® 4**, Lexone® 4L)	¼-½ pint	⅛-¼
(Lexone® 50WP)	¼-½ lb.	⅛-¼
chlorsulfuron*** (Glean® 75 DF)	⅙-½ wt. oz.	0.008-0.024
diuron (Karmex® 80WP)	½-2 lbs.	⅔-1⅓
terbutryn (Igran® 80W)	1½-2¾ lbs.	1⅕-2⅕
Finesse®*****	0.3-0.5wt.oz.	-

* Based on 4 pounds per gallon formulations of MCPA and 2,4-D.

** Application may be made after fall seeded wheat has started to grow and has a well established secondary root system or is beginning to tiller, but prior to the jointing stage.

*** When making tank mix applications with Glean, add a surfactant of at least 80% active ingredient at the rate of 1-2 quarts/100 gallons of spray or not more than ¼-½% by volume. Use the higher rate of surfactant when using the lower rate ranges of the tank mix and/or when treating more mature weeds or dense vegetative growth.

**** Use 0.25% surfactant per treated acre for improved control of broadleaf weeds.

SPECIAL USE TANK MIX FOR FALL SEEDEDWHEAT ONLY

BANVEL	¼ pint	⅛ lb. a.i.
plus	plus	plus
2,4-D amine	1 to 2 pints	½ to 1 lb. a.i.
or	or	or
2,4-D ester	1 to 1½ pints	½ to ¾ lb. a.i.

Note: Do not use unless possible crop injury will be acceptable.

SPRING SEEDED WHEAT

BANVEL HERBICIDE MUST BE APPLIED BEFORE SPRING SEEDED WHEAT EXCEEDS THE 5 LEAF STAGE.

BROADCAST RATE PER TREATED ACRE:
¼ pint (⅛ lb. a.i.)

TANK MIX TREATMENTS

For control of additional broadleaf weeds, BANVEL Herbicide may be tank mixed with the following herbicides. Read and follow the label of each tank mix product used for precautionary statements, directions for use, weeds controlled and geographic and other restrictions.

BROADCAST RATE PER TREATED ACRE:
Apply ⅛-¼ pint (1/16-⅛ lb. a.i.) BANVEL Herbicide with:

Herbicide	amount product*	lb. a.i.
2,4-D	½-¾ pint	¼-⅜
MCPA	½-¾ pint	¼-⅜
bromoxynil (Brominal, Buctril)	½-¾ pint 1-1½ pint	¼-⅜ ¼-⅜
chlorsulfuron** (Glean® 75 DF)	⅙-½ wt. oz.	0.008-0.024
Finesse®***	0.3-0.5wt.oz.	-
metsulfuron (Ally®)***	1/10 wt. oz.	0.0038

* Based on 4 pounds per gallon formulations of MCPA and 2,4-D.

** When making tank mix applications with Glean, add a surfactant of at least 80% active ingredient at the rate of 1-2 quarts per 100 gallons of spray or not more than ¼-½% by volume. Use the higher rate of surfactant when using the lower rate ranges of the tank mix and/or when treating more mature weeds or dense vegetative growth.

*** Use 0.25% surfactant per treated acre for improved control of broadleaf weeds.

FALL SEEDED BARLEY

BANVEL HERBICIDE MUST BE APPLIED TO FALL SEEDED BARLEY PRIOR TO THE JOINTING STAGE.

Note: For fall barley varieties that are seeded during the winter months or later, follow the rates and timings given for Spring Seeded Barley.

BROADCAST RATE PER TREATED ACRE:
¼ pint (⅛ lb. a.i.)

TANK MIX TREATMENTS

For control of additional broadleaf weeds, BANVEL Herbicide may be tank mixed with the following herbicides. Read and follow the label of each tank mix product used for precautionary statements, directions for use, weeds controlled and geographic and other restrictions.

BROADCAST RATE PER TREATED ACRE:
Apply ⅛-¼ pint (1/16-⅛ lb. a.i.) BANVEL Herbicide with:

Herbicide	amount product*	lb. a.i.
2,4-D	½ pint	¼
MCPA	½-¾ pint	¼-⅜
chlorsulfuron**		
(Glean® 75 DF)	⅙-½ wt. oz.	0.008-0.024
metsulfuron (Ally®)***	1/10 wt. oz.	0.0038
metribuzin		
Sencor 4	½-1 pint	¼-½
Sencor 75 DF	⅓-⅔ pound	¼-½

* Based on 4 pounds per gallon formulations of MCPA and 2,4-D.
** When making tank mix applications with Glean, add a surfactant of at least 80% active ingredient at the rate of 1-2 quarts/100 gallons of spray or not more than ¼-½% by volume. Use the highest rate of surfactant when using the lower rate ranges of the tank mix and/or when treating more mature weeds or dense vegetative growth.
*** Use 0.25% surfactant per treated acre for improved control of broadleaf weeds.

SPRING SEEDED BARLEY

BANVEL HERBICIDE MUST BE APPLIED BEFORE SPRING SEEDED BARLEY EXCEEDS THE 3 LEAF STAGE.

BROADCAST RATE PER TREATED ACRE:
3/16 pint (3/32 lb. a.i.)

TANK MIX TREATMENTS

For control of additional broadleaf weeds, BANVEL Herbicide may be tank mixed with the following herbicides. Read and follow the label of each tank mix product used for precautionary statements, directions for use, weeds controlled and geographic and other restrictions.

BROADCAST RATE PER TREATED ACRE:
Apply ⅛-3/16 pint (1/16-3/32 lb. a.i.) BANVEL Herbicide with:

Herbicide	product amount*	lb. a.i.
MCPA	½ pint	¼
metribuzin		
Sencor 4	½ pint	¼
Sencor 75DF	⅓ pound	¼
chlorsulfuron**		
(Glean® 75DF)	⅙-½ wt. oz.	0.008-0.024
metsulfuron (Ally®)***	1/10 wt. oz.	0.0038

* Based on 4 pounds per gallon formulations of MCPA.
** When making tank mix applications with Glean, add a surfactant of at least 80% active ingredient at the rate of 1-2 quarts/100 gallons of spray or not more than ¼-½% by volume. Use the highest rate of surfactant when using the lower rate ranges of the tank mix and/or when treating more mature weeds or dense vegetative growth.
*** Use 0.25% surfactant for improved control of broadleaf weeds.

FALL AND SPRING SEEDED OATS

BANVEL HERBICIDE MUST BE APPLIED BEFORE SPRING SEEDED OATS EXCEED THE 5 LEAF STAGE. APPLICATIONS TO FALL SEEDED OATS MUST BE MADE PRIOR TO THE JOINTING STAGE.

BROADCAST RATE PER TREATED ACRE:
¼ pint (⅛ lb. a.i.)

TANK MIX TREATMENTS

For control of additional broadleaf weeds, BANVEL Herbicide may be tank mixed with the following herbicides. Read and follow the label of each tank mix product used for precautionary statements, directions for use, weeds controlled and geographic and other restrictions.

BROADCAST RATE PER TREATED ACRE:
Apply ⅛-¼ pint (1/16-⅛ lb. a.i.) BANVEL Herbicide with:

Herbicide	amount product*	lb. a.i.
MCPA	½-¾ pint	¼-⅜

* Based on 4 pounds per gallon formulations of MCPA.

SUGARCANE

IMPORTANT

Observe all precautions on pages 11-12. Read and Follow mixing and application instructions on pages 12-13.

Consult your local or state authorities for possible application restrictions, especially concerning aerial applications and advice concerning special local use situations.

WEEDS CONTROLLED

BANVEL Herbicide, when applied at recommended rates, will control many ANNUAL, BIENNIAL and PERENNIAL broadleaf weeds commonly found in sugarcane. (Refer to GENERAL WEED LIST on pages 13-14.)

RATES AND TIMINGS

Application of BANVEL Herbicide may be made any time after weeds have emerged and are actively growing but before the close-in stage of sugarcane. Application rates and timings of BANVEL Herbicide are given below. Use the higher level of listed rate ranges when treating dense vegetative growth.

Weed Stage & Type	Broadcast rate per treated acre: product amount	Broadcast rate per treated acre: lbs.a.i.
Annual		
Small, actively growing	½-1 pt.	¼-½
Established weed growth	1-1½ pts.	½-¾
Biennial	1-2 pts.	½-1
Perennial		
Noted(*pg 3&4) Perennials	2-4 pts.	1-2
Other Perennials	4-6 pts.	2-3†

†Application made over the top of actively growing sugarcane may result in crop injury.

When possible, direct the spray beneath the sugarcane canopy in order to minimize the likelihood of crop injury. The use of directed sprays will also aid in maximizing spray coverage of weed foliage.

Retreatments may be made as needed, however, do not exceed a total of 6 pints (3 lbs. a.i.) of BANVEL Herbicide per treated acre during a growing season.

TANK MIX TREATMENTS

BANVEL Herbicide may be tank mixed with one or more of the following herbicides for control of grasses or additional broadleaf weeds. Read and follow the label of each tank mix product used for precautionary statements, directions for use, rates and timings, weeds controlled, geographic and other restrictions.

Herbicide	Rates per treated acre (lbs. a.i.)
ametryn (Evik®)	⅔ to 8
asulam (Asulox®)	2 to 3⅓
atrazine	⅔ to 4
dalapon (Dalapon®)	3½ to 8½
2,4-D	½ to 3*

* Application of BANVEL Herbicide plus 2,4-D tank mix at the higher listed rate ranges may result in crop injury.

PASTURE, RANGELAND AND NON-CROPLAND AREAS

BANVEL Herbicide is recommended for use on pasture rangeland, general farmstead weed and brush control and for use on non-cropland areas such as fence rows, roadways, rights-of-way (utility, railroad, highway, pipeline), non-selective forest brush control (including site preparation), wasteland and other non-cropland areas.

IMPORTANT

Observe all precautions on pages 11-12. Read and follow mixing and application instructions on pages 12-13.

BANVEL Herbicide uses described in this section also pertain to small grains such as barley, oats, rye or wheat grown for pasture use only.

NEWLY SEEDED AREAS, including small grains such as barley, oats, rye or wheat grown for pasture, may be severely injured if rates of BANVEL Herbicide are applied in excess of those listed for control of ANNUAL weeds.

ESTABLISHED GRASS CROPS growing under stress can exhibit various injury symptoms that may be more pronounced if herbicides are applied. Furthermore, rates of BANVEL Herbicide in excess of 2 quarts (2 lbs. a.i.) per treated acre may cause temporary injury to many grass species.

Bentgrass, carpetgrass, buffalograss and St. Augustine grass may be injured at rates exceeding 1 pint BANVEL Herbicide (½ lb. a.i.) per treated acre. Usually colonial bentgrasses are more tolerant than creeping types. Velvetgrasses are most easily injured. Treatments will kill or injure alfalfa, clovers, lespedeza, wild winter peas, vetch and other legumes.

REMOVE MEAT ANIMALS FROM TREATED AREAS 30 DAYS PRIOR TO SLAUGHTER.

THERE IS NO WAITING PERIOD BETWEEN TREATMENT AND GRAZING FOR NON-LACTATING ANIMALS.

TIMING RESTRICTIONS FOR LACTATING DAIRY ANIMALS FOLLOWING TREATMENT

BANVEL Herbicide Rate per Treated Acre	Days Before Grazing	Days Before Hay Harvest
Up to 1 pint (½ lb. a.i.)	7 days	37 days
Up to 1 quart (1 lb. a.i.)	21 days	51 days
Up to 2 quarts (2 lbs. a.i.)	40 days	70 days
Up to 8 quarts (8 lbs. a.i.)	60 days	90 days

Note: Observe all precautions and restrictions on labels of products used in tank mixtures.

MIXING AND APPLICATION

BANVEL Herbicide can be applied using water, oil in water emulsions (including invert systems), or sprayable fluid fertilizer as a carrier. A COMPATIBILITY TEST (pages 12-13 of this booklet) should be made prior to tank mixing.

To prepare oil in water emulsions, half-fill spray tank with water plus appropriate amount of herbicide. With continuous agitation, slowly add a premix of oil (such as diesel oil or fuel oil) plus a suitable emulsifier

to spray tank. Complete filling of spray tank with water. Maintain vigorous agitation during spray operation to prevent oil and water from forming separate layers.

BANVEL Herbicide may be applied broadcast using either ground or aerial application equipment. When using ground equipment, apply 5 to 600 gallons of diluted spray per treated acre. Volume of spray applied will depend on the height, density, and type of weeds or brush being treated and on the type of equipment being used. When using aerial equipment apply 3 to 40 gallons of diluted spray per treated acre.

BANVEL Herbicide may be applied to individual clumps or small areas (SPOT TREATMENT) of undesirable vegetation using handgun or similar types of application equipment. Apply diluted sprays to allow complete wetting (up to run-off) of foliage and stems.

ACCUTROL® Herbicide adjuvant or other spray additives (emulsifiers, surfactants, wetting agents, drift control agents, or penetrants) may be used for wetting, penetration, or drift control. Spray additives must be agriculturally approved when used in pasture applications. If spray additives are used, read and follow all use recommendations and precautions on product label.

WEEDS CONTROLLED

BANVEL Herbicide, when applied at recommended rates, will give control of many ANNUAL, BIENNIAL, and PERENNIAL broadleaf weeds, and many WOODY brush and vine species commonly found in pasture, rangeland and non-cropland areas. (Refer to GENERAL WEED LIST on pages 13-14.) Noted (*) PERENNIAL weeds may be controlled with lower rates of either BANVEL Herbicide or BANVEL Herbicide plus 2,4-D. See RATES AND TIMINGS below.

RATES AND TIMINGS

Application rates and timing of BANVEL Herbicide are given below. Use the higher level of listed rate ranges when treating dense or tall vegetative growth.

Weed Stage & Type	Broadcast rate per treated acre: product amount	lbs. a.i.
Annual		
Small, actively growing	½-1 pt.	¼-½
Established weed growth	1-1½ pts.	½-¾
†Biennial		
Rosette diameter		
Less than 3 inches	½-1 pt.	¼-½
3 inches or more	1-2 pts.	½-1
Bolting	2-3 pts.	1-1½
Perennial		
Suppression or top growth control	½-1 qt.	½-1
Noted (*) Perennials	1-2 qts.	1-2
Other perennials	2-4 qts.	2-4
Dense stands	4-6 qts.	4-6
Woody Brush & Vines		
Foliage Suppression	½-1 qt.	½-1
Stems	1-2 qts.	1-2
Stems and Stem Sprouts	½-1 gal.	2-4
Stems and Root Sprouts	1-2 gals.	4-8

†For best performance, make application when BIENNIAL WEEDS are in the rosette stage.

Retreatments may be made as needed; however, do not exceed a total of 2 gallons (8 lbs. a.i.) of BANVEL Herbicide per treated acre during a growing season.

TANK MIX TREATMENTS

READ AND FOLLOW THE LABEL OF EACH TANK MIX PRODUCT USED FOR PRECAUTIONARY STATEMENTS, DIRECTIONS FOR USE, APPLICATION RATES AND OTHER RESTRICTIONS. BANVEL Herbicide may be tank mixed with one or more of the following herbicides for control of grasses, additional broadleaf weeds, and woody brush and vines.

Herbicide	Rates per treated acre (lbs. a.i.)
Pasture, rangeland, and non-cropland use:	
atrazine	½ to 2
diuron (Karmex®)	4 to 48
glyphosate (Roundup®)	¾ to 3¾
simazine (Princep®)	5 to 40
paraquat	½ to 1
triclopyr (Garlon®)	¾ to 9
2,4-D	¼ to 6
Rangeland and non-cropland use only:	
picloram (Tordon®)	¼ to 3
2,4,5-T	¼ to 6
Non-cropland use only:	
amitrole	2 to 8
atratol (Atratol®)	4⅓ to 40
bromacil (Hyvar®)	1½ to 24
dalapon (Dalapon®)	4¼ to 12¾
diquat	½
fosamine ammonium (Krenite®)	6 to 12
hexazinone (Velpar®)	2 to 12
MSMA	2
prometon (Pramitol®)	10 to 60
sulfometuron methyl (Oust™)	0.14 to 0.56
tebuthiuron (Spike®)	1 to 16
2,4-DP (Weedone®)	½ to 11

Due to the variations that may occur in formulated products and specific use ingredients (e.g. water supplies), a COMPATIBILITY TEST as described on pages 12-13 is recommended prior to actual tank mixing.

CUT SURFACE TREE TREATMENTS

BANVEL Herbicide may be applied as a cut surface treatment for control of unwanted trees and prevention of sprouts of cut trees. A mix of 1 part BANVEL Herbicide with 1 to 3 parts water should be used in application. Use the lower dilution when treating difficult-to-control species.

• FRILL OR GIRDLE TREATMENTS*: Make a continuous cut or a series of overlapping cuts using an axe to girdle tree trunk. Spray or paint cut surface with the BANVEL Herbicide/water mix.

• STUMP TREATMENTS: Spray or paint freshly cut surface with the BANVEL Herbicide/water mix. The area adjacent to the bark should be thoroughly wet.

* **Note:** For more rapid foliar effects, 2,4-D may be added to the BANVEL Herbicide/water mix.

DORMANT APPLICATIONS FOR CONTROL OF MULTIFLORA ROSE

BANVEL Herbicide can be applied when plants are dormant as an undiluted SPOT-CONCENTRATE directly to the soil or as a LO-OIL BASAL BARK treatment using an oil-water emulsion solution.

MIXING AND APPLICATION

SPOT-CONCENTRATE applications of BANVEL Herbicide should be applied directly to the soil as close as possible to the root crown but within 6-8 inches of the crown. On sloping terrain, application should be made to the uphill side of the crown. Do not make application when snow or water prevents applying BANVEL Herbicide directly to the soil.

LO-OIL BASAL BARK applications of BANVEL Herbicide should be applied to the basal stem region from the ground line up to a height of 12-18 inches. Spray until runoff, with special emphasis on covering the root crown. For best results, make application when plants are dormant. Do not make application after bud break or when plants are showing signs of active growth. Do not make application when snow or water prevents applying BANVEL Herbicide to the ground line.

Note: To prepare oil-in-water emulsions, half fill spray tank with water plus appropriate amount of herbicide. With continuous agitation, slowly add a premix of oil plus a suitable emulsifier to the spray tank. Complete filling of spray tank with water. Maintain vigorous agitation during spray operation to prevent oil and water from forming separate layers.

RATES AND TIMINGS

Application rates of BANVEL Herbicide are given below:

SPOT CONCENTRATE TREATMENT

Canopy diameter (feet)	BANVEL Herbicide (ounces)
5	¼
10	1
15	2¼

Do not exceed a total of 2 gallons (8 lbs. a.i.) of BANVEL Herbicide per acre per year.

LO-OIL BASAL BARK TREATMENT

Mix the appropriate amount of BANVEL Herbicide with the appropriate amount of water, emulsifier and No. 2 diesel fuel to obtain the volume of spray desired. See table below. Refer to MIXING and APPLICATION section before mixing.Do not exceed 30 gallons of spray solution per acre per year.

Volume of spray solution desired (gal.)	Ounces			
	Water	Emulsifier	BANVEL Herbicide	No. 2 Diesel Fuel
1	100* (3 qts.)	½	8	20
2	200 (6 qts.)	1	16	40
5	500 (3.75 gals.)	2½	40	100
10	1000 (7.5 gals.)	5	80	200

*Conversion: 100 ounces = 3 quarts

CONSERVATION RESERVE PROGRAM (CRP) ACRES

IMPORTANT

Before using this product, read and carefully observe all applicable directions, restrictions, and precautionary statements on the EPA-registered container label and the BANVEL Herbicide Directions for Use booklet (especially pages 4-5 and 14-21) attached to the container.

Newly Seeded Areas - seedling grasses or small grains such as barley, oats, rye, wheat, or other grass species grown as a cover crop may be severely injured if rates of BANVEL Herbicide are applied in excess of those listed for control of ANNUAL weeds. **Do not apply BANVEL Herbicide to seedling grasses until grasses exceed the three-leaf stage of growth.**

Established grass stands growing under stress can exhibit various injury symptoms that may be more pronounced if herbicides are applied. Bentgrass, carpetgrass, smooth brome, buffalograss and St. Augustine grass may be injured at rates exceeding 1 pint of BANVEL Herbicide (0.5 lb a.i.) per treated acre. Depending on the rate used, treatment with BANVEL Herbicide will injure or kill alfalfa, clovers, lespedeza, wild winter peas, vetch or other legumes.

MIXING AND APPLICATION

BANVEL Herbicide can be applied using water, oil in water emulsions (including invert systems), or sprayable fluid fertilizer as a carrier. A COMPATIBILITY TEST (page 9 of the BANVEL Herbicide Booklet) should be made prior to tank mixing.

To prepare oil in water emulsions, half-fill the spray tank with water plus the appropriate amount of herbicide. With continuous agitation, slowly add a premix of oil (such as diesel oil or fuel oil) plus a suitable emulsifier to the spray tank. Complete filling of spray tank with water. Maintain vigorous agitation during spray operation to prevent oil and water from forming separate layers.

BANVEL Herbicide may be applied broadcast using either ground or aerial equipment. When using ground equipment, apply 5-50 gallons of diluted spray per treated acre. The volume of spray applied will depend on the height, density, and types of weeds being treated and the type of equipment being used. When using aerial equipment, apply 3-10 gallons of diluted spray per treated acre.

BANVEL Herbicide may be applied to individual clumps or small areas (SPOT TREATMENT) of weeds using a handgun or similar application equipment. Apply diluted sprays to allow complete wetting (up to runoff) of foliage and stems.

Agriculturally approved drift-reducing additives or surfactants may be used. If spray additives are used, read and follow all use recommendations and precautions on product label. Do not use adjuvants containing penetrants such as petroleum and crop oils after cover crop emergence.

DIRECTIONS FOR USE

BANVEL Herbicide, when applied at recommended rates, will control many annual and biennial weeds and provide top growth control of many perennial weeds. Many of the key broadleaf weed species controlled or suppressed (perennials) are listed below.

For perennial broadleaf suppression in established grass or in the fallow (stubble) or cover crop period prior to seeding a grass crop, apply 1 quart (1 lb a.i.) of BANVEL Herbicide per treated acre. Established grass is defined as: Grass that is treated the season after planting.

ANNUAL WEEDS CONTROLLED

Buckwheat, Wild
Chamomile, Corn
Cockle, Corn
Cockle, Cow
Cocklebur, Common
Henbit
Knotweed
Kochia
Ladysthumb
Lambsquarters, Common
Mallow, Common
Nightshade, Black
Pennycress, Field
Pigweed, Redroot
Pigweed, Rough
Pigweed, Tumble
Ragweed, Common
Ragweed, Giant
(Buffaloweed)
Smartweed, Green
Smartweed, Pennsylvania
Sowthistle, Annual
Sunflower, Common
(Wild)
Sunflower, Volunteer
Thistle, Russian
Velvetleaf

BIENNIAL WEEDS CONTROLLED

Knapweed, Diffuse
Knapweed, Spotted
Starthistle, Yellow
Sweetclover
Thistle, Bull
Thistle, Musk
Thistle, Plumeless

PERENNIALS (SUPPRESSION OR TOP GROWTH CONTROL)

Alfalfa (Volunteer)
Artichoke, Jerusalem
Bindweed, Field
Bindweed, Hedge
Blueweed, Texas
Bursage
(Bur Ragweed)
(Povertyweed)
(Lakeweed)
Dandelion, Common
Dock, Curly
Dogbane, Hemp
Garlic, Wild
Horsenettle, Carolina
Knapweed, Russian
Nightshade, Silverleaf
Redvine
Smartweed, Swamp
Spurge, Leafy
Sowthistle, Perennial
Thistle, Canada
Trumpetcreeper
(Buckvine)

RATES AND TIMING

Application rates and timing of BANVEL Herbicide treatment are given below. Use the higher rate of the rate range when vegetation is either dense or tall, or when weeds are growing under stressed conditions such as drought or cool temperature.

The addition of an agriculturally approved surfactant will improve wetting and coverage of weed foliage and improve control of drought stressed weeds.

	Broadcast rate per treated acre	
Weed Type[1] & Stage	**Amount of Formulated BANVEL Herbicide**	**Equivalent lbs a.i.**
Annuals		
Small actively growing	¼ to 1 pt.	⅛ to ½
Established weed growth	1 pt.	½
Biennials[2]		
Rosette diameter		
a) less than 3 inches	½ to 1 pt.	¼ to ½
b) 3 inches or greater	1 to 2 pts.	½ to 1
c) bolting biennial	2 to 3 pts.	1 to 1½
Perennials[2]		
Suppression/Control	2 to 4 pts.	1 to 2

[1] For best results, treat Biennial weeds with BANVEL Herbicide when they are in the rosette stage of growth. Retreatments may be made as needed; however, DO NOT EXCEED A TOTAL OF 2 QUARTS (2 lbs a.i.) of BANVEL Herbicide per treated acre during a growing season.

[2] Biennial and Perennial weeds will require follow-up (sequential) treatments for seedling control and escapes.

TANK MIX TREATMENTS

Read and follow the label of each tank mix product used for precautionary statements, directions for use, application rates, and other restrictions.

BANVEL Herbicide may be tank mixed with one or more of the following herbicides for control of grasses or additional broadleaf weeds.

Tank Mix Herbicide	**Rates Per Treated Acre (lbs a.i.)**
Atrazine*	½ to 2
chlorsulfuron (Glean 75DF)**	0.008 to 0.024
Glyphosate (Roundup)*	½ to 2
2,4-D	¼ to 6
metsulfuron (Ally)***	0.0038
Paraquat*	½ to 1

* Preplant application

** When making tank mix applications with Glean, add a surfactant of at least 80 percent active ingredient at the rate of 1-2 quarts/100 gallons of spray or not more than ¼ - ½ percent by volume. Use the highest rate of surfactant when using the lower rate ranges of the tank mix and/or when treating more mature weeds or dense vegetative growth.

*** Use 0.25 percent surfactant per treated acre for improved control of broadleaf weeds.

CAUTION

When used as a preplant application for control of existing weeds, allow 45 days per pint of BANVEL Herbicide applied per acre before seeding grass west of the Mississippi River, or 20 days per pint east of the Mississippi River. Exclude days when the ground is frozen. Do not apply prior to planting of grass-legume mixtures.

ASPARAGUS

For Use Only in the States of California, Oregon and Washington

IMPORTANT

Observe all precautions on pages 11-12. Read and follow mixing and application instructions on pages 13-14.

If spray contacts emerged spears, crooking (twisting) of some spears may result. If such crooking occurs, discard affected spears.

Do not harvest prior to 24 hours after treatment.

Make only one application per season.

RATES AND TIMINGS

Apply BANVEL Herbicide to emerged and actively growing weeds in 40 to 60 gallons of diluted spray per treated acre immediately after cutting the field, but at least 24 hours before the next cutting.

Weeds	Rate Per Treated Acre
Mustard, Black Pigweed, Redroot (carelessweed) Sowthistle, Annual *Thistle, Canada Thistle, Russian	½ to 1 pt. (¼-½ lb. a.i.)
*Bindweed, Field Chickweed, Common Goosefoot, Nettleleaf Radish, Wild Thistle, Milk	1 pt. (½ lb. a.i.)

BANVEL Herbicide plus 2,4-D herbicide tank mixture may be used for improved control of noted (*) weeds. READ AND FOLLOW 2,4-D PRODUCT LABELING FOR PRECAUTIONARY STATEMENTS, DIRECTIONS FOR USE, APPLICATION RATES AND TIMINGS, AND OTHER RESTRICTIONS.

TURF AND LAWNS

Including Golf Course Fairways, Aprons, Tees and Rough.

IMPORTANT

Observe all precautions on pages 11-12. Read and follow mixing and application instructions on pages 13-14.

To avoid injury to newly seeded grasses, application of BANVEL Herbicide should be delayed until after the second mowing. Furthermore, application rates in excess of 1 pint (½ lb. a.i.) per treated acre may cause noticeable stunting or discoloration of sensitive grass species such as bentgrass, carpetgrass, buffalograss, and St. Augustine grass.

In areas where roots of sensitive plants extend, do not apply in excess of ¼ pint (⅛ lb. a.i.) of BANVEL Herbicide per treated acre on coarse textured (sandy-type) soils, or in excess of ½ pint (¼ lb. a.i.) per treated acre on fine textured (clayey-type) soils. Do not make repeat applications in these areas for 30 days and until previous applications of BANVEL Herbicide have been activated in the soil by rain or irrigation.

WEEDS CONTROLLED

BANVEL Herbicide, when applied at recommended rates, will give control of many ANNUAL, BIENNIAL, and noted (*) PERENNIAL broadleaf weeds commonly found in turf. BANVEL Herbicide will also give growth suppression of many other listed PERENNIAL broadleaf weeds and WOODY brush and vine species. (Refer to GENERAL WEED LIST on pages 13-14.)

MIXING AND APPLICATION

Apply 30 to 200 gallons of diluted spray per treated acre (3 qts. to 4¼ gals. per 1,000 sq. ft.), depending on density or height of weeds treated and on the type of equipment used.

RATES AND TIMINGS

Use the higher level of listed rate ranges when treating dense vegetative growth.

Weed Stage & Type	BANVEL Herbicide: pints per treated acre	BANVEL Herbicide: lbs. a.i. per treated acre	BANVEL Herbicide: teaspoons per 1000 sq. ft.
Annual			
Small, actively growing	½-1	¼-½	1-2¼
Established weed growth	1-1½	½-¾	2¼-3¼
Biennial			
Rosette diameter			
Less than 3 inches	½-1	¼-½	1-2¼
3 inches or more	1-2	½-1	2¼-4½
Perennials and Woody			
Brush and Vines	1-2	½-1	2¼-4½

For best performance, apply when weeds are emerged and actively growing.

Retreatments may be made as needed; however, do not exceed a total of 2 pints (1 lb. a.i.) BANVEL Herbicide per treated acre during a growing season.

TANK MIX TREATMENTS

READ AND FOLLOW THE LABEL OF EACH TANK MIX PRODUCT USED FOR PRECAUTIONARY STATEMENTS, DIRECTIONS FOR USE, APPLICATION RATES AND TIMINGS AND OTHER RESTRICTIONS.

Tank mix treatments of BANVEL Herbicide may be made with 2,4-D, MCPA, MCPP, or bromoxynil for control of additional weeds listed on the tank mix product label.

Apply ⅕ to ½ pint (1/10-¼ lb. a.i.) of BANVEL Herbicide per treated acre with ½ to 1½ lbs. acid equivalent of 2,4-D, MCPA, or MCPP, or with ⅜ to ½ lb. a.i. of bromoxynil. Use the higher level of the listed rate ranges when treating established weeds. Repeat treatments may be made as needed; however, do not exceed 2 pints (1 lb. a.i.) of BANVEL Herbicide per treated acre during the growing season.

GRASS SEED CROPS

Perennial Grasses such as Bermuda grass, Bluegrass, Lawntype Fescue and Ryegrass

IMPORTANT

Observe all precautions on pages 11-12. Read and follow mixing and application instructions on pages 13-14.

Refer to the PASTURE, RANGELAND, AND NON-CROPLAND IMPORTANT section (pages 20-21) for possible grazing and feeding restrictions.

Do not use on bentgrass unless possible crop injury can be tolerated.

RATES AND TIMINGS

Apply ½ to 2 pints (¼-1 lb. a.i.) of BANVEL Herbicide in 5 to 40 gallons of diluted spray per treated acre after weeds have emerged and are actively growing for control of broadleaf weeds such as:

Alfalfa
*Bindweed, Field
Catchfly, Nightflowering
Chamomile, Corn
Chickweed, Common
Chickweed, Mouseear
Clover
Cockle, White
Dock, Curly
*Knapweed, Russian
Knotweed
Sorrel, Red (Sheep Sorrel)
Starwort, Little
*Thistle, Canada

*Top growth control only.

Use ½ to 1 pint (¼-½ lb. a.i.) of BANVEL Herbicide per treated acre on SEEDLING GRASS after the crop reaches the 3-5 leaf stage. Up to 2 pints (1 lb. a.i.) of BANVEL Herbicide per treated acre may be used on well-established PERENNIAL grass. DO NOT APPLY AFTER THE GRASS SEED CROP BEGINS TO JOINT.

For control of ANNUAL GRASS WEEDS such as:

Brome, Downy (Cheatgrass)
Brome, Ripgut
Fescue, Rattail

Apply 2 to 4 quarts (2-4 lbs. a.i.) of BANVEL Herbicide per treated acre in the fall or late summer after harvest and burning of established grass seed crops. Applications should be made within 3-14 days following first irrigation and before weeds have more than 2 leaves.

BETWEEN CROPPING APPLICATIONS (BCA) FOR BROADLEAF WEED CONTROL

IMPORTANT

Observe all precautions on pages 11-12. Read and follow mixing and application instructions on pages 13-14.

WEEDS CONTROLLED

BANVEL Herbicide, when applied at the recommended rates, will control many ANNUAL and BIENNIAL broadleaf weeds. (Refer to GENERAL WEED LIST on pages 13-14). In addition, BANVEL Herbicide will control the following PERENNIAL broadleaf weeds:

*Alfalfa
Artichoke, Jerusalem
Bindweed, Field
Bindweed, Hedge
Blueweed, Texas
*Bursage (Bur Ragweed) (Povertyweed) (Lakeweed)
*Dandelion, Common
*Dock, Curly
*Dogbane, Hemp
Garic, Wild**
Horsenettle, Carolina
Nightshade, Silverleaf
Redvine
Smartweed, Swamp
*Sowthistle, Perennial
Thistle, Canada**
Trumpetcreeper (Buckvine)

Noted(*) perennials may be controlled using BANVEL Herbicide at rates lower than those recommended for other listed perennial weeds. (See RATES AND TIMINGS, page 24.)

** SPECIAL TANK MIX TREATMENTS, page 24, for specific control program.

RATES AND TIMINGS

Apply BANVEL Herbicide as a broadcast or spot treatment to emerged and actively growing weeds after crop harvest and before a killing frost. Agriculturally approved spray additives, such as surfactants or oils, may be used to enhance spray coverage and the herbicide's penetration of weed foliage. See ROTATIONAL CROPS for recommended interval between application and planting to prevent crop injury.

For best performance, make application when ANNUAL weeds are less than 6 inches tall, when BIENNIAL weeds are in the rosette stage, and to PERENNIAL weed regrowth in late summer or fall following a mowing or tillage treatment. Most effective control of upright perennial broadleaf weeds, such as Canada thistle and Jerusalem artichoke, occurs if application is made when the majority of weeds is 8 inches or taller. Viney perennial broadleaf weeds, such as field bindweed and hedge bindweed, are best controlled when weeds are in or beyond the full bloom stage.

Avoid disturbing treated areas for at least 7 days following application. Treatments may not kill weeds which develop from seed or underground plant parts, such as rhizomes or bulblets, after the effective period for BANVEL Herbicide. For seedling control, a follow-up program or other cultural practices could be instituted (refer to pages 14-17 and 19, for corn, sorghum and wheat in-crop uses of BANVEL Herbicide).

Weed Stage & Type	BANVEL Herbicide per treated acre: product amount	lbs. a.i.
Annual	½-1 pt.	¼-½
Biennial	1-2 pts.	½-1
Perennial		
Perennial suppression	1-2 pts.	½-1
Noted (*) perennials	2-4 pts.	1-2
Other perennials	4 pts.	2

Retreatments may be made as needed; however, do not exceed a total of 4 pints (2 lbs. a.i.) of BANVEL Herbicide per treated acre during any given fallow period.

TANK MIX TREATMENTS

BANVEL Herbicide may be tank mixed with one or more of the following herbicides for control of grasses or additional broadleaf weeds. Read and follow the label of each tank mix product used for precautionary statements, directions for use, rates and timings, weeds controlled and geographic or other restrictions.

Herbicide	Rate per treated acre (lbs. a.i.)
ANNUAL WEED CONTROL	
atrazine	½ to 3
chlorsulfuron* (Glean®)	0.016 to 0.024 (⅓-½ wt. oz. product)
cyanazine (Bladex®)	1⅗ to 3⅕
glyphosate (Roundup®)	¼ to ½
metribuzin (Sencor®, Lexone®)	⅓ to ¾
paraquat	½ to 1
2,4-D	¼ to ½
PERENNIAL WEED CONTROL	
glyphosate	1 to 2
2,4-D	1 to 2

*When making tank mix applications with Glean, add a surfactant of at least 80% active ingredient at the rate of 1-2 quarts/100 gallons of spray or not more than ¼-½% by volume. Use the highest rate of surfactant when using the lower rate ranges of the tank mix and/or when treating more mature weeds or dense vegetative growth.

SPECIAL TANK MIX TREATMENTS

For suppression of perennial weeds, apply 0.25-0.50 lb. a.i. BANVEL Herbicide with 0.25-0.50 lb. a.i. Roundup herbcide per treated acre.

For wild garlic control, apply 1 pint (½ lb. a.i.) BANVEL Herbicide with 1½ lbs. acid equivalent 2,4-D low volatile ester per treated acre. Apply when wild garlic is 4 to 8 inches tall.

For Canada thistle control, use BANVEL Herbicide or BANVEL Plus Roundup Herbicide tank mix treatments.

Application may be made during fallow periods for control of volunteer barley, bulbous bluegrass, downy brome, jointed goatgrass, common rye and volunteer wheat when they are actively growing. Use 1 pint BANVEL Herbicide with 1/2-3/4 lb. Kerb 50W (0.25-0.38 lb. a.i.). Fall seeded wheat may be planted 9 months or more after application. For best performance, make application between mid-October and mid-December, prior to soil freeze up.

During fallow periods, apply BANVEL Herbicide plus Landmaster Herbicide to give improved control of kochia, wild buckwheat, prickly lettuce, field bindweed and Canada thistle. Use 4-8 fluid ounces of BANVEL Herbicide plus 40-54 fluid ounces of Landmaster Herbicide for annual weed control or 8-16 fluid ounces of BANVEL Herbicide plus 40-54 fluid ounces of Landmaster Herbicide for perennial weed suppression.

ROTATIONAL CROPS

The following recommendations are based on BANVEL Herbicide use rates up to 4 pints (2 lbs. a.i.) per treated acre.

CORN and SORGHUM may be planted in the spring following applications made during the previous year.

SOYBEANS may be planted in the spring following applications made during the previous year. If less than 1 inch of rainfall occurs between application and first killing frost, treated areas should be cultivated to allow herbicide to come in contact with moist soil. Cultivation may take place before or immediately after ground thaw.

Soybean injury may occur if the interval between application and planting is less than specified. In areas with greater than 30 inches of rainfall, delay planting for 30 days per pint of BANVEL Herbicide per treated acre. In areas with less than 30 inches of rainfall, delay planting for 45 days per pint of BANVEL Herbicide per treated acre. Exclude days when ground is frozen.

WHEAT may be planted in the fall or spring following applications. Also, spot applications may be made any time prior to crop emergence if crop injury can be tolerated in treated areas. Wheat injury may occur if the interval between application and planting is less than specified.

East of the Mississippi River, the interval is 20 days per pint of BANVEL Herbicide per treated acre. Exclude days when ground is frozen.

West of the Mississippi River, the interval is 45 days per pint of BANVEL Herbicide per treated acre. Exclude days when ground is frozen.

Following a normal harvest of corn, sorghum, soybeans, or wheat, any rotational crop may be planted. If the interval before harvest is shortened, such as when cover crops will be plowed under, do not follow up with the planting of a sensitive crop.

CONTROL OF PERENNIAL BROADLEAF WEEDS IN CROPLAND (SPOT APPLICATION ONLY)

For Use Only in the States of Idaho, Montana, Nevada, Oregon, Utah, and Washington.

IMPORTANT

Observe all precautions on pages 11-12. Read and follow mixing and application instructions on pages 13-14.

Do not treat subirrigated cropland or areas where the soil remains saturated with water throughout the year.

Make only one application of BANVEL Herbicide per year.

WEEDS CONTROLLED

BANVEL Herbicide, when applied at recommended rates, will control many broadleaf weeds including:

- Bindweed, Field
- Dock, Broadleaf (Bitterdock)
- Dock, Curly
- Knapweed, Black
- Knapweed, Russian
- Ragwort, Tansy
- Spurge, Leafy
- Thistle, Canada

RATES AND TIMINGS

BANVEL Herbicide may be applied at any time following a crop harvest to stubble fallow or other cropland. Application should be made when weeds are actively growing and prior to a killing frost.

Apply 4 to 6 quarts (4-6 lbs. a.i.) of BANVEL Herbicide per treated acre. Application may be made up to one month prior to the planting of wheat.

Note: Do not use unless injury to wheat or rotated barley will be acceptable.

Barley, oats, corn, sorghum (milo), annual or perennial grass crops may be planted into treated areas one year after application. Crops grown for seed (other than perennial grass seed) should not be planted into treated areas until three years after application. Do not plant broadleaf crops such as alfalfa, beans, peas, potatoes, or sugarbeets into treated areas until two years after application.

In most cases, treatments will not kill perennial weed seedlings which germinate from seed one or two years after treatment. Once the effect of the chemical has been lost, a follow-up program for seedling control or other cultural practices should be instituted.

WIPER APPLICATION USES

IMPORTANT

Observe all precautions on pages 11 - 12.

BANVEL Herbicide may be applied through wiper application equipment to control or suppress actively growing broadleaf weeds, brush and vines. Use a solution containing 1 part BANVEL Herbicide to 1 part water. Do not contact desirable vegetation with herbicide solution. Wiper application should only be made to crops (including pastures) and non-cropland areas described in this label with the exception of Grain Sorghum (Milo).

24(c) SPECIAL LOCAL NEED LABELING

24(c) SLN #50
BANVEL® Herbicide
Annual Weed Control in Millet (Nebraska) . .

24(c) SLN #61
BANVEL® Herbicide
Preharvest Application in Fall Seeded Wheat (Oklahoma) . . . . . .

24(c) SLN #66
BANVEL® Herbicide
Preharvest Application in Fall Seeded Wheat (Kansas) . . . . . .

24(c) SLN #86
BANVEL® Herbicide
For Control of Annual and Perennial Broadleaf Weeds Such as Field Bindweed in Between Cropping Applications to Wheat (Oklahoma) . . . . . .

24(c) SLN #89
BANVEL® Herbicide
For Control of Annual and Perennial Broadleaf Weeds such as Field Bindweed in Between Cropping Applications to Wheat (Texas) . . . . . .

24(c) SLN #90
BANVEL® Herbicide
Wild Buckwheat Control in Fall Seeded Wheat (Oklahoma) . . . . . .

24(c) SLN #91
BANVEL® Herbicide
Between Cropping Applications (BCA) BANVEL® Plus Landmaster® Tank Mix for Use in Fallow Rotated to Wheat (Colorado, Montana, No. Dakota, So. Dakota and Wyoming) . . . . . .

2(ee) RECOMMENDATIONS

2(ee) Recommendation #73
BANVEL® Herbicide
Tank Mix With Roundup® Herbicide for Preplant Applications to Spring Barley and Spring Wheat (Specific Counties in South Idaho) . . . . . .

2(ee) Recommendation #88
BANVEL® Herbicide
Between Cropping Applications (BCA) Banvel® Plus Landmaster® Tank Mix For Use in Fallow Rotated to Wheat (Montana and North Dakota) . . . . . .

2(ee) Recommendation #93
BANVEL® Herbicide
Between Cropping Applications (BCA) BANVEL® Plus Landmaster® Tank Mix For Use in Fallow Rotated to Wheat (Montana, North Dakota, Wyoming, Washington, Idaho, Utah and Nebraska) . . . . . .

STORAGE AND DISPOSAL

PROHIBITIONS

Do not contaminate water, food or feed by storage or disposal.

STORAGE

Store in original container in a well-ventilated area separately from fertilizer, feed and foodstuffs. Avoid cross-contamination with other pesticides. Spillage or leakage should be contained and absorbed with clay granules, sawdust, or equivalent material for disposal.

PESTICIDE DISPOSAL

Triple rinse pesticide from containers and use rinsates in the pesticide application. Wastes which cannot be used according to label instructions may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL

Plastic or Metal: After triple rinsing (or equivalent), offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities, such as burning of plastic containers. If burned, stay out of smoke.

LIMITED WARRANTY AND LIABILITY

NOTICE: Read this Limited Warranty and Liability before buying or using this product. If the terms are not acceptable, return it at once, unopened.

It is critical that this product be used and mixed only as specified on the label. The laws of a State may make some or all of this paragraph inapplicable or may give you rights in addition to your rights hereunder. Except to the extent prohibited by applicable law, the exclusive remedy of the user or buyer and the limit of liability of this Company or any other Seller for any and all losses, personal injuries or damages resulting from the use of this product, shall be the purchase price paid by the user or buyer for the quantity of product involved. Except to the extent prohibited by State Law, there is no warranty, and this Company and other Sellers disclaim all liability for losses, personal injury or damages: (i) arising from any use of this product in a manner or for a purpose not recommended in its label directions or from mixing this product before use with any substance except as recommended by the product's label; (ii) arising from handling or storage in violation of label instructions, (iii) for all indirect, special or consequential damages; (iv) when not reported to this Company within one year of discovery; and (v) arising from product not used within the label-designated shelf life or four years from the date of purchase, whichever first occurs. THERE ARE NO IMPLIED WARRANTIES AND NO WARRANTIES OF MERCHANTABILITY OR FITNESS

October 1988
Des Plaines, IL

SP-341

ROUNDUP

(GLYPHOSATE)

This sample label is current as of January 1, 1989. The product descriptions and recommendations provided in this sample label are for background information only. Always refer to the label on the product container before using Monsanto or any other agrichemical product.

Roundup®

Herbicide by Monsanto

Complete Directions for Use

EPA Reg. No. 524-308-AA

AVOID CONTACT WITH FOLIAGE, GREEN STEMS, OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, SINCE SEVERE INJURY OR DESTRUCTION MAY RESULT.

This product has been approved for use in California except as stated otherwise on page 118.

1988-2 **897.10-004.80**/CG

Read the entire label before using this product.

Use only according to label instructions.

Read "LIMIT OF WARRANTY AND LIABILITY" before buying or using. If terms are not acceptable, return at once unopened.

LIMIT OF WARRANTY AND LIABILITY

(Not applicable to consumer applications applied by the homeowner for noncommercial purposes as permitted by the supplemental labeling for one-quart containers.)

This Company warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes set forth in the Complete Directions for Use label booklet ("Directions") when used in accordance with those Directions under the conditions described therein. NO OTHER EXPRESS WARRANTY OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE. This warranty is also subject to the conditions and limitations stated herein.

Buyer and all users shall promptly notify this Company of any claims whether based in contract, negligence, strict liability, other tort or otherwise.

Buyer and all users are responsible for all loss or damage from use or handling which results from conditions beyond the control of this Company, including, but not limited to, incompatibility with products other than those set forth in the Directions, application to or contact with desirable vegetation, unusual weather, weather conditions which are outside the range considered normal at the application site and for the time period when the product is applied, as well as weather conditions which are outside the application ranges set forth in the Directions, application in any manner not explicitly set forth in the Directions, moisture conditions outside the moisture range specified in the Directions, or the presence of products other than those set forth in the Directions in or on the soil, crop or treated vegetation.

THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF THE LIABILITY OF THIS COMPANY OR ANY OTHER SELLER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT (INCLUDING CLAIMS BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE) SHALL BE THE PURCHASE PRICE PAID BY THE USER OR BUYER FOR THE QUANTITY OF THIS PRODUCT INVOLVED, OR, AT THE ELECTION OF THIS COMPANY OR ANY OTHER SELLER, THE REPLACEMENT OF SUCH QUANTITY OR, IF NOT ACQUIRED BY PURCHASE, REPLACEMENT OF SUCH QUANTITY. IN NO EVENT SHALL THIS COMPANY OR ANY OTHER SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES.

Buyer and all users are deemed to have accepted the terms of this LIMIT OF WARRANTY AND LIABILITY which may not be varied by any verbal or written agreement.

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

Keep out of reach of children.

WARNING!

CAUSES EYE IRRITATION.
HARMFUL IF SWALLOWED.
MAY CAUSE SKIN IRRITATION.

Do not get in eyes, on skin or on clothing.

Wash thoroughly after handling.

FIRST AID: IF IN EYES, immediately flush with plenty of water for at least 15 minutes. Call a physician.

IF ON SKIN, immediately flush with plenty of water. Remove contaminated clothing. Wash clothing before reuse.

IF SWALLOWED, this product will cause gastrointestinal tract irritation. Immediately dilute by swallowing water or milk. Call a physician.

In case of an emergency involving this product, Call Collect, day or night, (314) 694-4000.

Environmental Hazards

Do not apply directly to water or wetland (swamps, bogs, marshes or potholes.) Do not contaminate water by cleaning of equipment or disposal of wastes.

Physical or Chemical Hazards

Spray solutions of this product should be mixed, stored and applied only in stainless steel, aluminum, fiberglass, plastic and plastic-lined steel containers.

DO NOT MIX, STORE OR APPLY THIS PRODUCT OR SPRAY SOLUTIONS OF THIS PRODUCT IN GALVANIZED STEEL OR UNLINED STEEL (EXCEPT STAINLESS STEEL) CONTAINERS OR SPRAY TANKS. This product or spray solutions of this product react with such containers and tanks to produce hydrogen gas which may form a highly combustible gas mixture. This gas mixture could flash or explode, causing serious personal injury, if ignited by open flame, spark, welder's torch, lighted cigarette or other ignition source.

ACTIVE INGREDIENT:	
*Isopropylamine salt of glyphosate	41.0%
INERT INGREDIENTS:	59.0%
	100.0%

*Contains 480 grams per litre or 4 pounds of the active ingredient isopropylamine salt of N-(phosphonomethyl) glycine per U.S. gallon. Equivalent to 356 grams per litre or 3 pounds per U.S. gallon of the acid, glyphosate.

In case of an emergency involving this product, Call Collect, day or night, (314)694-4000.

MONSANTO COMPANY
AGRICULTURAL PRODUCTS
ST. LOUIS, MISSOURI, 63167 U.S.A.

GENERAL INFORMATION

DO NOT APPLY THIS PRODUCT USING AERIAL SPRAY EQUIPMENT EXCEPT UNDER CONDITIONS AS SPECIFIED WITHIN THIS LABEL.

Roundup® herbicide, a water soluble liquid, mixes readily with water to be applied as a foliar spray for the control or destruction of most herbaceous plants. It may be applied through most standard industrial or field-type sprayers after dilution and thorough mixing with water in accordance with label instructions.

This product moves through the plant from the point of foliage contact to and into the root system. Visible effects on most annual weeds occur within 2 to 4 days, but on most perennial weeds may not occur for 7 days or more. Extremely cool or cloudy weather following treatment may slow down activity of this product and delay visual effects of control. Visible effects are a gradual wilting and yellowing of the plant which advances to complete browning of above ground growth and deterioration of underground plant parts.

Unless otherwise specified on this label, delay application until vegetation has emerged and reached the stages described for control of such vegetation under the "Weeds Controlled" section of this label. Unemerged plants arising from unattached underground rhizomes or root stocks of perennials will not be affected by the spray and will continue to grow. For this reason, best control of most perennial weeds is obtained when treatment is made at late growth stages approaching maturity.

Always use the higher rate of this product per acre within the recommended range when (1) weed growth is heavy or dense, or (2) weeds are growing in an undisturbed (noncultivated) area.

Do not treat weeds under poor growing conditions such as drought stress, disease or insect damage, as reduced weed control may result. Reduced results may also occur when treating weeds heavily covered with dust.

Reduced control may result when applications are made to annual or perennial weeds that have been mowed, grazed, or cut, and have not been allowed to regrow to the recommended stage for treatment.

Rainfall or irrigation occurring within 6 hours after application may reduce effectiveness. Heavy rainfall or irrigation within 2 hours after application may wash the

chemical off the foliage and a repeat treatment may be required.

Roundup herbicide does not provide residual weed control. For subsequent residual weed control, follow a label-approved herbicide program. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used.

Buyer and all users are responsible for all loss or damage in connection with the use or handling of mixtures of Roundup with herbicides or other materials that are not expressly recommended in this labeling. Mixing this product with herbicides or other materials not recommended on this label may result in reduced performance.

For best results, spray coverage should be uniform and complete. Do not spray weed foliage to the point of runoff.

Keep people and pets off treated areas until spray solution has dried.

DOMESTIC ANIMALS: This product is considered to be relatively nontoxic to dogs and other domestic animals. However, ingestion of this product or large amounts of freshly sprayed vegetation may result in temporary gastrointestinal irritation (vomiting, diarrhea, colic, etc.). If such symptoms are observed, provide the animal with plenty of fluids to prevent dehydration. Call a veterinarian if symptoms persist for more than 24 hours.

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ATTENTION

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS

Do not allow the herbicide solution to mist, drip, drift, or splash onto desirable vegetation since minute quantities of this herbicide can cause severe damage or destruction to the crop, plants, or other areas on which treatment was not intended. The likelihood of injury occurring from the use of this product is greatest when winds are gusty or in excess of 5 miles per hour or when other conditions, including lesser wind velocities, will allow spray drift to occur. When spraying, avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) which are likely to drift. AVOID APPLYING AT EXCESSIVE SPEED OR PRESSURE.

NOTE: Use of this product in any manner not consistent with this label may result in injury to persons, animals or crops, or other unintended consequences. Keep container closed to prevent spills and contamination.

MIXING, ADDITIVES AND APPLICATION INSTRUCTIONS

APPLY THESE SPRAY SOLUTIONS IN PROPERLY MAINTAINED AND CALIBRATED EQUIPMENT CAPABLE OF DELIVERING DESIRED VOLUMES. DO NOT APPLY UNDER WIND OR OTHER CONDITIONS WHICH ALLOW DRIFT TO OCCUR. HAND GUN APPLICATIONS SHOULD BE PROPERLY DIRECTED TO AVOID SPRAYING DESIRABLE PLANTS. NOTE: REDUCED RESULTS MAY OCCUR IF WATER CONTAINING SOIL IS USED, such as WATER FROM PONDS AND UNLINED DITCHES.

MIXING

This product mixes readily with water. Mix spray solutions of this product as follows: Fill the mixing or spray tank with the required amount of water. Add the proper amount of this product (see "Directions for Use" and "Weeds Controlled" sections of this label) near the end of the filling process and mix well. Remove hose from tank immediately after filling to avoid siphoning back into the carrier source. During mixing and application foaming of the spray solution may occur. To prevent or minimize foam, avoid the use of mechanical agitators, place the filling hose below the surface of the spray solution, terminate by-pass and return lines at the bottom of the tank and if needed use an approved anti-foam or defoaming agent.

TANK MIXTURES

Always predetermine the compatibility of labeled tank mixtures of this herbicide with water carrier by mixing small proportional quantities in advance.

Mix labeled tank mixtures of Roundup herbicide with water as follows:

1. Place a 20 to 35 mesh screen or wetting basket over filling port.
2. Through the screen, fill the sprayer tank one-half full with water and start agitation.
3. If a wettable powder is used, make a slurry with the water carrier, and add it SLOWLY through the screen into the tank. Continue agitation.
4. If a flowable formulation is used, pre-mix one part flowable with one part water. Add diluted mixture SLOWLY through the screen into the tank. Continue agitation.
5. If an emulsifiable concentrate formulation is used, pre-mix one part emulsifiable concentrate with two parts water. Add diluted mixture slowly through the screen into the tank. Continue agitation.
6. Continue filling the sprayer tank with water and add the required amount of Roundup herbicide near the end of the filling.
7. Where nonionic surfactant is recommended, add this to the spray tank before completing the filling process.
8. Add individual formulations to the spray tank as follows: wettable powder, flowable, emulsifiable concentrate, drift control additive, water soluble liquid followed by surfactant.

Maintain good agitation at all times until the contents of the tank are sprayed. If the spray mixture is allowed to settle, thorough agitation is required to resuspend the mixture before spraying is resumed.

Keep by-pass line on or near bottom of tank to minimize foaming. Screen size in nozzle or line strainers should be no finer than 50 mesh. Carefully select proper nozzle to avoid spraying a fine mist. For best results with conventional ground application equipment, use flat fan nozzles.

Clean sprayer and parts immediately after using this product by thoroughly flushing with water.

ADDITIVES

SURFACTANTS

Nonionic surfactants which are labeled for use with herbicides may be used. Do not reduce rates of this herbicide when adding surfactant. When adding additional surfactant or label instructions require the use of additional surfactant, use 0.5 percent surfactant concentration (2 quarts per 100 gallons of spray solution) when using surfactants which contain at least 50 percent active ingredient or a 1 percent surfactant concentration (4 quarts per 100 gallons of spray solution) for those surfactants containing less than 50 percent active ingredient. Read and carefully observe surfactant cautionary statements and other information appearing on the surfactant label.

AMMONIUM SULFATE

The addition of 2 percent dry ammonium sulfate by weight or 17 pounds per 100 gallons of water may increase the performance of Roundup and Roundup plus 2,4-D amine or Banvel™ tank mixtures on annual and perennial weeds. The improvement in performance may be apparent where environmental stress is a concern. Low-quality ammonium sulfate may contain material that will not readily dissolve which could result in nozzle tip plugging. To determine quality, perform a jar test by adding ½ cup of ammonium sulfate to 1 gallon of water and agitate for 1 minute. If undissolved sediment is observed, predissolve the ammonium sulfate in water and filter prior to addition to the spray tank. If ammonium sulfate is added directly to the spray tank, add slowly with agitation. Adding too quickly may clog outlet lines. Ensure that ammonium sulfate is completely dissolved in the spray tank before adding herbicides or surfactant. Thoroughly rinse the spray system with clean water after use to reduce corrosion.

NOTE: The use of ammonium sulfate as an additive does not preclude the need for additional surfactant. Do not use herbicide rates lower than recommended in this label

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COLORANTS OR DYES

Agriculturally approved colorants or marking dyes may be added to this product. Colorants or dyes used in spray solutions of this product may reduce performance, especially at lower rates or dilutions. Use colorants or dyes according to the manufacturer's recommendations.

APPLICATION EQUIPMENT AND TECHNIQUES

Do not apply this product through any type of irrigation system.

This product may be applied with the following application equipment:

Aerial—Fixed Wing and Helicopter

Broadcast Spray

Controlled Droplet Applicator (CDA)—Hand-held or boom-mounted applicators which produce a spray consisting of a narrow range of droplet sizes.

Hand-Held and High-Volume Spray Equipment—Knapsack and backpack sprayers, pump-up pressure sprayers, handguns, handwands, lances and other hand-held spray equipment used to direct the spray onto weed foliage and vehicle mounted high-volume spray equipment for spray-to-wet applications.

Selective equipment—Recirculating sprayers, shielded sprayers and wiper applicators.

See the appropriate part of this section for specific rates of application and instructions.

AERIAL EQUIPMENT

Use the recommended rates of this herbicide in 3 to 15 gallons of water per acre unless otherwise specified on this label. See the "Weeds Controlled" section of this

label for specific rates. Unless otherwise specified, do not exceed the one-quart rate per acre of this product.

(Aerial applications of this product may be made in annual cropping conventional tillage systems, fallow and reduced tillage systems, preharvest, silvicultural sites, and rights-of-way. Refer to the individual use area sections of this label for recommended volumes and application rates.) FOR AERIAL APPLICATION IN CALIFORNIA, REFER TO THE FEDERAL SUPPLEMENTAL LABEL FOR AERIAL APPLICATIONS IN THAT STATE FOR SPECIFIC INSTRUCTIONS, RESTRICTIONS AND REQUIREMENTS.

Avoid direct application to any body of water.

AVOID DRIFT—DO NOT APPLY DURING INVERSION CONDITIONS, WHEN WINDS ARE GUSTY, OR UNDER ANY OTHER CONDITION WHICH WILL ALLOW DRIFT. DRIFT MAY CAUSE DAMAGE TO ANY VEGETATION CONTACTED TO WHICH TREATMENT IS NOT INTENDED. TO PREVENT INJURY TO ADJACENT DESIRABLE VEGETATION, APPROPRIATE BUFFER ZONES MUST BE MAINTAINED.

Coarse sprays are less likely to drift; therefore, do not use nozzles or nozzle configurations which dispense spray as fine spray droplets. Do not angle nozzles forward into the airstream and do not increase spray volume by increasing nozzle pressure.

Drift control additives may be used. When a drift control additive is used, read and carefully observe the cautionary statements and all other information appearing on the additive label.

Ensure uniform application—To avoid streaked, uneven or overlapped application, use appropriate marking devices.

Thoroughly wash aircraft, especially landing gear, after each day of spraying to remove residues of this product accumulated during spraying or from spills. PROLONGED EXPOSURE OF THIS PRODUCT TO UNCOATED STEEL SURFACES MAY RESULT IN CORROSION AND POSSIBLE FAILURE OF THE PART. LANDING GEAR ARE MOST SUSCEPTIBLE. The maintenance of an organic coating (paint) which meets aerospace specification MIL-C-38413 may prevent corrosion.

BROADCAST EQUIPMENT

For control of annual or perennial weeds listed on this label using broadcast equipment--Use the recommended rates of this product in 3 to 40 gallons of water per acre as a broadcast spray unless otherwise specified on this label. See the "Weeds Controlled" section of this label for specific rates. As density of weeds increases, spray gallonage should be increased within the recommended range to ensure complete coverage. Carefully select proper nozzle to avoid spraying a fine mist. For best results with ground application equipment, use flat fan nozzles. Check for even distribution of spray droplets.

CONTROLLED DROPLET APPLICATION (CDA)

The rate of this product applied per acre by vehicle-mounted CDA equipment must not be less than the amount recommended in this label when applied by conventional broadcast equipment. For vehicle-mounted CDA equipment apply 3 to 15 gallons of water per acre.

For the control of labeled annual weeds with hand-held CDA units, apply a 20 percent solution of this product at a flow rate of 2 fluid ounces per minute and a walking speed of 1.5 MPH (1 quart per acre). For the control of labeled perennial weeds, apply a 20 to 40 percent solution of this product at a flow rate of 2 fluid ounces per minute and a walking speed of 0.75 MPH (2 to 4 quarts per acre).

Controlled droplet application equipment produces a spray pattern which is not easily visible. Extreme care must be exercised to avoid spray or drift contacting the foliage or any other green tissue of desirable vegetation as damage or destruction may result.

HAND-HELD and HIGH-VOLUME EQUIPMENT

Use coarse sprays only.

Mix this product in clean water and apply to foliage of vegetation to be controlled. For applications made on a spray-to-wet basis, spray coverage should be uniform and complete. Do not spray to the point of runoff.

For control of annual weeds listed on this label, apply a 0.5 percent solution of this product plus nonionic surfactant to weeds less than 6 inches in height or runner length. Apply prior to seedhead formation in grass or bud formation in broadleaves. Allow three or more days before tillage or mowing.

For annual weeds over 6 inches tall, or when not using additional surfactant, or unless otherwise specified, use a 1 percent solution. For best results, use a 2 percent solution on harder-to-control perennials, such as bermudagrass, dock, field bindweed, hemp dogbane, milkweed and Canada thistle.

Less than complete coverage of weeds may result from the use of spray equipment designed for motorized spot treatments. Where less than complete coverage of annual weeds occurs, use a 5 percent solution. Do not reduce recommended concentrations of Roundup when adding surfactant.

Prepare the desired volume of spray solution by mixing the amount of this product in water as shown in the following table:

Spray Solution

DESIRED VOLUME	AMOUNT OF ROUNDUP®				
	½%	1%	1½%	2%	5%
1 gallon	⅔ oz	1⅓ oz	2 oz	2⅔ oz	6½ oz
25 gallons	1 pt	1 qt	1½ qt	2 qt	5 qt
100 gallons	2 qt	1 gal	1½ gal	2 gal	5 gal

2 tablespoons = 1 ounce

For use in knapsack sprayers, it is suggested that the proper amount of this product be mixed with water in a larger container. Fill sprayer with the mixed solution.

For hand-held WIPER APPLICATORS see the "Selective Equipment" section and for hand-held CONTROLLED DROPLET APPLICATORS see the "Controlled Droplet Applicator (CDA)" section of this label.

SELECTIVE EQUIPMENT

This product may be applied through a recirculating spray system, a shielded applicator, or a wiper applicator after dilution and thorough mixing with water to listed weeds growing in any noncrop site specified on this label and only when specifically recommended in cropping systems.

A recirculating spray system directs the spray solution onto weeds growing above desirable vegetation, while spray solution not intercepted by weeds is collected and returned to the spray tank for reuse.

A shielded applicator directs the herbicide solution onto weeds while shielding desirable vegetation from the herbicide.

A wiper applicator applies the herbicide solution onto weeds by rubbing the weed with an absorbent material containing the herbicide solution.

AVOID CONTACT WITH DESIRABLE VEGETATION.

Contact of the herbicide solution with the desirable vegetation may result in damage or destruction. Applicators used above desired vegetation should be adjusted so that the lowest spray stream or wiper contact point is at least two inches above the desirable vegetation. Droplets, mist, foam, or splatter of the herbicide solution settling on desirable vegetation may result in discoloration, stunting, or destruction.

Applications made above the crops should be made when the weeds are a minimum of 6 inches above the desirable vegetation. Better results may be obtained when more of the weed is exposed to the herbicide solution. Weeds not contacted by the herbicide solution will not be affected. This may occur in dense clumps, severe infestations, or when the height of the weeds varies so that not all weeds are contacted. In these instances, repeat treatment may be necessary.

See the "Weeds Controlled" section of this label for recommended stage of growth for specific weeds.

NOTE

- Maintain equipment in good operating condition. Avoid leakage or dripping onto desirable vegetation.
- Adjust height of applicator to insure adequate contact with weeds.
- Keep nozzle tips and wiping surfaces clean.
- Keep spray patterns aligned into recovery chamber of the recirculating sprayer.
- Keep shields on shielded applicators adjusted to protect desirable vegetation.
- Maintain recommended roller RPM on roller applicators while in use.
- Keep wiper material at proper degree of saturation with herbicide solution.
- DO NOT use wiper equipment when weeds are wet.
- DO NOT operate equipment at ground speeds greater than 5 mph. Weed control may be affected by speed of application equipment. As weed density increases, reduce equipment ground speed to insure good coverage of weeds.
- Be aware that on sloping ground the herbicide solution may migrate, causing dripping on the lower end and drying on the upper end of a wiper applicator.
- Variation in equipment design may affect weed control. With wiper applicators, the wiping material and its orientation must allow delivery of sufficient quantities of the recommended herbicide solution directly to the weed.
- Care must be taken with all types of wipers to ensure that the absorbent material does not become oversaturated, causing the herbicide to drip on desirable vegetation.
- Mix only the amount of solution to be used during a one-day period, as reduced activity may result from use of leftover solutions. With all equipment, drain and clean sprayer and wiper parts immediately after using this product by thoroughly flushing with water.

RECIRCULATING SPRAYERS

Recirculating sprayer calibration is made on the basis of ground speed and delivery volume. Two procedures can be used to calibrate: (1) determine the discharge being

delivered per minute, then operate at the designated ground speed, or (2) select the desired ground speed and then adjust the sprayer to deliver the recommended volume per minute (this may require nozzle changes). Use the appropriate table below.

Do not operate at nozzle pressure above 20 PSI.

Table 1. Use this table when calibrating box or row-type recirculating sprayers. Box or row-type sprayer calibration is based on the total discharge collected per row.

Use only straight stream or 15° fan-type nozzles.

*VOLUME PER MINUTE PER ROW	
MPH	Ounces
2	26 to 35
3	38 to 51
4	51 to 68
5	65 to 86

*NOTE Be certain the amount collected is for all spray streams treating one row.

Table 2. Use this table when calibrating broadcast type recirculating sprayers. Broadcast recirculating sprayer calibration is based on the discharge collected per minute from one nozzle on a 20-inch spacing.

VOLUME PER MINUTE PER NOZZLE	
MPH	Ounces
2	7 to 9
3	10 to 13
4	13 to 18
5	16 to 22

When applied as recommended under the conditions described for recirculating sprayers, this product will control the following weeds growing a minimum of 6 inches above desirable vegetation

Perennial Broadleaf Weeds—To SUPPRESS the following weeds, mix in a ratio of 4 quarts of this product in 20 gallons of water and apply as directed

Dogbane, hemp *Apocynum cannabinum*
Milkweed *Asclepias syriaca*

Perennial Grasses and Annual Broadleaf Weeds—To control the following weeds, mix in a ratio of 3 quarts of this product in 20 gallons of water and apply as directed:

Cocklebur *Xanthium strumarium*
Pigweed, redroot *Amaranthus retroflexus*
Johnsongrass *Sorghum halepense*
Sunflower *Helianthus annuus*

Annual Grasses—To control the following weeds, mix in a ratio of 2 quarts of this product in 20 gallons of water and apply as directed:

Corn *Zea mays*
Shattercane *Sorghum bicolor*

SHIELDED APPLICATORS

When applied as directed under conditions described for shielded applicators, this product will control those weeds listed in the "Weeds Controlled" section of this label.

Shielded applicators which apply the herbicide solution as a spray band should be calibrated on a broadcast equivalent rate and volume basis. To determine these:

$$\frac{\text{Band width in inches}}{\text{Row width in inches}} \times \text{Herbicide Broadcast RATE per acre} = \text{Herbicide Band RATE per acre}$$

$$\frac{\text{Band width in inches}}{\text{Row width in inches}} \times \text{Broadcast VOLUME of solution per acre} = \text{Band VOLUME of solution per acre}$$

Use nozzles that provide uniform coverage within the treated area. EXTREME CARE MUST BE EXERCISED TO AVOID CONTACT WITH DESIRABLE VEGETATION.

For specific rates of application and instructions for control of various annual and perennial weeds, see the "Weeds Controlled" section of this label.

WIPER APPLICATORS

Wiper applicators include either roller or wick devices which physically wipe appropriate concentrations or amounts of this product directly onto the weed. Equipment must be designed, maintained, and operated to prevent the herbicide solution from contacting desirable vegetation. Operate this equipment at ground speeds no greater than 5 mph. Performance may be improved by reducing speed in areas of heavy weed infestations to ensure adequate wiper saturation. Better results may be obtained if two applications are made in opposite directions.

Do not add surfactant to the herbicide solution

For Roller Applicators—Mix 1 gallon of this product in enough water to prepare 10 gallons of herbicide solution (10 percent solution). Apply this solution to perennial weeds or annual broadleaf weeds listed in this "Wiper Applicators" section

Mix 1 gallon of this product in enough water to provide 20 gallons of herbicide solution (5 percent solution). Apply this solution to annual grasses listed in this "Wiper Applicators" section.

Roller speed should be maintained at 40 to 60 RPM.

For Wick or Wiper Applicators—Mix 1 gallon of this product in 2 gallons of water to prepare a 33 percent solution. Apply this solution to weeds listed in this "Wiper Applicators" section

In severe infestations, reduce equipment ground speed to ensure that adequate amounts of this product are wiped on the weeds. A second treatment in the opposite direction may be beneficial.

Do not permit herbicide solution to contact desirable vegetation.

When applied as recommended under the conditions described for "Wiper Applicators", this product CONTROLS the following weeds:

ANNUAL GRASSES

Corn *Zea mays*
Rye, common *Secale cereale*
Panicum, Texas *Panicum texanum*
Shattercane *Sorghum bicolor*

ANNUAL BROADLEAVES

Sicklepod *Cassia obtusifolia*
Starbur, bristly *Acanthospermum hispidum*
Spanishneedles *Bidens bipinnata*

When applied as recommended under the conditions described for "Wiper Applicators", this product SUPPRESSES the following weeds:

ANNUAL BROADLEAVES

Beggarweed, Florida *Desmodium tortuosum*
Dogfennel *Eupatorium capilliflorium*
Pigweed, redroot *Amaranthus retroflexus*
Ragweed, common *Ambrosia artemisiifolia*
Ragweed, giant *Ambrosia trifida*
Sunflower *Helianthus annuus*
Thistle, musk *Carduus nutans*
Velvetleaf *Abutilon theophrasti*

PERENNIAL GRASSES

Bermudagrass *Cynodon dactylon*
Guineagrass *Panicum maximum*
Johnsongrass *Sorghum halepense*
Smutgrass *Sporobolus poiretii*
Vaseygrass *Paspalum urvillei*

PERENNIAL BROADLEAVES

Dogbane, hemp *Apocynum cannabinum*
Milkweed *Asclepias syriaca*
Nightshade, silverleaf *Solanum elaeagnifolium*
Thistle, Canada *Cirsium arvense*

WEEDS CONTROLLED

This herbicide controls many annual and perennial grasses and broadleaf weeds.

ANNUAL WEEDS

- Apply to actively growing grass and broadleaf weeds.
- Allow at least 3 days after treatment before tillage
- For maximum agronomic benefit, apply when weeds are 6 inches or less in height.
- To prevent seed production, applications should be made prior to seedhead formation.
- This product does not provide residual control; therefore, delay application until maximum weed emergence. Repeat treatments may be necessary to control later germinating weeds.

LOW-VOLUME BROADCAST APPLICATION (LOW-RATE TECHNOLOGY)

When applied as directed under the conditions described, this product will control the weeds listed below when:

1. Water carrier volumes are 3 to 10 gallons per acre for ground applications and 3 to 5 gallons per acre for aerial applications. (See the "Aerial Application" section of this label for approved sites.)
2. A nonionic surfactant is added at 0.5 to 1 percent by total spray volume. Use 0.5 percent surfactant concentration when using surfactants which contain at least 50 percent active ingredient or a 1 percent surfactant concentration for those surfactants containing less than 50 percent active ingredient.

NOTE

- The addition of 2 percent dry ammonium sulfate by weight or 17 pounds per 100 gallons of water may increase the performance of this herbicide on annual weeds. The improvement in performance may be apparent where environmental stress is a concern.

Refer to the "Mixing, Additives and Application Instructions" section of this label.

- Do not tank-mix with soil residual herbicides when using these rates unless otherwise specified.
- For weeds that have been mowed, grazed, or cut, allow regrowth to occur prior to treatment.
- Refer to the "Tank Mixtures" portion of this section for control of additional broadleaf weeds.

WEED SPECIES	MAXIMUM HEIGHT	RATE PER ACRE**
Foxtail *Setaria spp.*	12"	8 oz.
Barnyardgrass *Echinochloa crus-galli*	6" (0 to 4" (4 to 6"	12 oz. 16 oz.[1]) 24 oz.[1])
Bluegrass, annual *Poa annua*		
Brome, downy* *Bromus tectorum*		
Mustard, blue *Chorispora tenella*		
Mustard, tansy *Descurainia pinnata*		
Mustard, tumble *Sisymbrium altissimum*		
Mustard, wild *Sinapis arvensis*		
Spurry, umbrella *Holosteum umbellatum*		
Barley *Hordeum vulgare*	12"	
Rye *Secale cereale*		
Sandbur, field *Cenchrus spp.*		
Shattercane *Sorghum bicolor*		
Stinkgrass *Eragrostis cilianensis*		
Wheat *Triticum aestivum*	18"	
Morningglory *Ipomea spp.*	2"	16 oz.
Sicklepod *Cassia obtusifolia*		
Bluegrass, bulbous *Poa bulbosa*	6"	
Cheat *Bromus secalinus*		
Chickweed, mouseear *Cerastium vulgatum*		
Corn *Zea mays*		
Groundsel, common *Senecio vulgaris*		
Horseweed/Marestail *Conyza canadensis*		
Lambsquarters, common *Chenopodium album*	6"	16 oz.
Pennycress, field		
Fanweed *Thlaspi arvense*		
Rocket, London *Sisymbrium irio*		
Ryegrass, Italian *Lolium multiflorum*		
Shepherdspurse *Capsella bursa-pastoris*		
Buttercup *Ranunculus spp.*	12"	
Cocklebur *Xanthium strumarium*		
Crabgrass *Digitaria spp.*		
Dwarfdandelion *Krigia cespitosa*		
Falseflax, smallseed *Camelina microcarpa*		
Foxtail, Carolina *Alopecurus carolinianus*		
Johnsongrass, seedling *Sorghum halepense*		
Oats, wild *Avena fatua*		
Panicum, fall *Panicum dichotomiflorum*		
Panicum, Texas *Panicum texanum*		
Pigweed, redroot *Amaranthus retroflexus*		
Pigweed, smooth *Amaranthus hybridus*		
Witchgrass *Panicum capillare*		
Sicklepod *Cassia obtusifolia*	3 to 4"	24 oz
Signalgrass, broadleaf *Brachiaria platyphylla*	4"	
Horseweed/Marestail *Conyza canadensis*	7 to 12"	
Lambsquarters, common *Chenopodium album*		
Teaweed *Sida spinosa*	4"	32 oz.
Rice, red *Oryza sativa*	6"	
Geranium, Carolina *Geranium carolinianum*	12"	
Goosegrass *Eleusine indica*		
Primrose, cutleaf evening *Oenothera laciniate*		
Pusley, Florida *Richardia scabra*	12"	32 oz.
Sicklepod *Cassia obtusifolia*	5 to 12"	
Spanishneedles *Bidens bipinnata*		
Filaree *Erodium spp.*	12"	48 oz.

[1]Use these rates in Alabama, Arkansas, Mississippi, Missouri, Louisiana and Texas for preplant treatments.

*For control in no-till systems, use 16 fluid ounces per acre.

**For those rates less than 32 ounces per acre, Roundup at rates up to 32 ounces per acre may be used where heavy weed densities exist..

TANK MIXTURES

ROUNDUP® plus BANVEL plus NONIONIC SURFACTANT

ROUNDUP plus 2,4-D AMINE plus NONIONIC SURFACTANT

DO NOT APPLY BANVEL OR 2,4-D AMINE TANK MIXTURES BY AIR IN CALIFORNIA.

These tank mixtures are recommended for use in fallow and reduced tillage areas only. Follow use directions as given in the "Low-Volume Broadcast Application" section.

Roundup plus Banvel or 2,4-D amine will control the annual grasses and broadleaf weeds previously listed for Roundup alone at the indicated heights (except 8 ounces per acre applications), plus the following broadleaf weeds. For those weeds previously listed at 8 ounces of Roundup herbicide alone per acre, use the 12-ounce rate in these tank mixtures.

NOTE: Refer to the specific product labels for crop rotation restrictions and cautionary statements of all products used in tank mixtures. Some crop injury may occur if Banvel is applied within 45 days of planting. The addition of Banvel in a mixture with this product may provide short-term residual control of selected weed species.

Apply 12 to 16 ounces of this product plus 0.25 lb. a.i. of Banvel or 0.5 pound a.e. of 2,4-D amine, plus 0.5 to 1 percent nonionic surfactant by total spray volume per acre to control dense populations of the following annual broadleaf weeds when less than 6 inches in height:

Kochia* *Kochia scoparia*

Lambsquarters *Chenopodium album*

Lettuce, prickly *Lactuca serriola*

Pigweed, redroot *Amaranthus retroflexus*

Thistle, Russian *Salsola kali*

*Controlled with Banvel tank mixture only.

HIGH-VOLUME BROADCAST APPLICATIONS

When applied as directed under the conditions described, this product will control the weeds listed below when water carrier volumes are 10 to 40 gallons per acre for ground applications.

Use 1 quart of this product per acre if weeds are less than 6 inches tall. If weeds are over 6 inches tall, use 1.5 quarts of this product per acre. If weeds have been mowed, grazed, or cut allow adequate time for new growth to recommended stages prior to treatment. These rates will also provide control of weeds listed in the "Low-Volume Broadcast Application" section.

WEED SPECIES

Balsamapple*
Momordica charantia

Bassia, fivehook
Bassia hyssopifolia

Brome
Bromus spp.

Fiddleneck
Amsinckia spp

Flaxleaf Fleabane
Conyza bonariensis

Fleabane
Erigeron spp.

Kochia
Kochia scoparia

Lettuce, prickly
Lactuca serriola

Panicum
Panicum spp.

Ragweed, common
Ambrosia artemisiifolia

Ragweed, giant
Ambrosia trifida

Smartweed, Pennsylvania
Polygonum pensylvanicum

Sowthistle, annual
Sonchus oleraceus

Sunflower
Helianthus annuus

Thistle, Russian
Salsola kali

Velvetleaf
Abutilon theophrasti

*Apply with hand-held equipment only.

PERENNIAL WEEDS

Apply this product as follows to control or destroy most perennial weeds:

NOTE: If weeds have been mowed or tilled, do not treat until plants have resumed active growth and are at the recommended stages.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seed. Repeat treatments must be made prior to crop emergence.

The addition of 2 percent dry ammonium sulfate by weight or 17 pounds per 100 gallons of water may increase the performance of this herbicide on perennial weeds. The improvement in performance may be apparent where environmental stress is a concern. Refer to the "Mixing, Additives and Application Instructions" section of this label.

When applied as recommended under the conditions described, this product WILL CONTROL the following PERENNIAL WEEDS:

Alfalfa
Medicago sativa

Alligatorweed*
Alternanthera philoxeroides

Artichoke, Jerusalem
Helianthus tuberosus

Bahiagrass
Paspalum notatum

Bentgrass
Agrostis spp.

Bermudagrass
Cynodon dactylon

Bindweed, field
Convolvulus arvensis

Bluegrass, Kentucky
Poa spp.

Blueweed, Texas
Helianthus ciliaris

Brackenfern
Pteridium aquilinum

Bromegrass, smooth
Bromus inermis

Bursage, woollyleaf
Franseria tomentosa

Canarygrass, reed
Phalaris arundinacea

Cattail
Typha spp.

Clover, red
Trifolium pratense

Clover, white
Trifolium repens

Cogongrass
Imperata cylindrica

Dallisgrass
Paspalum dilatatum

Dandelion
Taraxacum officinale

Dock, curly
Rumex crispus

Dogbane, hemp
Apocynum cannabinum

Fescues
Festuca spp.

Fescue, tall
Festuca arundinacea

Guineagrass
Panicum maximum

Horsenettle
Solanum carolinense

Horseradish
Armoracia rusticana

Johnsongrass
Sorghum halepense

Kikuyugrass
Pennisetum clandestinum

Knapweed
Centaurea repens

Lantana
Lantana camara

Milkweed
Asclepias spp.

Muhly, wirestem
Muhlenbergia frondonsa

Mullein, common
Verbascum thapsus

Napiergrass
Pennisetum purpureum

Nightshade, silverleaf
Solanum elaeagnifolium

Nutsedge, purple, yellow
Cyperus rotundus
Cyperus esculentus

Orchardgrass
Dactylis glomerata

Pampas
Cortaderia jubata

Paragrass
Brachiaria mutica

Phragmites*
Phragmites spp.

Quackgrass
Agropyron repens

Ryegrass, perennial
Lolium perenne

Smartweed, swamp
Polygonum coccineum

Sweet potato, wild*
Ipomoea pandurata

Thistle, Canada
Cirsium arvense

Timothy
Phleum pratense

Torpedograss*
Panicum repens

Vaseygrass
Paspalum urvillei

Wheatgrass, western
Agropyron smithii

*Partial Control

See "Directions for Use" and "Mixing, Additives and Application Instructions" sections of this label for labeled uses and specific application instructions.

Alfalfa—Apply 1 quart of this product per acre plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre. Make application after the last hay cutting in the fall. Allow alfalfa to regrow to a height of 6 to 8 inches or more prior to treatment. Applications should be followed with deep tillage at least 7 days after treatment, but before soil freeze-up.

Alligatorweed—Apply 4 quarts of this product per acre or apply a 1½ percent solution with hand-held equipment to provide partial control. Apply when most of the plants are in bloom. Repeat applications will be required to maintain such control.

Bentgrass—For suppression in grass seed production areas. For ground applications only, apply 1.5 quarts of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 10 to 20 gallons of water per acre. Ensure entire crown area has resumed growth prior to a fall application. Bentgrass should be actively growing and have at least 3 inches of growth. Tillage prior to treatment should be avoided. Tillage 7 to 10 days after application is recommended for best results. Failure to use tillage after treatment may result in unacceptable control.

Bermudagrass—For control, apply 5 quarts of this product per acre and for partial control, apply 3 quarts per acre. Treat when bermudagrass is actively growing and seedheads are present. Retreatment may be necessary to maintain control. Allow 7 or more days after application before tillage.

Bindweed, field/Blueweed, Texas—Apply 4 to 5 quarts of this product per acre west of the Mississippi River and 3 to 4 quarts per acre east of the Mississippi River. Apply when weed is actively growing and is at or beyond full bloom. Do not treat when weed is under drought stress as good soil moisture is necessary for active growth. New leaf development indicates active growth. For best results, apply in late summer or fall. Fall treatments must be applied before a killing frost. Allow 7 or more days after application before tillage.

Bindweed, field (suppression irrigated lands where annual tillage is performed)—Apply 1 quart of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre. Apply to actively growing bindweed that has reached a length of 12 inches or greater. Allow maximum weed emergence and runner growth. Do not treat when weed is under drought stress as good soil moisture is necessary for active growth. Allow 3 or more days after application before tillage.

Bluegrass, Kentucky / Bromegrass, smooth / Orchardgrass—Apply 2 quarts of this product in 10 to 40 gallons of water per acre when the grasses are actively growing and most plants have reached boot-to-early seedhead stage of development. For partial control in pasture or hay crop renovation apply 1 to 1½ quarts of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre. Apply to actively growing plants when most have reached 4 to 12 inches in height. Allow 7 or more days after application before tillage.

Orchardgrass (sods going to no-till corn)—Apply 1 to 1.5 quarts of this product per acre plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre. Apply to orchardgrass that is a minimum of 12 inches tall for spring applications and 6 inches tall for fall applications. Allow at least three days following application before planting. A sequential application of 3.75 to 4.5 quarts of Lariat® herbicide, or equivalent, will be necessary for optimum results. Lariat should be applied within 3 to 10 days following spring applications to prevent annual weed growth.

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Brackenfern—Apply 3 to 4 quarts of this product per acre as a broadcast spray or as a 1 to 1½ percent solution with hand-held equipment. Apply to fully expanded fronds which are at least 18 inches long.

Bursage, woollyleaf—For control apply 2 quarts of this product plus 1 pint of Banvel per acre. For partial control apply 1 quart of this product plus 1 pint of Banvel per acre. Add 0.5 to 1 percent nonionic surfactant by total spray volume and apply 3 to 20 gallons of water per acre. Apply when plants are producing new active growth which has been initiated by moisture for at least 2 weeks and when plants are at or beyond flowering.

Canarygrass, reed/Timothy / Wheatgrass, western—Apply 2 to 3 quarts of this product per acre. For best results, apply to actively growing plants when most have reached the boot-to-head stage of growth. Allow 7 or more days after application before tillage.

Cogongrass—Apply 3 to 5 quarts of this product plus 0.5 to 1 percent nonionic surfactant in 10 to 40 gallons of water per acre. Apply when Cogongrass is at least 18

inches tall and actively growing in late summer or fall. Allow 7 or more days after application before tillage or mowing. Due to uneven stages of growth and the dense nature of vegetation preventing good spray coverage, repeat treatments may be necessary to maintain control.

Dogbane, hemp/Knapweed/Horseradish—Apply 4 quarts of this product per acre. Apply when actively growing and when most weeds have reached the late bud to flower stage of growth. Following crop harvest or mowing, allow weeds to regrow to a mature stage prior to treatment. For best results, apply in late summer or fall. Allow 7 or more days after application before tillage.

Fescue, tall—Apply 3 quarts of this product in 10 to 40 gallons of water per acre to actively growing plants when most have reached boot-to-early seedhead stage of development.

Fall applications only—Apply 1 quart of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre. Apply to fescue in the fall when actively growing and plants have 6 to 12 inches of new growth. Allow 7 or more days after application before tillage. A sequential application of 1 pint per acre of this product plus nonionic surfactant will improve long-term control and control seedlings germinating after fall treatments or the following spring.

Guineagrass—Apply 3 quarts of this product per acre or use a 1 percent solution with hand-held equipment. Apply to actively growing guineagrass when most has reached at least the 7-leaf stage of growth. Ensure thorough coverage when using hand-held equipment. Allow 7 or more days after application before tillage.

Johnsongrass/Ryegrass, perennial—Apply 1 to 3 quarts of this product per acre. In annual cropping systems apply 1 to 2 quarts of this product per acre. Apply 1 quart of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre. Use 2 quarts of this product when applying 10 to 40 gallons of water per acre. In noncrop or areas where annual tillage (no-till), is not performed, apply 2 to 3 quarts of this product in 10 to 40 gallons of water per acre. For best results, apply to actively growing plants when most have reached the boot-to-head stage of growth or in the fall prior to frost. Allow 7 or more days after application before tillage. Do not tank-mix with residual herbicides when using the 1 quart per acre rate.

For burndown of Johnsongrass, apply 1 pint per acre plus 0.5 to 1 percent nonionic surfactant in 3 to 10 gallons of water per acre before the plants reach a height of 12 inches. For this use, allow at least 3 days after treatment before tillage.

Spot Treatment (partial control or suppression)—Apply a 1 percent solution of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume when johnsongrass is 12 to 18 inches in height. Coverage should be uniform and complete.

Kikuyugrass—Apply 2 to 3 quarts of this product per acre. Spray when most kikuyugrass is at least 8 inches in height (3 or 4-leaf stage of growth) and actively growing. Allow 3 or more days after application before tillage.

Lantana—Apply this product as a 1 to 1¼ percent solution using hand-held equipment only. Apply to actively growing lantana at or beyond the bloom stage of growth. Use the higher application rate for plants that have reached the woody stage of growth. Allow 7 or more days after application before tillage.

Milkweed, common—Apply 3 quarts of this product per acre. Apply when actively growing and most of the milkweed has reached the late bud to flower stage of growth. Following small grain harvest or mowing, allow milkweed to regrow to a mature stage prior to treatment. Allow 7 or more days after application before tillage.

Muhly, wirestem—Apply 1 to 2 quarts of this product per acre. Use 1 quart of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre. Use 2 quarts of this product when applying 10 to 40 gallons of water per acre or in pasture, sod, or noncrop areas. Spray when the wirestem muhly is 8 inches or more in height and actively growing. Do not till between harvest and fall applications or in the fall or spring prior to spring applications. Allow 3 or more days after application before tillage. This product will not provide residual control of wirestem muhly from seeds which germinate after a Roundup herbicide application. Do not tank mix with residual herbicides when using the 1 quart per acre rate.

Nightshade, silverleaf—For control, apply 2 quarts of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre. Applications should be made when at least 60 percent of the plants have berries. Fall treatments must be applied before a killing frost. Allow 7 or more days after application before tillage. Do not treat when weed is under drought stress as good soil moisture is necessary for active growth.

Nutsedge: purple, yellow—Apply 3 quarts of this product per acre as a broadcast spray, or apply a 1 percent solution from hand-held equipment to control existing nutsedge plants and immature nutlets attached to treated plants. Treat when plants are in flower or when new nutlets can be found at rhizome tips. Nutlets which have not germinated will not be controlled and may germinate following treatment. Repeat treatments will be required for long-term control. Wait 7 days after treatment before tillage. Tillage will stimulate nutlet germination.

Apply 1 pint to 1 quart of this product per acre, plus 0.5 to 1 percent nonionic surfactant in 3 to 40 gallons of water per acre to provide suppression or partial control of existing nutsedge plants. Treat when plants have 3 to 5 leaves (less than 6 inches). Repeat treatments will be required to control subsequent emerging plants. Wait 7 days after treatment before tillage or mowing.

Pampas—Apply this product as a 1½ to 2 percent solution using hand-held equipment. Apply to plants that are actively growing at or beyond the boot stage of growth. Thorough coverage is necessary for best control.

Phragmites—For partial control of phragmites in Florida and the counties of other states bordering the Gulf of Mexico, apply 5 quarts per acre as a broadcast spray or apply a 2 percent solution from hand-held equipment. In other areas of the U.S., apply 3 quarts per acre as a broadcast spray or apply a 1 percent solution from hand-held equipment for partial control. For best results, treat during late summer or fall months or when plants are actively growing and in full bloom. Treatment before or after this stage may lead to reduced control. Due to the dense nature of the vegetation, which may prevent good spray coverage or uneven stages of growth, repeat treatments may be necessary to maintain control. Visual control symptom will be slow to develop.

Quackgrass—In Annual Cropping Systems, or in Pastures and Sods Followed by Deep Tillage: Apply 1 to 2 quarts of this product per acre. For the one quart rate, apply 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre. For the 2 quart rate, apply in 10 to 40 gallons of water per acre. Do not tank mix with residual herbicides when using the 1 quart rate. Spray when quackgrass is 8 to 12 inches in height and actively growing. Do not till between harvest and fall applications or in fall or spring prior to spring application. Allow 3 or more days after application before tillage. In pastures or sods, for best results use a moldboard plow.

Quackgrass—Pasture or Sod or Other Noncrop Areas Where Deep Tillage is Not Planned Following Application: Apply 2 to 3 quarts in 10 to 40 gallons of water per acre. Spray when the quackgrass is greater than 8 inches tall and actively growing. Do not till between harvest and fall application or in fall or spring prior to spring application. Allow 3 or more days after application before tillage.

Sweet Potato, wild—Apply this product as a 2 percent solution using hand-held equipment. Apply to actively growing weeds that are at or beyond the bloom stage of growth. Repeat applications will be required. Allow the plant to reach the recommended stage of growth before retreatment. Allow 7 or more days before tillage.

Thistle, Canada—Apply 2 to 3 quarts of this product per acre. Apply to actively growing thistles when most are at or beyond the bud stage of growth. After harvest, mowing or tillage in the late summer or fall, allow at least 4 weeks for initiation of active growth and rosette development prior to the application of this product. Fall treatments must be applied before a killing frost. Allow 3 or more days after application before tillage.

For suppression of Canada thistle, apply 1 quart per acre of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre in the late summer or fall after harvest, mowing or tillage. Allow rosette regrowth to a minimum of 6 inches in diameter before treating. Applications can be made as long as leaves are still green and plants are actively growing at the time of application. Allow 3 or more days after application before tillage.

Torpedograss—Apply 4 to 5 quarts of this product per acre to provide partial control of torpedograss. Apply to actively growing torpedograss when most plants are at or beyond the seedhead stage of growth. Repeat applications will be required to maintain control. Fall treatments must be applied before frost. Allow 7 or more days after application before tillage.

Other perennials listed on this label—Apply 3 to 5 quarts of this product per acre. Apply when actively growing and most have reached early head or early bud stage of growth. Allow 7 or more days after application before tillage.

TANK MIXTURES

When applied as directed, under the conditions described, Roundup plus Banvel or 2,4-D amine will suppress or control the following perennial broadleaf weed:

Bindweed, field
Convolvulus arvensis

For suppression, apply 16 ounces of this product plus 0.5 lb a.e. of 2,4-D amine or 0.25 lb a.i. of Banvel, plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre for ground applications and 3 to 5 gallons of water per acre for aerial applications. Applications should be delayed until maximum emergence has occurred and when vines are between 6 to 18 inches in length. These tank mixtures may be applied using aerial application equipment (except in California) in fallow and reduced tillage systems only.

For control, apply 2 quarts of this product plus 0.5 pound a.i. of Banvel in 10 to 20 gallons of water per acre. At these rates, apply using ground application equipment only.

Irrigated Agricultural Lands

Apply 1 to 2 quarts of this product plus 1 quart per acre of 2,4-D amine in 10 to 20 gallons of water per acre with ground equipment only for partial control (suppression) of field bindweed. Applications should be made following harvest or in fall fallow ground when the bindweed is actively growing and the majority of runners are 12 inches or more in length. The use of at least one irrigation will promote active bindweed growth.

Dogbane, hemp
Apocynum cannabium

For suppression, apply 16 ounces of this product plus 16 ounces of 2,4-D amine plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre for ground applications and 3 to 5 gallons of water per acre for aerial applications. Delay applications until maximum emergence of dogbane has occurred. For control, apply 4 quarts of this product in 3 to 20 gallons of water using ground application equipment only.

Smartweed, Swamp
Polygonum coccineum

For control, apply 16 ounces of this product plus 0.5 pounds active ingredient of 2,4-D amine plus 0.5 to 1 percent nonionic surfactant by total volume in 3 to 10 gallons of water per acre in the late summer or fall. Apply when plants are actively growing and most have reached the early bud stage of growth. Allow 7 or more day after application before tillage

Refer to the specific product labels for crop rotation restrictions and cautionary statements of all products in tank mixture.

WOODY BRUSH AND TREES

When applied as recommended under the conditions described, this product CONTROLS or PARTIALLY CONTROLS the following woody brush plants and trees

Alder
Alnus spp.

Ash*
Fraxinus spp.

Aspen, quaking
Populus tremuloides

Bearmat (Bearclover)
Chamaebatia foliolosa

Birch
Betula spp.

Blackberry
Rubus spp.

Broom:
French
Cytisus monspessulanus
Scotch
Cytisus scoparius

Buckwheat, California*
Eriogonum fasciculatum

Cascara*
Rhamnus purshiana

Catsclaw*
Acacia greggi

Ceanothus*
Ceanothus spp.

Chamise
Adenostoma fasciculatum

Cherry:
Bitter
Prunus emarginata
Black
Prunus serotina
Pin
Prunus pensylvanica

Coyote brush
Baccharis consanguinea

Creeper, Virginia*
Parthenocissus quinquefolia

Dewberry
Rubus trivialis

Elderberry
Sambucus spp.

Elm*
Ulmus spp.

Eucalyptus, Bluegum
Eucalyptus glotulus

Hasardia*
Haplopappus squamosus

Hawthorn
Crataegus spp.

Hazel
Corylus spp

Honeysuckle
Lonicera spp

Kudzu
Pueraria lobata

Locust, black*
Robinia pseudoacacia

Madrone
Arbutus menziesii

Manzanita
Arctostaphylos spp.

Maple:
Red**
Acer rubrum
Sugar
Acer saccharum
Vine*
Acer circinatum

Monkey Flower*
Mimulus guttatus

Oak:
Black*
Quercus velutina
Northern Pin
Quercus palustris
Post
Quercus stellata
Red
Quercus rubra
Southern Red
Quercus falcata
White*
Quercus alba

Persimmon*
Diospyros spp.

Poison Ivy
Rhus radicans

Poison Oak
Rhus toxicodendron

Poplar*, yellow
Liriodendron tulipifera

Raspberry
Rubus spp.

Rose, multiflora
Rosa multiflora

Sage, black
Salvia mellifera

Sagebrush, California
Artemisia californica

Salmonberry
Rubus spectabilis

Sassafras
Sassafras aibidum

Sourwood
Oxydendrum arboreum

Sumac:
Poison*
Rhus vernix
Smooth*
Rhus glabra
Winged*
Rhus copallina

Sweetgum
Liquidambar styraciflua

Swordfern*
Polystichum munitum

Tallowtree, Chinese
Sapium sebiferum

Tan Oak
Lithocarpus densiflorus

Thimbleberry
Rubus parviflorus

Tobacco, tree*
Nicotiana glauca

Trumpetcreeper
Campsis radicans

Willow
Salix spp.

*Partial control
**See below for control or partial control instructions.

NOTE: If brush has been mowed or tilled or trees have been cut, do not treat until regrowth has reached the recommended stages of growth.

Apply this product when plants are actively growing, and unless otherwise directed, after full leaf expansion. Use the higher rate for larger plants and/or dense areas of growth. On vines, use the higher rate for plants that have reached the woody stage of growth. Best results are obtained when application is made in late summer or fall after fruit formation.

In arid areas, best results are obtained when application is made in the spring to early summer when brush species are at high moisture content and are flowering.

Ensure thorough coverage when using hand-held equipment. Symptoms may not appear prior to frost or senescence with fall treatments.

Allow 7 or more days after application before tillage, mowing or removal. Repeat treatments may be necessary to control plants regenerating from underground parts or seed. Some autumn colors on undesirable deciduous species are acceptable provided no major leaf drop has occurred. Reduced performance may result if fall treatments are made following a frost.

See "Directions for Use", and "Mixing, Additives, and Application Instructions" sections of this label for labeled uses and specific application instructions.

Apply this product as follows to control or partially control the following woody brush and trees.

Alder/Dewberry/Honeysuckle/Post Oak/Raspberry—For control, apply 3 to 4 quarts per acre of this product as a broadcast spray or as a 1 to 1½ percent solution with hand-held equipment.

Aspen, quaking/Cherry: bitter, black, pin/Hawthorn /Oak, southern red/Sweetgum/Trumpetcreeper— For control, apply 2 to 3 quarts of this product per acre as a broadcast spray or as a 1 to 1½ percent solution with hand-held equipment.

Birch/Elderberry/Hazel/Salmonberry/ Thimbleberry—For control, apply 2 quarts per acre of this product as a broadcast spray or as a 1 percent solution with hand-held equipment.

Blackberry—For control, apply 3 to 4 quarts per acre of this product as a broadcast spray, or 1 to 1½ percent solution with hand-held equipment. Make application after plants have reached full leaf maturity. Best results are obtained when applications are made in late summer or fall. After berries have set or dropped in late fall, blackberry can be controlled by applying a 3/4 percent solution of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume with hand-held equipment. For control of blackberries after leaf drop and until killing frost or as long as stems are green, apply 3 to 4 quarts of this product in 10 to 40 gallons of water per acre.

Broom: French, Scotch—For control, apply a 1½ to 2 percent solution with hand-held equipment.

Buckwheat, California/Hasardia/Monkey Flower/ Tobacco, tree—For partial control of these species, apply a 1 to 2 percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Catsclaw—For partial control, apply as a 1 to 1½ percent solution with hand-held equipment.

Coyote Brush—For control, apply a 1½ to 2 percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Eucalyptus/Bluegum—For control of eucalyptus resprouts, apply a 2 percent solution of this product with hand-held equipment when resprouts are 6 to 12 feet tall. Ensure complete coverage. Apply when plants are growing actively. Avoid application to drought-stressed plants.

Kudzu—For control, apply 4 quarts of this product per acre as a broadcast spray or as a 2 percent solution with hand-held equipment. Repeat applications will be required to maintain control.

Maple, red**—For control, apply as a 1 to 1½ percent solution with hand-held equipment when at least 50 per-

cent of the new leaves are fully developed. For partial control, apply 2 to 4 quarts of this product per acre as a broadcast spray.

Maple, sugar/Oak, northern pin/Oak red—For control, apply as a 1 to 1½ percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Poison Ivy/Poison Oak—For control, apply 4 to 5 quarts of this product per acre as a broadcast spray or as a 2 percent solution with hand-held equipment. Repeat applications may be required to maintain control. Fall treatments must be applied before leaves lose green color.

Rose, multiflora—For control, apply 2 quarts of this product per acre as a broadcast spray or as a 1 percent solution with hand-held equipment. Treatments should be made prior to leaf deterioration by leaf-feeding insects.

Sage, black/Sagebrush, California/Chamise/Tallowtree, Chinese—For control of these species, apply a 1 percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Willow—For control, apply 3 quarts of this product per acre as a broadcast spray or as a 1 percent solution with hand-held equipment.

Other Woody Brush and Trees listed on this label—For partial control, apply 2 to 4 quarts of this product per acre as a broadcast spray or as a 1 to 2 percent solution with hand-held equipment.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in any manner inconsistent with its labeling.

Storage and Disposal

Do not contaminate water, foodstuffs, seed or feed by storage or disposal.

See container label for STORAGE AND DISPOSAL instructions.

NONCROP USES

See "General Information" and "Mixing, Additives and Application Instructions" sections of this label for essential product performance information and the following "Noncrop" sections for specific recommended uses.

EXTREME CARE MUST BE EXERCISED TO AVOID CONTACT OF SPRAY WITH FOLIAGE OF DESIRABLE TURFGRASSES, TREES, SHRUBS, OR OTHER DESIRABLE VEGETATION SINCE SEVERE DAMAGE OR DESTRUCTION MAY RESULT.

NOTE: If spraying areas adjacent to desirable plants, use a shield made of cardboard, sheet metal or plyboard while spraying to help prevent spray from contacting foliage of desirable plants.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seeds.

Roundup herbicide does not provide residual weed control. For subsequent weed control, follow a label-approved herbicide program.

Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used.

INDUSTRIAL, RECREATIONAL AND PUBLIC AREAS

When applied as directed for "Noncrop Uses", under conditions described, this product controls annual and perennial weeds listed on this label growing in areas such as airports, ditch banks, dry ditches, dry canals, fencerows, golf courses, highways, industrial plant sites, lumber yards, parking areas, parks, petroleum tank farms and pumping installations, pipelines, power and telephone rights-of-way, railroads, roadsides, schools, storage areas, other public areas and similar industrial or noncrop areas.

For specific rates of application and instructions for control of various annual and perennial weeds and woody brush and trees, see the "Weeds Controlled" section of this label.

This product may be applied with recirculating sprayers, shielded applicators, or wiper applicators in any noncrop site specified on this label. See the "Selective Equipment part of "Application Equipment and Techniques" section of this label for information on proper use and calibration of this equipment.

TANK MIXTURES FOR INDUSTRIAL SITES AND FORESTRY SITE PREPARATIONS

ROUNDUP® plus OUST™

Use on industrial sites including airports, industrial plants, lumberyards, petroleum tank farms, pumping stations, pipelines, railroads, roadsides, storage areas or other similar sites where bare ground is desired.

This tank mixture may also be used as a site preparation treatment for sites to be planted to jack pine, loblolly pine, red pine, slash pine and Virginia pine.

When applied as directed for "Noncrop Uses" under the conditions described, this product plus Oust provides control of annual weeds listed in the "Weeds Controlled" section of the label for this product and Oust, and control or partial control of the perennial weeds listed below.

Apply 1 to 2 quarts of this product with 2 to 4 ounces of Oust in 10 to 40 gallons of spray solution per acre as a broadcast spray to actively growing weeds.

This mixture may be applied by aerial equipment in site prep operations. When applied by air, use the recommended rates in 5 to 15 gallons of spray solution per acre.

For control of annual weeds, use the lower rates of these products.

For control of the listed perennial weeds, use the higher rates of both products. For partial control, use the lower rates.

Bahiagrass
Paspalum notatum

Bermudagrass*
Cynodon dactylon

Broomsedge
Andropogon virginicus

Dock, curly
Rumex crispus

Dogfennel
Eupatorium capilliforium

Johnsongrass**
Sorghum halepense

Poorjoe**
Diodia teres

Quackgrass
Agropyron repens

Trumpetcreeper*
Campsis radicans

Vaseygrass
Paspalum urvillei

Fescue, tall
Festuca arundinacea

Vervain, blue
Verbena hastata

*Suppression at the higher rates only.

**Control at the lower rates.

Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used.

™Oust is a trademark of E. I. du Pont de Nemours and Company.

TANK MIXTURES NONCROP SITES

When applied as a tank mixture, this product provides control of the emerged annual weeds and partial control of the emerged perennial weeds listed in this label. When applied as a tank mixture, the following residual herbicides will provide preemergence control of the weeds listed in the individual product labels.

- **ROUNDUP plus DIURON**
- **ROUNDUP® plus KROVAR™ I**
- **ROUNDUP plus KROVAR II**
- **ROUNDUP plus RONSTAR™ 50WP**
- **ROUNDUP plus SIMAZINE, CALIBER™ 90**
- **ROUNDUP plus SIMAZINE 4L**
- **ROUNDUP plus SIMAZINE 80W**
- **ROUNDUP plus SURFLAN™ 75W**
- **ROUNDUP plus SURFLAN AS**

When tank mixing with residual herbicides, add an agriculturally approved nonionic surfactant at 0.5 to 1 percent by volume of spray solution. See the "Mixing, Additives and Application Instructions" section of this label before preparing these tank mixtures.

Read and carefully observe the label claims, cautionary statements, recommended use rates and all other information on the labels of all products used in these tank mixtures. Use according to the most restrictive label directions for each product in the mixture.

CONTROL OF EMERGED WEEDS

Annual Weeds—Apply 1 quart per acre of this product in these tank mixtures when weeds are less than 6 inches tall and 1½ quarts per acre when weeds are more than 6 inches tall.

Perennial Weeds—For partial control of perennial weeds using these tank mixtures, apply 2 to 5 quarts per acre of this product. Follow the recommendations in the "Weeds Controlled" section of this label for stage of growth and rate of application for specific perennial weeds.

PREEMERGENCE WEED CONTROL

The following are the labeled rates for the recommended residual herbicides for noncrop uses:

PRODUCT	RATE/ACRE
Diuron, Karmex™ 50WP	2 to 8 lbs
Krovar I	4 to 6 lbs
Krovar II	2 to 5 lbs
Ronstar 50WP	4 to 8 lbs
Simazine, Caliber 90	5.3 to 11.1 lbs
Simazine 80W	6 to 12½ lbs
Simazine 4L	4.8 to 10 qts
Surflan 75W	2¾ to 5½ lbs
Surflan AS	2 to 4 qts

Refer to the individual product labels for specific noncrop sites, rates, carrier volumes and precautionary statements.

Mix only the quantity of spray solution which can be used during the same day. Do not allow these tank mixtures to stand overnight as this may result in reduced weed control.

APPLY THESE TANK MIXTURES THROUGH CONVENTIONAL BROADCAST EQUIPMENT ONLY.

TMCaliber is a trademark of Ciba-Geigy Corporation.
TMKarmex and TMKrovar are trademarks of E.I. du Pont de Nemours and Company.
TMRonstar is a trademark of Rhone-Poulenc, Inc.
TMSurflan is a trademark of Elanco Products Company.

FARMSTEAD WEED CONTROL

When applied as directed for "Noncrop Uses", under conditions described, this product controls undesirable vegetation listed on this label around farmstead building foundations, along and in fences, shelterbelts, and for general nonselective farmstead weed control.

For specific rates of application and instructions for control of various annual and perennial weeds, see the "Weeds Controlled" section of this label.

ORNAMENTALS

THIS PRODUCT IS NOT RECOMMENDED FOR USE AS AN OVER-THE-TOP BROADCAST SPRAY IN ORNAMENTALS.

When applied as directed for the conditions described for "Noncrop Uses", this product controls undesirable vegetation listed on this label prior to planting ornamentals, in established ornamentals, and within and around greenhouses and shadehouses.

For specific rates of application and instructions for control of various annual and perennial weeds, see the "Weeds Controlled" section of this label.

Where repeat applications are necessary, do not exceed 10.6 quarts of this product per acre per year.

Site Preparation—Following preplant applications of this product, any ornamental species may be planted. Precautions should be taken to protect nontarget plants during site preparation applications.

Greenhouse/Shadehouse Use—This product may be used to control weeds listed on this label which are growing in greenhouses. Desirable vegetation must not be present during application and air circulation fans must be turned off.

Postdirected Spray—Use as a directed spray toward the base of established woody ornamentals species listed below.

Arborvitae
Thuja spp.

Azalea
Rhododendron spp

Boxwood
Buxus spp.

Crabapple
Malus spp.

Euonymus
Euonymus spp.

Fir
Abies spp.
Pseudotsuga spp.

Hollies
Ilex spp.

Lilac
Syringa spp.

Magnolia
Magnolia spp.

Maple
Acer spp.

Oak
Quercus spp.

Privet
Ligustrum spp.

Pine
Pinus spp.

Spruce
Picea spp.

Yew
Taxus spp.

SILVICULTURAL SITES, RIGHTS-OF-WAY and CHRISTMAS TREES

NOTE: NOT RECOMMENDED FOR USE AS AN OVER-THE-TOP BROADCAST SPRAY IN SILVICULTURAL NURSERIES, OR CHRISTMAS TREE PLANTATIONS.

When applied as directed for "Noncrop Uses" under conditions described, this product controls undesirable vegetation listed on this label. This product also suppresses or controls undesirable vegetation listed on this label when applied at recommended rates for release of established coniferous species listed on this label.

For specific rates of application and instructions for control of various brush, annual and perennial weeds, see the "Weeds Controlled" section of this label. For specific rates of application for release of listed coniferous species, see the "Conifer Release" part of this section of the label.

Where repeat applications are necessary, do not exceed 10.6 quarts of this product per acre per year

Aerial Application—This product may be applied using aerial spray equipment for silvicultural site preparation, conifer release and rights-of-way treatments. See the "Application Equipment and Techniques" part of the "Mixing, Additives and Application Instruction" section of this label for information on how to properly spray this product by air.

DO NOT APPLY THIS PRODUCT BY AIR TO RIGHTS-OF-WAY SITES IN THE STATE OF CALIFORNIA.

In order to reduce the aerial application drift hazard to aquatic sites*, to nontarget sites, or any site containing desirable vegetation, always maintain appropriate buffer zones. A buffer zone of the following minimum distances should be maintained:

- Helicopters using a Microfoil™ boom, a Thru-Valve™ boom (TVB-45), or equivalent drift control systems, should maintain at least a 50-foot buffer zone.
- When using other aerial equipment:

1. Maintain at least a 75-foot buffer zone for applications using 2 quarts or less per acre of this product.
2. Maintain at least a 125-foot buffer zone for application using more than 2 quarts per acre of this product.
3. Maintain at least a 400-foot buffer zone for applications on rights-of-way when applied from 75 feet or more above ground level.

These distances should be increased if conditions favoring drift exist.

*Aquatic sites include all lakes, ponds, and streams used for significant domestic purposes or angling.

TMMicrofoil is a trademark of Union Carbide Agricultural Products, Inc.

TMThru-Valve is a trademark of Waldrum Specialties, Inc.

SITE PREPARATION

Following preplant applications of this product, any silvicultural species may be planted.

POSTDIRECTED SPRAY

In established silvicultural sites, use as a spray on the foliage of undesirable vegetation. Care must be exercised to avoid contact of spray, drift or mist with foliage or green bark of desirable species.

CONIFER RELEASE

For release, apply only where conifers have been established for more than one year. Vegetation should not be disturbed prior to treatment or until visual symptoms appear after treatment. Symptoms of treatment are slow to appear, especially in woody species treated in late fall. Injury may occur to conifers treated for release, especially where spray patterns overlap or the higher rates are applied or when applications are made during periods of active conifer growth. **Do not use additional surfactant with conifer release applications.**

Applications must be made after formation of final conifer resting buds in the fall or prior to initial bud swelling in spring. Some autumn colors on undesirable deciduous species are acceptable provided no major leaf drop has occurred. Use the following rates for conifer release to control or partially control the weeds listed in the "Weeds Controlled" section of this label.

For release of the following conifer species:

Douglas fir
Pseudotsuga menziesii

Fir
Abies spp.

Hemlock
Tsuga spp

Pines*
Pinus spp.

Spruce
Picea spp.

*Includes all species except eastern white pine, loblolly pine or slash pine.

Apply 1½ to 2 quarts of this product per acre except in Washington and Oregon, west of the crest of the Cascade Mountains. For spring treatments west of the crest of the Cascade Mountains, apply 1 quart of this product per acre before conifer bud swell for control of annual weeds. For fall treatments in Washington and Oregon, west of the crest of the Cascade Mountains, apply 1 to 1½ quarts of this product per acre before any major leaf drop of deciduous species.

For release of western hemlock apply 1 quart of this product per acre.

For release of the following conifer species:

Loblolly pine
Pinus taeda

Eastern white pine
Pinus strobus

Slash pine
Pinus elliottii

Late Season Application—Apply 1½ to 2 quarts of this product in a minimum of 5 gallons of spray solution per acre during early autumn. Applications made prior to September 1 or when conditions are conducive to rapid growth of conifers will result in potential for increased injury in the form of tip and/or needle burn. Injury may decrease with later applications. Some autumn colors are acceptable at time of application. Apply prior to frost or leaf drop of undesirable plants. Applications made according to label direction will release loblolly pine, eastern white pine and slash pine by reducing competition from the following species:

Ash
Fraxinus spp.

Cherry:
Black
Prunus serotina
Pin
Prunus pensylvanica

Persimmon
Diospyros spp.

Poplar, yellow
Liriodendron tulipifera

Sassafras
Sassafras albidum

Elm
Ulmus spp.

Hawthorn
Crataegus spp.

Locust, black
Robina pseudoacacia

Maple, red
Acer rubra

Oak:

Black
Quercus velutina

Post
Quercus stellata

Southern Red
Quercus falcata

White
Quercus alba

Sourwood
Oxydendrum arboreum

Sumac:

Poison
Rhus vernix

Smooth
Rhus glabra

Winged
Rhus copallina

Sweetgum
Liquidambar styraciflua

Apply only to those sites where woody brush and trees listed in this label constitute the majority of the undesirable species.

■ Roundup plus Oust Tank Mixtures for Conifer Release from Herbaceous Weeds ■

To release **loblolly pines** from herbaceous weeds, tank mixtures of this product with Oust will provide control of annual weeds listed in the "Weeds Controlled" section of this and the Oust label, and partial control of the perennial weeds listed below.

Apply 16 to 24 fluid ounces of Roundup with 2 to 4 ounces of Oust in 10 to 30 gallons of spray solution per acre. Make application to actively growing weeds as a broadcast spray over the top of the young loblolly pines.

This tank mixture may be applied using aerial equipment. When applying by air, use the recommended rate in 5 to 15 gallons of spray solution per acre.

For control of annual weeds below 12 inches in height (or runner length on annual vines) use the low rates of both products. Use the higher rates of both products when annual weeds are in more advanced stages of growth and approaching flower or seed formation.

Use the higher rates of both products for partial control of the following perennial weeds. Use the lower rates for suppression of growth.

Bahiagrass
Paspalum notatum

Broomsedge
Andropogon virginicus

Dock, curly
Rumex crispus

Dogfennel
Eupatorium capilliforium

Fescue, tall
Festuca arundinacea

Johnsongrass**
Sorghum halepense

Poorjoe**
Diodia teres

Trumpetcreeper*
Campsis radicans

Vaseygrass
Paspalum urvillei

Vervain, blue
Verbena hastata

*Suppression at the higher rates only.

**Control at the higher rates.

Pine damage may occur or can be accentuated if treatment takes place when young trees are under stress from drought, flood water, insects or disease.

Read and observe the cautionary statements and all other information appearing on the label of all herbicides used.

NOTE TO USER

This product must not be used in areas where adverse impact on Federally designated endangered/threatened plant or aquatic species is likely.

Prior to making applications, the user of this product must determine that no such species are located in or immediately adjacent to the area to be treated.

■ CUT STUMP TREATMENTS ■

Woody vegetation may be controlled by treating freshly cut stumps of trees and resprouts with this product. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut vegetation close to the soil surface. Apply a 50 to 100 percent solution of this product to the freshly cut surface immediately after cutting. Delays in application may result in reduced performance. For best results, applications should be made during periods of active growth and full leaf expansion.

When used according to directions for cut stump application, this product will CONTROL, PARTIALLY CONTROL or SUPPRESS many types of woody brush and tree species, some of which are listed below:

Alder
Alnus spp.

Eucalyptus/Bluegum
Eucalyptus glotulus

Madrone
Arbutus menziesii

Oak
Quercus spp.

Reed, giant
Arundo donax

Saltcedar
Tamarisk spp.

Sweetgum
Liquidambar styraciflua

Tan Oak
Lithocarpus densiflorus

Willow
Salix spp.

■ INJECTION AND FRILL APPLICATIONS ■

Woody vegetation may be controlled by injection or frill application of this product. Apply this product using suitable equipment which must penetrate into the living tissue. Apply the equivalent of 1 ml of this product per each 2 to 3 inches of trunk diameter. This is best achieved by applying 50 to 100 percent concentration of this material either to a continuous frill around the tree or as cuts evenly spaced around the tree below all branches. As tree diameter increases in size, better results are achieved by applying diluted material to a continuous frill or more closely spaced cuttings. Avoid application techniques that allow runoff to occur from frill or cut areas in species that exude sap freely after frills or cutting. In species such as this, make frill or cut at an oblique angle so as to produce a cupping effect and use undiluted material. For best results, application should be made during periods of active growth and after full leaf expansion.

This treatment WILL CONTROL the following woody species:

Oak
Quercus spp.

Poplar
Populus spp.

Sweetgum
Liquidambar styraciflua

Sycamore
Platanus occidentalis

This treatment WILL SUPPRESS the following woody species:

Black gum
Nyssa sylvatica

Dogwood
Cornus spp.

Hickory
Carya spp.

Maple, red
Acer rubrum

TURFGRASSES AND GRASSES FOR SEED PRODUCTION

■ PREPLANT AND RENOVATION ■

When applied as directed for "Noncrop Uses", under conditions described, this product controls most existing vegetation prior to the planting or renovation of either turfgrasses or grass seed production areas.

For specific rates of application and instructions for control of various annual and perennial weeds, and woody brush and trees, see the "Weeds Controlled" section of this label.

For maximum control of existing vegetation, delay planting to determine if any regrowth from escaped underground plant parts occurs. Where repeat treatments are necessary, sufficient regrowth must be attained prior to application. For warm-season grasses, such as bermudagrass, summer or fall application provide best control.

DO NOT DISTURB SOIL OR UNDERGROUND PLANT PARTS BEFORE TREATMENT. Tillage or renovation techniques such as vertical mowing, coring or slicing should be delayed for 7 days after application to allow proper translocation into underground plant parts.

TURFGRASSES

Where existing vegetation is growing in a field or unmowed situation, apply this product to actively growing weeds at the stages of growth given in the "Weeds Controlled" section of this label.

Where existing vegetation is growing under mowed turfgrass management, apply this product after omitting at least one regular mowing to allow sufficient growth for good interception of the spray.

Desirable turfgrasses may be planted following the above procedures.

GRASSES FOR SEED PRODUCTION

Apply this product to actively growing weeds at the stages of growth given in the "Weeds Controlled" section of this label prior to planting or renovation of turf or forage grass areas grown for seed production.

DO NOT feed or graze treated areas within 8 weeks after application.

■ ANNUAL WEED CONTROL IN DORMANT BERMUDAGRASS AND BAHIAGRASS TURF ■

When applied as directed for "Noncrop Uses", this product will provide control or suppression of many winter annual weeds and tall fescue for effective release of dormant bermudagrass and bahiagrass turf. Refer to the rate table for Roundup alone under the "Release of Bermudagrass or Bahiagrass" section of this label for recommended rates and volumes on the species to be suppressed or controlled. Treat only when turf is dormant and prior to spring greenup. Spot treatments or broadcast applications of the product in excess of 16 ounces per acre may result in injury or delayed greenup in highly maintained turfgrass areas; i.e., golf courses, lawns, etc.

DO NOT APPLY TANK MIXTURES of Roundup plus Oust in highly maintained turfgrass areas.

RELEASE OF BERMUDAGRASS OR BAHIAGRASS

NOTE: Use only in areas where bermudagrass or bahiagrass are desirable ground covers and where some temporary injury or discoloration can be tolerated. Use Roundup plus Oust tank-mixtures only on railroads, highways, utility plant sites, or other right-of-way areas.

When applied as directed for "Noncrop Uses", this product will provide control or suppression of many winter annual weeds and tall fescue for effective release of dormant bermudagrass or bahiagrass. This product may be tank-mixed with Oust as recommended for residual control. Make applications to dormant bermudagrass or bahiagrass. Roundup plus Oust tank mixture may delay greenup. **To avoid delays in greenup and minimize injury, do not add more than 1 ounce per acre of Oust on bermudagrass or more than ½ ounce per acre on bahiagrass, or treat when these grasses are in a semi-dormant condition.**

For best results on winter annuals, treat when plants are in an early growth stage (below 6 inches in height) after most have germinated. For best results on tall fescue, treat when fescue is in or beyond the 4 to 6-leaf stage.

WEEDS CONTROLLED

Rate recommendations for control or suppression of winter annuals and tall fescue are listed below:

Apply the recommended rates of this product alone or as a tank mixture in 10 to 25 gallons of water, plus 0.5 to 1 percent nonionic surfactant by total spray volume per acre.

For the best recommendation for the mixture of weeds within your geographic areas, contact your Monsanto sales representative.

WEEDS CONTROLLED OR SUPPRESSED WITH ROUNDUP® ALONE*

NOTE C = Control
S = Supression

	ROUNDUP® OZ/ACRE					
WEED SPECIES	8	12	16	24	32	64
Barley, little *Hordeum pusilium*	S	C	C	C	C	C
Bedstraw, catchweed *Galium aparine*	S	C	C	C	C	C
Bluegrass, annual *Poa annua*	S	C	C	C	C	C
Chervil *Chaerophyllum tainturieri*	S	C	C	C	C	C
Chickweed, common *Stellaria media*	S	C	C	C	C	C
Clover, crimson *Trifolium incarnatum*	•	S	S	C	C	C
Clover, large hop *Trifolium campestre*	•	S	S	C	C	C
Fescue, tall *Festuca arundinaceae*	•	•	•	•	S	S
Geranium, Carolina *Geranium carolinianum*	•	•	S	S	C	C
Henbit *Lamium amplexicaule*	•	S	C	C	C	C
Ryegrass Italian *Lolium multiflorum*	•	•	S	C	C	C
Speedwell, corn *Veronica arvensis*	S	C	C	C	C	C
Vetch, common *Vicia sativa*	•	•	S	C	C	C

*These rates apply only to sites where an established competitive turf is present

WEEDS CONTROLLED OR SUPPRESSED WITH ROUNDUP® PLUS OUST*

NOTE: C = Control
S = Suppression

		ROUNDUP® + OUST (OZ/ACRE)						
	ROUNDUP	8	12	12	16	16	12	16
WEED SPECIES	+ OUST	+ ¼	+ ¼	+ ½	+ ¼	+ ½	+ 1	+ 1
Barley, little *Hordeum pusilium*		C	C	C	C	C	C	C
Bedstraw, catchweed *Galium aparine*		C	C	C	C	C	C	C
Bluegrass, annual *Poa annua*		S	C	C	C	C	C	C
Chervil *Chaerophyllum tainturieri*		C	C	C	C	C	C	C
Chickweed, common *Stellaria media*		S	C	C	C	C	C	C
Clover, crimson *Trifolium incarnatum*		S	S	S	S	C	C	C
Clover, large hop *Trifolium campestre*		•	•	S	S	S	C	C
Fescue, tall *Festuca arundinaceae*		•	•	•	•	•	S	S
Geranium, Carolina *Geranium carolinianum*		•	S	S	C	C	C	C
Henbit *Lamium amplexicaule*		•	S	C	C	C	C	C
Ryegrass, Italian *Lolium multiflorum*		•	S	S	C	C	C	C
Speedwell, corn *Veronica arvensis*		S	C	C	C	C	C	C
Vetch, common *Vicia sativa*		C	C	C	C	C	C	C

*These rates or mixtures of rates apply only to sites where an established competitive turf is present.

RELEASE OF ACTIVELY GROWING BERMUDAGRASS

When applied as directed, this product will aid in the release of bermudagrass by providing control of annual species listed in the "Weeds Controlled" section of this and the Oust label, and suppression or partial control of certain perennial weeds.

For control or suppression of those annual species listed on this label, use 1 to 3 pints of this product as a broadcast spray in 10 to 25 gallons of spray solution per acre. Use the lower rate when treating annual weeds below 6 inches in height (or length of runner in annual vines). Use higher rate as size of plants increases or as they approach flower or seedhead formation.

Use the higher rate of this product for partial control of the following perennial species. Use the lower rates for suppression of growth. For best results, see the "Weeds Controlled" section of this label for proper stage of growth.

Bahiagrass *Paspalum notatum*
Bluestem, silver *Andropogon saccharoides*
Fescue, tall *Festuca arundinacea*
Johnsongrass** *Sorghum halepense*
Trumpetcreeper* *Campsis radicans*
Vaseygrass *Paspalum urvillei*

*Suppression at higher rates only.

**Control at the higher rates

This product may be tank-mixed with Oust. If tank-mixed, use no more than 1 to 2 pints per acre of Roundup herbicide with 1 to 2 ounces of Oust per acre.

Use the lower rates of both mixtures to control annual weeds below 6 inches in height (or runner length in annual vines) that are listed in the "Weeds Controlled" section of this booklet and the Oust label. Use the higher rates as annual weeds increase in size and approach the flower or seedhead stages

Use the higher rates of this product to provide partial control of the following perennial weeds. Use the lower rates for suppression of growth.

Bahiagrass *Paspalum notatum*
Bluestem, silver *Andropogon saccharoides*
Broomsedge *Andropogon virginicus*
Dock, curly *Rumex crispus*
Dogfennel *Eupatorium capilliforium*
Fescue, tall *Festuca arundinacea*
Johnsongrass* *Sorghum halepense*
Poorjoe** *Diodia teres*
Trumpetcreeper* *Campsis radicans*
Vaseygrass *Paspalum urvillei*
Vervain, blue *Verbena hastata*

*Suppression at higher rates only.

**Control at the higher rates

Use only on well-established bermudagrass. Bermudagrass injury may result from the treatment but regrowth will occur under moist conditions. Repeat applications in the same season are not recommended, since severe injury may result.

Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used

BAHIAGRASS SEEDHEAD AND VEGETATIVE SUPPRESSION

When applied as directed in the indicated noncrop areas (roadsides, airports, golf course roughs, and plant sites) this product will provide significant inhibition of seedhead emergence and will suppress vegetative growth for a period of approximately 45 days with single applications and approximately 120 days with sequential applications.

Apply Roundup herbicide 1 to 2 weeks after full greenup of bahiagrass or after the bahiagrass has been mowed to a uniform height of 3 to 4 inches. Applications must be made prior to seedhead emergence. Apply 6 fluid ounces per acre of this product plus 0.5 to 1 percent non-

ionic surfactant by total spray volume in 10 to 25 gallons of water per acre.

Sequential applications of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume may be made at approximately 45 day intervals to extend the period of seedhead and vegetative growth suppression. For continued seedhead suppression, sequential applications must be made prior to seedhead emergence. Apply no more than 2 sequential applications per year. As a first sequential application, apply 4 fluid ounces of this product per acre plus nonionic surfactant. A second sequential application of 2 to 4 fluid ounces per acre plus nonionic surfactant may be made approximately 45 days after the last application.

A tank mixture of Roundup plus Oust **may be applied only on roadsides** for seedhead inhibition and vegetative suppression. Apply 6 fluid ounces per acre of this product plus 0.25 ounce per acre of Oust, plus 0.5 to 1 percent nonionic surfactant by total spray volume 1 to 2 weeks following an initial spring mowing. When using Roundup plus Oust for suppression of bahiagrass, make only one application per year.

CROPPING SYSTEMS

See "General Information" and "Mixing, Additives and Application Instructions" sections of this label for essential product performance information.

See the following "Cropping Systems" sections for specific recommended uses.

EXTREME CARE MUST BE EXERCISED TO AVOID CONTACT OF SPRAY WITH FOLIAGE, GREEN STEMS OR FRUIT OF DESIRABLE CROPS, PLANTS, TREES OR OTHER DESIRABLE VEGETATION SINCE SEVERE DAMAGE OR DESTRUCTION MAY RESULT.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seed. Except as otherwise specified on this label, repeat treatments must be made before the crop emerges in accordance with the instructions of this label.

Except as otherwise specified in a crop section of this label, the combined total of all treatments must not exceed 8 quarts per acre of this product per year.

Do not plant subsequent crops other than those on the label for 30 days following application.

For other cropping systems, except following spot treatment in forage grasses and legumes, do not harvest or feed treated crops for 8 weeks after application. Allow 14 days following spot treatment or selective equipment use before grazing domestic livestock or harvesting forage grasses and legumes.

When applied as directed for "Cropping Systems", under the conditions described, this product controls annual and perennial weeds listed on this label, prior to the emergence of direct seeded crops or prior to transplanting of crops listed on this label.

ALFALFA*
ARTICHOKE, JERUSALEM
ASPARAGUS*
BARLEY*
BEANS (All)
BEET GREENS
BEETS (Red, Sugar)
BLACKBERRY
BLUEBERRY
BOYSENBERRY
BROCCOLI
CABBAGE
CARROT
CAULIFLOWER
CELERY
CHICORY
CORN (All)*
COTTON*
CRANBERRY
CUCUMBER***
CURRANT
DEWBERRY
EGGPLANT***
ELDERBERRY
FORAGE GRASSES*
FORAGE LEGUMES*
GARLIC***
GOOSEBERRY
GOURDS***
HORSERADISH
HUCKLEBERRY
KALE
LENTILS
LETTUCE
LOGANBERRY
MELONS***
MUSTARD GREENS
OATS*
OKRA
OLALLIEBERRY
ONION
PEANUTS
PEAS (All)
PEPPER***
PINEAPPLE****
POTATO (Irish, Sweet)
PUMPKIN***
RADISH
RASPBERRY (Black, Red)
RICE**
RUTABAGA
SORGHUM (Milo)
SOYBEANS*
SPINACH
SQUASH*** **(Summer, Winter)**
TOMATILO***
TOMATOES***†**
TURNIPS
WATERMELON***
WATERCRESS***
WHEAT*

*Spot treatments may be applied in these crops.

**Do not treat rice fields or levees when the fields contain flood water.

***Apply only prior to planting. Allow at least 3 days between application and planting.

****Do not feed or graze treated pineapple forage following application.

† Use is restricted to direct seeded crops only.

Spot Treatment (Only those crops with "*" can be spot treated.)—Applications in growing crops must be made prior to heading of small grains and milo, initial pod set in soybeans, silking of corn, boll opening on cotton.

For forage grasses and forage legumes see "Spot Treatment" in the "Pastures" section of "Cropping Systems" in this label.

For dilution and rates of application using boom or handheld equipment, see "Mixing, Additives and Application Instructions" and "Weeds Controlled" sections of this label.

NOTE: FOR FORAGE GRASSES AND FORAGE LEGUMES, NO MORE THAN ONE-TENTH OF ANY ACRE SHOULD BE TREATED AT ONE TIME. FOR ALL OTHER CROPS, DO NOT TREAT MORE THAN 10 PERCENT OF THE TOTAL FIELD AREA TO BE HARVESTED.

THE CROP RECEIVING SPRAY IN TREATED AREA WILL BE KILLED. TAKE CARE TO AVOID DRIFT OR SPRAY OUTSIDE TARGET AREA FOR THE SAME REASON.

Selective Equipment—This product may be applied through recirculating sprayers, shielded applicators, or wiper applicators in cotton and soybeans. Shielded and wiper applicators may also be used in tree crops and grapes. Wiper applicators may be used in rutabagas, forage grasses and forage legumes, including pasture sites and sorghum milo.

See the "Selective Equipment" part of the "Application Equipment and Techniques" section of this label for information on proper use and calibration of this equipment.

Allow at least the following time intervals between application and harvest:

Cotton, Soybeans	7 days
Apples, Avocado, Cherry, Citrus, Grapes, Pear, Rutabagas	14 days
Stone Fruit	17 days
Nut Crops	21 days
Sorghum (milo)*	40 days

*Do not use roller applicators. Do not feed or graze treated milo fodder. Do not ensile treated vegetation.

ASPARAGUS

When applied as directed for "Cropping Systems" under the conditions described, this product controls weeds listed on this label in asparagus.

For specific rates of applications and instructions for control of various annual and perennial weeds, see the "Weeds Controlled" section of this label.

Prior to Crop Emergence—Apply this product prior to crop emergence for the control of emerged labeled annual and perennial weeds. DO NOT APPLY WITHIN A WEEK BEFORE THE FIRST SPEARS EMERGE.

Spot Treatment—Apply this product immediately after cutting, but prior to the emergence of new spears. Do not treat more than 10 percent of the total field area to be harvested. Do not harvest within 5 days of treatment.

Postharvest—Apply this product after the last harvest and all spears have been removed. If spears are allowed to regrow, delay application until ferns have developed. Delayed treatments should be applied as directed or shielded spray in order to avoid contact of the spray with ferns, stems or spears. Direct contact of the spray with the asparagus may result in serious crop injury.

NOTE: Select and use recommended types of spray equipment for postemergence postharvest applications. A directed spray is any application where the spray pattern is aligned in such a way as to avoid direct contact of the spray with the crop. A shielded spray is any application where a physical barrier is positioned and maintained between the spray and the crop to prevent contact of spray with the crop.

BERRIES AND SMALL FRUITS

For cranberries, apply after fruit set and no later than 30 days before harvest.

For other berries, apply as a preplant broadcast application, or as a directed spray or wiper application postplanting.

Wiper applicators may be used in cranberries in accordance with instructions in this section.

See "General Information" and "Mixing, Additives and Application Instructions" sections of this label for essential product performance information.

See the "Selective Equipment" part of the "Application Equipment and Techniques" section of this label for information on recommended use and calibration of this equipment.

For Wick or other Wiper Applicators—Mix 1 gallon of this product in 4 gallons of water to prepare a 20 percent solution. Apply the solution to emerged weeds. Apply after cranberry fruit set and no later than 30 days before harvest.

In severe infestations, reduce equipment ground speed to insure that adequate amounts of this product are wiped on the weeds. A second treatment in the opposite direction may be beneficial.

Do not permit herbicide solution to contact desirable vegetation, including green shoots, canes, or foliage.

FALLOW AND REDUCED TILLAGE SYSTEMS

FOR AERIAL APPLICATION IN CALIFORNIA, REFER TO SUPPLEMENTAL LABEL.

Use this product in fallow and reduced tillage systems for control of annual weeds prior to emergence of crops listed in this label. Refer to the "Weeds Controlled" section of this label for specific rates and instructions. This product may be applied using ground or aerial spray equipment. See the "Application Equipment and Techniques" section of this label for instructions.

TANK MIXTURES

- **ROUNDUP® plus BANVEL plus NONIONIC SURFACTANT**
- **ROUNDUP plus 2,4-D AMINE plus NONIONIC SURFACTANT**
- **ROUNDUP plus GLEAN™ plus NONIONIC SURFACTANT**
- **ROUNDUP plus GOAL™ plus NONIONIC SURFACTANT**

DO NOT APPLY BANVEL, GLEAN, OR 2,4-D AMINE TANK MIXTURES BY AIR IN CALIFORNIA.

The additions of Banvel in a mixture with this product may provide short-term residual control of selected weed species. Some crop injury may occur if Banvel is applied within 45 days of planting. Refer to the Banvel and 2,4-D labels for cropping restrictions and other use instructions.

The Roundup plus Glean plus nonionic surfactant tank mixture provides postemergence control and soil residual control of labeled annual weeds in fallow and reduced tillage areas to be planted only to wheat.

Use ⅓ to ½ ounce of Glean with the recommended rates of Roundup and nonionic surfactant as instructed in the "Low-Volume Broadcast Application" section of this label booklet. Refer to the Glean label for planting, cropping and other restrictions. Follow all precautionary statements on this and the Glean label.

Roundup® plus Goal Tank Mixtures

This product alone or in tank mixtures with Goal plus 0.5 to 1 percent nonionic surfactant by total spray volume will provide control of those weeds listed below.

Make applications when weeds are actively growing and at the recommended stages of growth. Avoid spraying when weeds are subject to moisture stress, when dust is on the foliage or when straw canopy covers the weeds.

ROUNDUP® 12 oz/acre		ROUNDUP 16 oz/acre	
Wheat	18"*	Annual grasses at	
Barley	12"	left plus:	
Bluegrass, annual	6"	Ryegrass, annual	6"
Barnyardgrass	6"	Chickweed	6"
Rye	6"	Groundsel	6"
		Marestail	6"
		Rocket, London	6"
		Shepherdspurse	6"
		Crabgrass	12"
		Johnsongrass, seedling	12"
		Lambsquarters	12"
		Oats, wild	12"
		Pigweed, redroot	12"
		Mustards	12"

ROUNDUP 12 oz/acre + GOAL** 2 to 4 oz/acre		ROUNDUP 16 oz/acre + GOAL** 2 to 4 oz/acre	
Annual grasses above plus:		Annual weeds above plus	
Cheeseweed, common	3"	Cheeseweed, common	6"
Chickweed	3"	Groundsel	6"
Groundsel	3"	Chickweed	12"
Rocket, London	6"	Rocket, London	12"
Shepherdspurse	6"	Shepherdspurse	12"

*Maximum height or length in inches.

**Use the higher rate when weeds approach maximum recommended height or stands are dense.

These recommended tank mixtures may be applied using ground or aerial spray equipment. Refer to the "Weeds Controlled" section of this label for specific rates and instructions.

™Glean is a trademark of E. I. du Pont de Nemours and Company.
™Goal is a trademark of Rohm and Haas Company

AID TO TILLAGE

This product, when used in conjunction with preplant tillage practices, will provide control of downy brome, cheat, volunteer wheat, tansy mustard and foxtail. Apply 8 fluid ounces of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre. Make applications when weeds are actively growing and before they are 6 inches in height. Application must be followed by conventional tillage practices no later than 15 days after treatment and before regrowth occurs. Allow at least 1 day after application before tillage. Tank mixtures with residual herbicides may result in reduced performance.

PASTURES

Apply this product prior to planting forage grasses and legumes.

Pasture or Hay Crop Renovation—When applied as a broadcast spray this product controls the annual and perennial weeds listed in this label prior to planting forage grasses or legumes. Remove domestic livestock before application and wait 8 weeks after application before grazing or harvesting.

Spot Treatment—When applied as a spot treatment as recommended, this product controls annual and perennial weeds listed in this label which are growing in pastures, forage grasses and forage legumes composed of bahiagrass, bermudagrass, bluegrass, brome, fescue, orchardgrass, ryegrass, timothy, wheatgrass, alfalfa or clover.

Wiper Application—When applied as directed this product controls or suppresses the weeds listed under "Wiper Applicators" in the "Selective Equipment" section of this label. For spot treatment and wiper application, apply in areas where the movement of domestic livestock can be controlled. No more than one-tenth of any acre should be treated at one time. Further applications may be made in the same area at 30 day intervals. Remove domestic livestock before application and wait 14 days after application before grazing livestock or harvesting.

SUGARCANE

When applied as directed for "Cropping Systems", under the condition described, this product controls those emerged annual and perennial weeds listed on this label growing in or around sugarcane or in fields to be planted to sugarcane. This product will also control undesirable sugarcane.

NOTE: Where repeat treatments are necessary, do not exceed a total of 10.6 quarts of this product per acre per year. Do not apply to vegetation in or around ditches, canals or ponds containing water to be used for irrigation.

Broadcast Treatment—Apply this product in 10 to 40 gallons of water per acre on emerged weeds growing in fields to be planted to sugarcane.

For specific rates of application and instructions for control of various annual and perennial weeds, see the "Weeds Controlled" section of this label.

For removal of last stubble or ratoon cane, apply 4 to 5 quarts of this product in 10 to 40 gallons of water per acre to new growth having at least 7 or more new leaves. Allow 7 or more days after application before tillage.

Spot Treatment in or Around Sugarcane Fields—For dilution and rates of application using hand-held equipment, see "Mixing, Additives and Application Instructions" and "Weeds Controlled" sections of this label.

For control of volunteer or diseased sugarcane, make a 1 percent solution of this product in water and spray to wet the foliage of vegetation to be controlled.

NOTE: When spraying volunteer or diseased sugarcane, the plants should have at least 7 new leaves.

Avoid spray contact with healthy cane plants since severe damage or destruction may result.

Do not feed or graze treated sugarcane forage following application.

MINIMUM TILLAGE SYSTEMS
Tank Mixtures
CORN AND SOYBEANS

When applied as recommended under the conditions described, these tank mixtures control many emerged weeds, and give preemergence control of many annual weeds when corn or soybeans will be planted directly into a cover crop, established sod, or in previous crop residues.

Refer to specific product labels for crop rotation restrictions and cautionary statements of all products used in these tank mixtures. For mixing instructions, see the "Mixing, Additives and Application Instructions" section of this label.

CORN

- **ROUNDUP® plus LASSO®**
- **ROUNDUP plus LASSO plus ATRAZINE**
- **ROUNDUP plus LASSO plus BLADEX™**
- **ROUNDUP plus LASSO plus SIMAZINE**
- **ROUNDUP plus ATRAZINE plus SIMAZINE**

SOYBEANS

- **ROUNDUP® plus LASSO®**
- **ROUNDUP plus LASSO plus LINURON**
- **ROUNDUP plus LASSO plus LEXONE™**
- **ROUNDUP plus LASSO plus SENCOR™**

Apply these tank mixtures in 10 to 40 gallons of water per acre after planting or during planting in such manner that the planter does not disturb the treated soil. Do not apply these mixtures after crop emergence.

REDUCED CONTROL MAY RESULT IF THIS PRODUCT IS USED IN TANK MIXTURES CONTAINING FLUID FERTILIZERS.

CONTROL OF EMERGED WEEDS

Annual Weeds—Apply to actively growing grasses and broadleaf weeds. Use 1 quart of Roundup herbicide per acre in these tank mixtures if weeds are less than 6 inches tall. If weeds are over 6 inches tall, apply 1.5 quarts of this product per acre. For emerged annual weeds controlled, see the "Weeds Controlled" section of this label.

Perennial Weeds—At normal application rates in minimum tillage systems, perennial weeds may not be at the proper stage of growth for control. See the "General Information" section of this label for the proper stage of growth for perennial weeds.

Use of 2 to 4 quarts of Roundup herbicide per acre in these tank mixtures, under these conditions provides top kill and reduces competition from many emerged perennial grass and broadleaf weeds. For emerged perennial weeds controlled, see the "Weeds Controlled" section of this label.

To obtain the desired stage of growth, it may be necessary to apply Roundup herbicide alone in the late summer or fall and then follow with a label-approved, seedling weed control program at planting.

NOTE: When using these tank mixtures, do not exceed 4 quarts of Roundup herbicide per acre.

USE OF THESE TANK MIXTURES FOR BERMUDAGRASS OR JOHNSONGRASS CONTROL IN MINIMUM TILLAGE SYSTEMS IS NOT RECOMMENDED. For bermudagrass control, follow the instructions under "Control of Perennial Weeds" section of this label and then use a label-approved, seedling weed-control program in a minimum tillage or conventional tillage system. For Johnsongrass control, follow the instructions under "Control of Perennial Weeds" section of the label, and then use a label-approved seedling weed-control program with conventional tillage.

The following are labeled ranges for the recommended preemergence herbicides:

PRODUCT	RATES/ACRE (QUARTS)	RATES/ACRE (POUNDS)
Lasso	2 to 4	•
Atrazine 4L	1 to 2	•
Atrazine 80WP	•	1.25 to 2.3
Atrazine 90DF	•	1.1 to 2
Bladex 4L	1 to 2.2	•
Bladex 80WP	•	1.25 to 2.75
Simazine 4L	1 to 2.2	•
Simazine 80WP	•	1.25 to 2.75
Linuron 4L	0.5 to 1.5	•
Linuron 50WP	•	1 to 3
Lexone 4L or Sencor 4F	0.25 to 0.75	•
Lexone or Sencor 50 WP	•	0.5 to 1.55
Lexone or Sencor 75DF	•	0.33 to 1

Read and carefully observe the label claims, cautionary statements, rates and all other information on the labels of all products. Use according to the most restrictive label directions for each product in the mixture.

® Lasso is a registered trademark of Monsanto Company.

TM Bladex and TM Lexone are trademarks of E. I. du Pont de Nemours and Company.

TM Sencor is a trademark of the parent company of Farbenfabriken Bayer GmbH, Leverkusen.

PREHARVEST APPLICATIONS

When applied as directed under the conditions described, this product controls annual and perennial weeds listed on this label prior to the harvest of COTTON.

Weed Control—For specific rates of application and instructions for control of various annual and perennial weeds, see the "Weeds Controlled" section of this label.

Broadcast Applications—This product may be applied using either aerial or ground spray equipment. For ground applications with broadcast equipment, apply this product in 10 to 40 gallons of water per acre. For aerial applications, apply this product in 3 to 15 gallons of water per acre.

To control Johnsongrass using multiple nozzle-directed spray equipment, apply 1 quart of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 10 to 20 gallons of water per acre. Ensure complete coverage.

For partial control of field bindweed, apply one quart of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 40 gallons of water per acre. Apply when bindweed is actively growing and 12 inches or greater in length. Reduced performance may result if bindweed is under drought stress.

Tank Mixtures

Roundup® plus Def™ 6
Roundup plus Folex™

When applied as recommended under the conditions described, these tank mixtures control annual and perennial weeds listed on this label prior to the harvest of cotton. For application guidelines, precautions and defoliant rates, refer to the supplemental label for cotton harvest aid.

Timing of Application—Apply this product or these tank mixtures for preharvest weed control after 60 percent of the cotton bolls have opened.

NOTE: DO NOT APPLY TO CROPS GROWN FOR SEED. Allow a minimum of 7 days between application and harvest.

Do not feed or graze treated cottonseed forage or hay following preharvest applications.

TM Def is a trademark of Mobay Chemical Corporation.

TM Folex is a trademark of Rhone-Poulenc, Inc.

TREE AND VINE CROPS

This product is recommended for weed control in established groves, vineyards, or orchards, or for site preparation prior to transplanting crops listed in this section. Applications may be made with boom equipment, CDA, shielded sprayers, hand-held and high-volume wands, lances, or orchard guns, or with wiper applicator equipment, except as directed in this section. See the "Application Equipment and Techniques" section of this label for specific information on use of equipment.

When applying Roundup alone, refer to the "Weeds Controlled" section for recommended rates to be used.

NOTE

Repeat treatments may be necessary to control weeds originating from underground parts of untreated weeds or from seeds. This product does not provide residual weed control. For subsequent weed control, follow a program using residual herbicides or use repeated applications of this product. Do not apply more than 10.6 quarts of this product per acre per year.

EXTREME CARE MUST BE EXERCISED TO AVOID CONTACT OF HERBICIDE SOLUTION, SPRAY, DRIFT, OR MIST WITH FOLIAGE OR GREEN BARK OF TRUNK, BRANCHES, SUCKERS, FRUIT, OR OTHER PARTS OF TREES OR VINES. CONTACT OF THIS PRODUCT WITH OTHER THAN MATURED BROWN BARK CAN RESULT IN SERIOUS CROP DAMAGE.

AVOID PAINTING OUT STUMPS WITH THIS PRODUCT AS INJURY RESULTING FROM ROOT GRAFTING MAY OCCUR IN ADJACENT TREES.

Reduced control may result when applications are made to annual or perennial weeds that have been mowed, grazed or cut and have not been allowed to regrow to the recommended stage for treatment.

For specific rates of applications and instructions, see the "Weeds Controlled" section of this label.

TANK MIXTURES TREE AND VINE CROPS

When applied as a tank mixture, this product provides control of the emerged annual weeds and partial control of the emerged perennial weeds listed in this label. The following residual herbicides will provide preemergence control of those weeds listed in the individual product labels.

- **ROUNDUP® plus GOAL™ 1.6E**
- **ROUNDUP plus KARMEX™ WP**
- **ROUNDUP plus KROVAR™ I**
- **ROUNDUP plus KROVAR™ II**
- **ROUNDUP plus SIMAZINE, CALIBER™ 90**
- **ROUNDUP plus SIMAZINE 4L**
- **ROUNDUP plus SIMAZINE 80W**
- **ROUNDUP plus SOLICAM™ 80WP**
- **ROUNDUP plus SURFLAN™ AS**
- **ROUNDUP plus SURFLAN 75W**
- **ROUNDUP plus SIMAZINE (80W, or 4L, or CALIBER 90) plus SURFLAN (AS or 75W)**
- **ROUNDUP plus GOAL (1.6E) plus SURFLAN (AS or 75W)**
- **ROUNDUP plus GOAL (1.6E) plus SIMAZINE (80W, or 4L, or CALIBER 90)***
- **ROUNDUP plus GOAL (1.6E) plus SURFLAN (AS or 75W) plus simazine (80W, 4L, or Caliber 90)**

*See the Roundup plus Goal plus simazine tank mixture section below for specific use instructions.

When tank-mixing with residual herbicides, add an agriculturally approved nonionic surfactant.

Do not apply these tank mixtures in Puerto Rico.

CONTROL OF EMERGED WEEDS

Annual Weeds—Apply 1 quart per acre of this product in these tank mixtures, when weeds are less than 12 inches tall. For weeds greater than 12 inches tall, apply 1.5 quarts per acre.

Perennial Weeds—For partial control of perennial weeds using these tank mixtures, apply 2 to 5 quarts per acre of this product. Follow the recommendations in the "Weeds Controlled" section of this label for stage of growth and rate of application for specific perennial weeds.

PREEMERGENCE WEED CONTROL

The following are the labeled rates for the recommended residual herbicides:

PRODUCT	RATE/ACRE
Goal 1.6E	1.25 to 5 qts.
Karmex WP	2 to 8 lbs.
Krovar I	2 to 8 lbs.
Krovar II	2 to 8 lbs.
Simazine, Caliber 90	1.1 to 10.6 lbs.
Simazine, 80W	1¼ to 12 lbs
Simazine 4L	2 to 9.6 qts.
Solicam 80WP	2½ to 5 lbs.
Surflan AS	2 to 4 qts.
Surflan 75W	2⅔ to 5⅓ lbs

NOTE: These residual herbicides may provide postemergence activity on certain annual weed species.

Refer to the individual product labels for specific crops, rates, geographical restrictions and precautionary statements.

Read and carefully observe the label claims, cautionary statements, rates and all other information on the labels of all products.

For specific rates of application and instructions see the "Weeds Controlled" section of this label.

■ ROUNDUP® Plus GOAL ■

Roundup alone and Roundup plus Goal tank mixtures will control or suppress annual weeds listed below

Apply the recommended rates of Roundup or Roundup plus Goal tank mixtures plus 0.5 to 1 percent nonionic surfactant by spray volume in 3 to 10 gallons of water per acre. Apply when weeds are actively growing and less than 6 inches in height. If weeds are under drought stress, irrigate prior to application

RECOMMENDED RATES AND WEEDS CONTROLLED

C = Control S = Suppression

WEEDS	Roundup rate (fl oz/acre)			Roundup + Goal (fl oz/acre)
SPECIES	8	12	16	16 + 4 to 16
Bluegrass, annual	C	C	C	C
Barley	C	C	C	C
Cheeseweed, common (3")	S	S	S	C
Rocket, London	S	S	C	C
Shepherdspurse	S	S	C	C
Chickweed	S	C	C	C
Fleabane, flaxleaf	S	C	C	C
Red Maids	S	C	C	C
Barnyardgrass	S	C	C	C
Cheeseweed, common (3-6")	S	S	S	C
Crabgrass	S	S	C	C
Groundsel, common	S	S	C	C
Junglerice	S	S	C	C
Lambsquarters	S	S	C	C
Marestail	S	S	C	C
Pigweed, redroot	S	S	C	C
Ryegrass, common	S	S	C	C
Sowthistle, annual	S	S	C	C
Purslane, common	S	S	C	C
Nettle, stinging	S	S	C	C
Filaree	S	S	S	S

■ ROUNDUP® plus GOAL plus SIMAZINE ■

(California only)

Roundup may be tank-mixed with Goal plus simazine for broad-spectrum postemergence and preemergence control. Refer to the following table for approved crops and rate ranges for each product in this tank mix. Refer to the individual product labels for weeds controlled, geographical restrictions, precautionary statements and specific use rates.

	RATE RANGES*		
CROP	ROUNDUP® (quarts)	+ GOAL 1.6E (quarts)	+ SIMAZINE 80W** (pounds)
Grapes	1 to 1.5	1.25 to 5	2.5 to 5
Almond	1 to 1.5	1.25 to 5	1.25 to 2.5

Use equivalent rate of Caliber 90 or simazine 4L.

*Rate dependent on weeds present.

**Rate dependent on soil type and weeds present.

ROUNDUP® plus GOAL plus SIMAZINE/SURFLAN

This product plus Goal, applied alone or as a three-way or four-way with simazine and/or Surflan, will provide postemergence control of those weeds listed below when applied as recommended.

Refer to individual product labels for preemergence rates, weeds controlled, precautionary statements and other important information.

Apply these tank mixtures in 3 to 40 gallons of water. Add 0.5 to 1 percent nonionic surfactant by total spray volume to the spray solution.

WEEDS CONTROLLED

Weed Species	Maximum Height (inches)	Roundup® + Goal (quarts/acre)
Barley, wild	4	0.5 to 1 + 0.5 to 5
Bluegrass, annual	4	0.5 to 1 + 0.5 to 5
Cheeseweed, common	4	0.5 to 1 + 0.5 to 5
Chickweed, common	4	0.5 to 1 + 0.5 to 5
Flaxleaf, fleabane	4	0.5 to 1 + 0.5 to 5
Groundsel, common	4	0.5 to 1 + 0.5 to 5
Marestail	4	0.5 to 1 + 0.5 to 5
Pineappleweed	4	0.5 to 1 + 0.5 to 5
Rocket, London	4	0.5 to 1 + 0.5 to 5
Shepherdspurse	4	0.5 to 1 + 0.5 to 5
Sowsthistle, annual	4	0.5 to 1 + 0.5 to 5
Cheeseweed, common	12	1 to 1.5 + 1 to 5
Nettle, stinging	12	1 to 1.5 + 1 to 5
Filaree	12	1 to 1.5 + 1 to 5

TMGoal is a trademark of Rohm and Haas Company

TMSolicam is a trademark of Sandoz, Inc.

■ PERENNIAL GRASS SUPPRESSION ORCHARD FLOORS ■

When applied as directed this product will suppress vegetative growth as indicated below.

Bahiagrass

This product will provide significant inhibition of seedhead emergence and will suppress vegetative growth for a period of approximately 45 days with a single application and approximately 120 days with sequential applications. Apply this product 1 to 2 weeks after full green-up or after mowing to a uniform height of 3 to 4 inches. Applications must be made prior to seedhead emergence. Apply 6 fluid ounces of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 10 to 25 gallons of water per acre.

Sequential applications of this product plus nonionic surfactant may be made at approximately 45-day intervals to extend the period of seedhead and vegetative growth suppression. For continued seedhead suppression, sequential applications must be made prior to seedhead emergence. Apply no more than 2 sequential applications per years. As a first sequential application, apply 4 fluid ounces of this product plus nonionic surfactant. A second sequential application of 2 to 4 fluid ounces may be made approximately 45 days after the last application.

Bermudagrass

For burndown, apply 1 to 2 quarts of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 20 gallons of water per acre. Use 1 quart of this product in 3 to 20 gallons of water per acre east of the Rocky Mountains. Use 1 to 2 quarts of this product in 3 to 10 gallons of water per acre west of the Rocky Mountains. Use this treatment only if reduction of the bermudagrass stand can be tolerated. When burndown is required prior to harvest, allow at least 21 days to ensure sufficient time for burndown to occur.

Suppression only (east of the Rocky Mountains)—Apply 6 to 16 fluid ounces plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 20 gallons of water per acre no sooner than 1 to 2 weeks after full green-up. Mowing prior to application may occur provided a minimum height of 3 inches is maintained. Rates of 6 to 10 fluid ounces plus nonionic surfactant should be used in shaded conditions or where a lesser degree of suppression is desired. Sequential applications may be made when regrowth occurs and bermudagrass injury and stand reduction can be tolerated.

Suppression only (west of the Rocky Mountains)—Apply 16 fluid ounces of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 10 gallons of water per acre up to 6 inches in height and no sooner than 1 to 2 weeks after full green-up. Mowing prior to application may occur provided a minimum height of 3 inches is maintained. Sequential applications may be made when regrowth occurs and bermudagrass injury and stand reduction can be tolerated.

Cool Season Grass Covers

For suppression of tall fescue, fine fescue, orchardgrass and quackgrass, apply 8 fluid ounces of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 10 to 20 gallons of water per acre. For best suppression, add ammonium sulfate to the spray solution at a rate of 2 percent by weight or 17 pounds per 100 gallons of spray solution.

For suppression of Kentucky bluegrass covers, apply 6 fluid ounces of this product plus nonionic surfactant. Do not add ammonium sulfate.

For best results, mow cool-season grass covers in the spring to even their height and apply the recommended rate of this product 3 to 4 days after mowing. Avoid treating cool season grass covers under poor growing conditions, such as drought stress (drip irrigation), disease or insect damage.

LOW VOLUME APPLICATION (FLORIDA AND TEXAS)

For burndown or control of listed perennial weeds, apply the recommended rates of this product plus 0.5 to 1 percent nonionic surfactant by total spray volume in 3 to 20 gallons of water per acre. Where weed foliage is dense, use 10 to 20 gallons of water per acre.

Apply when weeds are actively growing and at the growth stages listed in the "Perennial Weeds Controlled" section of this label. If perennial weeds are mowed, allow weeds to regrow to the recommended stage of growth.

S = Suppression B = Burndown
PC = Partial control C = Control

WEED SPECIES	ROUNDUP RATE PER ACRE 1 qt	2 qts	3 qts	5 qts
Bermudagrass	B	•	PC	C
Guineagrass				
Texas and Florida Ridge	B	C	C	C
Florida Flatwoods	•	B	C	C
Paragrass	B	C	C	C
Torpedograss	S	•	PC	C

TREE CROPS

Citrus*: citron, grapefruit, kumquat, lemon, lime, orange, tangelo, tangerine.

Nuts**: almond, filbert, macadamia, pecan, pistachio, walnut.

Pome Fruit*: apple, pear.

Stone Fruit***: apricots, cherries, nectarines, olives, peaches, plums/prunes.

For cherries, any application equipment listed in this section may be used in all states.

For citron and olives, apply as a directed spray only.

Any application equipment listed in this section may be used in apricots, nectarines, peaches, and plums/prunes growing in Arizona, California, Colorado, Idaho, Kansas, Kentucky, New Jersey, North Dakota, Oklahoma, Oregon, Texas, Utah, and Washington, except for peaches grown in the states specified in the following paragraph. In all other states use wiper equipment only.

For PEACHES grown in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee only, apply with a shielded boom sprayer or shielded wiper applicator which prevents any contact of this product with the foliage or bark of trees. Apply no later than 90 days after first bloom. Applications made after this time may result in severe damage.

Remove suckers and low hanging limbs at least 10 days prior to application. Avoid applications near trees with recent pruning wounds or other mechanical injury. Apply only near trees which have been planted in the orchard for 2 or more years. EXTREME CARE MUST BE TAKEN TO ENSURE NO PART OF THE PEACH TREE IS CONTACTED.

Tropical Fruit: acerola, avocado*, banana (plantains), coffee****, figs*, guava, mango*, papaya, tea. Allow minimum of 1 day between last application and harvest of guava and papaya. In coffee and banana, delay applications 3 months after transplanting to allow the new coffee or banana plant to become established.

NOTE:

*Allow a minimum of 14 days between last application and harvest.

**Allow a minimum of 21 days between last application and harvest of these crops.

***Allow a minimum of 17 days between last application and harvest.

****Allow a minimum of 28 days between last application and harvest.

VINE CROPS

Kiwi Fruit*

Grapes:* Any variety of table, wine, or raisin grape may be treated with any equipment listed in this section.

In the northeast and Great Lakes regions, applications must be made prior to the end of bloom stage of grapes to avoid injury.

*Applications should not be made when green shoots, canes, or foliage are in the spray zone.

*Allow a minimum of 14 days between last application and harvest.

CALIFORNIA

Roundup® herbicide has been approved by the U.S. Environmental Protection Agency for the uses, crops and sites listed in this label and by California under label designation 1988-1. Approval of the items listed below is pending under the State of California registration requirements. With the exception of these items, this booklet contains the material approved by California in label 1988-1.

These use conditions, crops and sites may not be treated with this product in California until approval is received:

- Aerial application of Roundup plus Oust at the rate of 5 to 15 gallons of spray solution per acre for conifer release.
- Prior to planting or transplanting of strawberries.

EPA Reg. No. 524-308-AA

897 10-004.80/CG

This product has been approved for use in California except as stated otherwise on page 118.

In case of an emergency involving this product. Call Collect, day or night, (314) 694-4000.

MONSANTO COMPANY
AGRICULTURAL PRODUCTS
ST. LOUIS, MISSOURI 63167 U.S.A.

Monsanto

ARSENAL

(IMAZAPYR)

SEPTEMBER 1988

ARSENAL®

herbicide

ACTIVE INGREDIENT:	
Isopropylamine salt of Imazapyr (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridinecarboxylic acid)*	27.6%
INERT INGREDIENT	72.4%
TOTAL	100.0%

*Equivalent to 22.6% 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridinecarboxylic acid or 2 pounds acid per gallon.

EPA Reg. No. 241-273

KEEP OUT OF REACH OF CHILDREN
CAUTION!

See next page for Additional Precautionary Statements

PRECAUCION

PRECAUCION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta le haya sido explicado ampliamente.

In case of emergency endangering life or property involving this product, call collect, day or night, Area Code 201-835-3100.

*Registered Trademark of American Cyanamid Company

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS
CAUTION!

Avoid contact with skin, eyes or clothing. Avoid breathing spray mist. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

FIRST AID

IF ON SKIN: Wash with plenty of soap and water.

IF IN EYES: Flush with plenty of water. Get medical attention if irritation persists.

PHYSICAL AND CHEMICAL HAZARDS

Spray solutions of ARSENAL should be mixed, stored and applied only in stainless steel, fiberglass, plastic and plastic-lined steel containers.

DO NOT mix, store or apply ARSENAL or spray solutions of ARSENAL in unlined steel (except stainless steel) containers or spray tanks.

ENVIRONMENTAL HAZARDS

DO NOT apply directly to water or wetlands. **DO NOT** contaminate water when disposing of equipment washwaters.

IMPORTANT

DO NOT use on food or feed crops. **DO NOT** treat irrigation ditches. Keep from contact with fertilizers, insecticides, fungicides and seeds. **DO NOT** apply or drain or flush equipment on or near desirable trees or other plants, or on areas where their roots may extend, or in locations where the chemical may be washed or moved into contact with their roots. **DO NOT** use on lawns, walks, driveways, tennis courts, or similar areas. **DO NOT** side trim desirable vegetation with this product. Prevent drift of spray to desirable plants. **DO NOT USE** in California.

Clean application equipment after using this product by thoroughly flushing with water.

GENERAL INFORMATION

ARSENAL herbicide is an aqueous solution to be mixed in water and applied as a spray for control of most annual and perennial grasses and broadleaf weeds on noncropland areas.

ARSENAL may be applied either preemergence or postemergence to the weeds; however, postemergence application is the method of choice in most situations, particularly for control of perennials. For maximum activity, weeds should be growing vigorously at the time of postemergence applications. The preemergence activity of ARSENAL will provide residual control of most weed species following a postemergence application.

ARSENAL is readily absorbed through foliage and roots and is translocated rapidly throughout the plant, with accumulation in the meristematic regions. Treated plants stop growing soon after spray application. Chlorosis appears first in the newest leaves, and necrosis spreads from this point. In perennials, the herbicide is translocated into and kills underground storage organs, thus preventing regrowth. Chlorosis and tissue necrosis may not be apparent in some plant species until two weeks after application. Complete kill of plants may not occur for several weeks.

DISCLAIMER

The label instructions for the use of this product reflect the opinion of experts based on field use and tests. The directions are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks inherently associated with use of this product. Ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the use or application of the product contrary to label instructions, all of which are beyond the control of American Cyanamid Company. All such risks shall be assumed by the user.

American Cyanamid Company warrants only that the material contained herein conforms to the chemical description on the label and is reasonably fit for the use therein described when used in accordance with the directions for use, subject to the risks referred to above.

Any damages arising from a breach of this warranty shall be limited to direct damages and shall not include consequential commercial damages such as loss of profits or values or any other special or indirect damages.

American Cyanamid Company makes no other express or implied warranty, including other express or implied warranty of FITNESS or of MERCHANTABILITY.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

ARSENAL herbicide should be used only in accordance with recommendations on the leaflet label attached to the container. Keep containers closed to avoid spills and contamination.

A postemergence use of ARSENAL is recommended for control of most annual and perennial grasses and broadleaf weeds on noncropland areas such as railroad, utility, highway and pipeline rights-of-way, utility plant sites, petroleum tank farms, pumping installations, fence rows, storage areas, nonirrigation ditch banks, and other similar areas. ARSENAL is recommended for the establishment and maintenance of wildlife openings. ARSENAL may also be used for the release of improved bermudagrass (see specific labeling).

STORAGE AND DISPOSAL

PROHIBITIONS: DO NOT store below 10°F. DO NOT contaminate water, food or feed by storage or disposal.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in an approved sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

FOR CONTROL OF UNDESIRABLE WEEDS IN UNIMPROVED BERMUDAGRASS

For use on unimproved bermudagrass turf such as roadsides, utility rights-of-way and other non-cropland industrial sites. The application of ARSENAL on established Common and Coastal Bermudagrass provides control of labeled broadleaf and grass weeds. Competition from these weeds is eliminated, releasing the bermudagrass. Treatment of bermudagrass with ARSENAL results in a compacted growth habit and seedhead inhibition.

Uniformly apply with properly calibrated ground equipment using at least 20 gallons of water per acre with a spray pressure 20 to 50 psi.

DOSAGE RATES AND TIMING

EARLY SPRING—DORMANT: Apply ARSENAL at 6 to 12

fluid oz. per acre when the bermudagrass is still dormant and has not initiated new growth.

SPRING—UP TO 25% GREEN-UP: Apply ARSENAL at 6 to 8 fluid oz. per acre after the bermudagrass has initiated green-up but has not exceeded 25% green-up.

WEEDS CONTROLLED

Bedstraw *(Galium* spp.*)*
Bishopweed *(Ptilimnium capillaceum)*
Buttercup *(Ranunculos parviflorus)*
Carolina geranium *(Geranium carolinianum)*
Fescue *(Festuca* spp.*)*
Foxtail *(Setaria* spp.*)*
Little barley *(Hordeum pusillum)*
Seedling Johnsongrass *(Sorghum halepense)*
Wild carrot *(Daucus carota)*
White clover *(Trifolium repens)*
Yellow woodsorrel *(Oxalis stricta)*

1. DO NOT APPLY to bermudagrass during its first growing season.
2. DO NOT APPLY to bermudagrass that is under stress from drought, disease, insects, or other causes.
3. Temporary yellowing of bermudagrass may occur when treatment is made after growth commences.
4. DO NOT add a surfactant.

APPLICATION EQUIPMENT AND TECHNIQUES

ARSENAL herbicide may be applied with the following application equipment:

Aerial—fixed wing and helicopter.

Boom—conventional boom mounted, manifold mounted, and off-center nozzles.

Low-volume hand-held spray equipment-backpack, knapsack and other pump-up type pressure sprayers and backpack mist blowers used to direct application to weed foliage.

High-volume spray equipment - pressure handguns and vehicle mounted high- volume directed spray equipment.

AERIAL EQUIPMENT

Uniformly apply the recommended amount of ARSENAL with properly calibrated aerial equipment in 5 to 30 gallons of water per acre. All precautions should be taken to minimize or eliminate spray drift. Aerial equipment designed to minimize spray drift, such as a helicopter equipped with a MICROFOIL boom, THRU-VALVE boom or raindrop nozzles, must be used. Applications should not be made under gusty conditions or when wind velocity exceeds 5 mph. Except when applying with a MICROFOIL boom, a drift control agent may be added at the recommended label rate. A foam reducing agent may be added at the recommended label rate, if needed.

IMPORTANT: DO NOT make applications by fixed wing aircraft unless appropriate buffer zones can be maintained to insure that drift does not occur off the target area. Thoroughly clean application equipment, including landing gear, immediately after use. Prolonged exposure of this product to uncoated steel (except stainless steel) surfaces may result in corrosion and failure of the exposed part.

BOOM EQUIPMENT

Mix the recommended amount of ARSENAL in 15 to 60 gallons of water per acre in the spray tank with the agitator running. A foam reducing agent may be added at the recommended label rate, if needed, If desired, a spray pattern indicator may be added at the recommended label rate. Check for even distribution in spray pattern.

IMPORTANT: To minimize drift, select proper nozzles to avoid spraying a fine mist, DO NOT exceed spray pressure of 50 psi, and DO NOT spray under windy or gusty conditions.

Clean application equipment after using this product by thoroughly flushing with water.

LOW-VOLUME HAND-HELD SPRAY EQUIPMENT

Thoroughly mix a ½ to 1 percent solution of ARSENAL in water. To determine the proper percent solution of ARSENAL to use, see the "WEEDS CONTROLLED" section of this label and the "PERCENT SOLUTION RATE GUIDE" below.

PERCENT SOLUTION RATE GUIDE

ARSENAL RATE PER ACRE	PERCENT SOLUTION TO MIX
1–3 pints	½%
3–4 pints	¾%
4–6 pints	1%

For best results, uniformly cover the foliage of the vegetation to be controlled with the spray solution.

DO NOT over apply and cause runoff from the treated foliage.

To mix the spray solution, add the volume of ARSENAL indicated in the table below to the desired amount of water.

SPRAY SOLUTION MIXING GUIDE

SOLUTION VOLUME	AMOUNT OF ARSENAL TO USE (fluid ounces)		
	½%	¾%	1%
1 gallon	⅔ fl. oz.	1 fl. oz.	1⅓ fl. oz.
5 gallons	3⅓ fl. oz.	5 fl. oz.	6½ fl. oz.
10 gallons	6⅔ fl. oz.	10 fl. oz.	13 fl. oz.
25 gallons	1 pint	1½ pints	2 pints

2 tablespoons = 1 fluid ounce

It is not necessary to add additional surfactants or wetting agents.

IMPORTANT: DO NOT exceed recommended dosage rate per acre. DO NOT side-trim desirable vegetation with this product. Clean application equipment after using this product by thoroughly flushing with water.

HIGH-VOLUME SPRAY EQUIPMENT

ARSENAL may be applied using high-volume spray equipment. For best results, apply ARSENAL using the least amount of water practical to obtain uniform coverage of the vegetation foliage. Using excessive spray volumes which cause runoff from the plant foliage may result in reduced performance.

When using spray volumes greater than 60 gallons per acre, additional nonionic surfactant such as Ortho* 1 X-77 must then be added at the rate of 1 quart per 100 gallons of spray solution to provide optimum wetting and/or contact activity. A foam reducing agent may be added at the recommended label rate, if needed. If desired, a spray pattern indicator may be added at the recommended label rate.

To mix the spray solution, determine the proper ARSENAL pints per acre rate from the "WEEDS CONTROLLED" section of this label and mix according to the table below.

SPRAY SOLUTION MIXING GUIDE

SPRAY VOLUME (GAL/ACRE)	PINTS ARSENAL TO MIX PER 100 GALLONS WATER			
	3 PTS/ACRE	4 PTS/ACRE	5 PTS/ACRE	6 PTS/ACRE
50	6	8	10	12
100	3	4	5	6
150	2	2¾	3¼	4

IMPORTANT: DO NOT side-trim desirable vegetation with this product. Clean application equipment after using this product by thoroughly flushing with water.

*Registered trademark of Chevron Chemical Company.

FOR CONTROL OF UNDESIRABLE WEEDS UNDER PAVED SURFACES

ARSENAL herbicide can be used under asphalt, pond liners and other paved areas, ONLY in industrial sites or where the pavement has a suitable barrier along the permimeter that prevents encroachment of roots of desirable plants.

ARSENAL should be used only where the area to be treated has been prepared according to good construction practices. If rhizomes, stolons, tubers or other vegetative plant parts are present in the site, they should be removed by scalping with a grader blade to a depth sufficient to insure their complete removal.

Application Directions:

Applications should be made to the soil surface only when final grade is established. Do not move soil following ARSENAL application.

Uniformly apply ARSENAL to the area to be surfaced, including the shoulder areas at a rate of 6 pts. per acre.

Apply ARSENAL in sufficient water (at least 100 gal. per acre) to insure thorough wetting of the soil surface. Add the recommended amount of ARSENAL to clean water in the spray tank during the filling operation. Agitate before spraying.

For Herbicide Activation:

On Moist Subsoils: Apply ARSENAL after final grading and immediately before laying asphalt or liner surface. Apply uniformly, using at least 100 gallons of water per acre.

If Moisture Is Not Present: Incorporation of ARSENAL is needed for herbicide activation. ARSENAL can be incorporated into the soil to a depth of 4 to 6 inches using a rototiller or disc. Rainfall or irrigation of 1 inch will also provide uniform incorporation. Do not allow treated soil to wash or move into untreated areas.

IMPORTANT

Paving should follow ARSENAL applications as soon as possible. DO NOT apply where the chemical may contact the roots of desirable trees or other plants.

The product is not recommended for use under pavement on residential properties such as driveways or parking lots, nor is it recommended for use in recreational areas such as under bike or jogging paths, golf cart paths, or tennis courts, or where landscape plantings could be anticipated.

Injury or death of desirable plants may result if this product is applied where roots are present or where they may extend into the treated area. Roots of trees and shrubs may extend a considerable distance beyond the branch extremities or so called drip line.

WEEDS CONTROLLED

ARSENAL herbicide will provide postemergence control with residual control of the following target vegetation species at the rates listed. ARSENAL herbicide should be used only in accordance with the recommendation on this label and the leaflet label.

GRASSES

Apply 2-3 pints per acre*

Annual bluegrass *(Poa annua)*
Broadleaf signalgrass *(Brachiaria platphylla)*
Canada bluegrass *(Poa compressa)*
Downy brome *(Bromus tectorum)*
Fescue *(Festuca* spp.*)*
Foxtail *(Setaria* spp.*)*
Italian ryegrass *(Lolium multiflorum)*
Johnsongrass *(Sorghum halepense)*
Kentucky bluegrass *(Poa pratensis)*
Lovegrass *(Eragrostis* spp.*)*
Orchardgrass *(Dactylis glomerata)*
Paragrass *(Brachiaria mutica)*
Quackgrass *(Agropyron repens)*
Saltgrass *(Distichlis stricta)*
Sandbur *(Cenchrus* spp.*)*
Smooth brome *(Bromus inermis)*
Vaseygrass *(Paspalum urvillei)*
Wild oats *(Avena fatua)*
Witchgrass *(Panicum capillare)*

Apply 3-4 pints per acre*

Beardgrass *(Andropogon* spp.*)*
Cheat *(Bromus secalinus)*
Crabgrass *(Digitaria* spp.*)*
Fall panicum *(Panicum dichotomiflorum)*
Goosegrass *(Eleusine indica)*
Prairie threeawn *(Aristida oligantha)*
Reed canary grass *(Phalaris arundinacea)*
Torpedograss *(Panicum repens)*
Wild barley *(Hordeum* spp.*)*

Apply 4-6 pints per acre*

Bahiagrass *(Paspalum notatum)*
Bermudagrass *(Cynodon dactylon)*
Big bluestem *(Andropogon geradi)*
Cattail *(Typha* spp.*)*
Dallisgrass *(Paspalum dilatatum)*
Feathertop *(Pennisetum villosum)*
Guineagrass *(Panicum maximum)*
Phragmites *(Phragmites australis)*
Prairie cordgrass *(Spartina pectinata)*
Sand dropseed *(Sporobolus cryptandrus)*
Timothy *(Phleum pratense)*
Wirestem muhly *(Muhlenbergia frondosa)*

BROADLEAF WEEDS

Apply 2-3 pints per acre*

Burdock *(Arctium* spp.)
Camphorweed *(Heterotheca subaxillaris)*
Carpetweed *(Mullugo verticillata)*
Carolina geranium *(Geranium carolinianum)*
Clover *(Trifolium* spp.)
Common chickweed *(Stellaria media)*
Common ragweed *(Ambrosia artemisiifolia)*
Dandelion *(Taraxacum officinale)*
Dogfennel *(Eupatorium capillifolium)*
Filaree *(Erodium* spp.)
Fleabane *(Erigeron* spp.)
Hoary vervain *(Verbena stricta)*
Horseweed *(Conyza canadensis)*
Indian mustard *(Brassica juncea)*
Kochia *(Kochia scoparia)*
Lambsquarters *(Chenopodium album)*
Lespedeza *(Lespedeza* spp.)
Miners lettuce *(Montia perfoliata)*
Mullein *(Verbascum* spp.)
Nettleleaf goosefoot *(Chenopodium murale)*
Oxeye daisy *(Chrysanthemum leucanthemum)*
Pepperweed *(Lepidium* spp.)
Pigweed *(Amaranthus* spp.)
Plantain *(Plantago* spp.)
Russian thistle *(Salsola kali)*
Smartweed *(Polygonum* spp.)
Sorrell *(Rumex* spp.)
Sunflower *(Helianthus* spp.)
Sweet clover *(Melilotus* spp.)
Tansymustard *(Descurainia pinnata)*
Western ragweed *(Ambrosia psilostachya)*
Wild carrot *(Daucus carota)*
Wild lettuce *(Lactuca* spp.)
Wild parsnip *(Pastinaca sativa)*
Wild turnip *(Brassica campestris)*
Woollyleaf bursage *(Ambrosia grayi)*
Yellow woodsorrel *(Oxalis stricta)*

BROADLEAF WEEDS *(Continued)*

Apply 3-4 pints per acre*

Bull thistle *(Circium volgare)*
Cocklebur *(Xanthium strumarium)*
Dock *(Rumex* spp.)
Goldenrod *(Solidago* spp.)
Pokeweed *(Phytolacca americana)*
Purslane *(Portulaca* spp.)
Saltbush *(Atriplex* spp.)
Yellow starthistle *(Centaurea solstitialis)*

Apply 4-6 pints per acre*

Arrowwood *(Pluchea sericea)*
Canada thistle *(Circium arvense)*
Giant ragweed *(Ambrosia trifida)*
Little mallow *(Malva parviflora)*
Milkweed *(Asclepias* spp.)
Primrose *(Oenothera kunthiana)*
Silverleaf nightshade *(Solanum elaeagnifolium)*
Sowthistle *(Sonchus* spp.)
Texas thistle *(Circium texanum)*

VINES AND BRAMBLES

Apply 1 pint per acre

Field bindweed *(Convolvulus arvensis)*
Hedge bindweed *(Calystegia sequium)*

Apply 2-3 pints per acre*

Wild buckwheat *(Polygonum convolvulus)*

Apply 3-4 pints per acre*

Greenbriar *(Smilax* spp.)
Honeysuckle *(Lonicera* spp.)
Morningglory *(Ipomoea* spp.)
Poison ivy *(Rhus radicans)*
Redvine *(Brunnichia cirrhosa)*
Wild rose *(Rosa* spp.)
Including: Multiflora rose *(Rosa multiflora)*
Macartney rose *(Rosa bractreata)*

Apply 4-6 pints per acre*

Blackberry *(Rubus* spp.)**
Dewberry *(Rubus* spp.)**
Kudzu *(Pueraria lobata)*
Trumpetcreeper *(Campsis radicans)*
Virginia creeper *(Parthenocissus quinquefolia)*
Wild grape *(Vitis* spp.)

BRUSH SPECIES

Apply 4-6 pints per acre*

American beech *(Fagus grandifolia)*
Ash *(Fraxinus* spp.)
Bald cypress *(Taxodium distichum)*
Bigleaf maple *(Acer macrophylum)*
Blackgum *(Nyssa sylvatica)*
Boxelder *(Acer negundo)*
Cherry *(Prunus* spp.)
Chinaberry *(Melia azadarach)*
Chinese tallow-tree *(Sapium sebiferum)*
Dogwood *(Cornus* spp.)
Hawthorn *(Crataegus* spp.)
Hickory *(Carya* spp.)
Maple *(Acer* spp.)
Mulberry *(Morus* spp.)
Oak *(Quercus* spp.)
Persimmon *(Diospyros virginiana)*
Poplar *(Populus* spp.)
Privet *(Ligustrum vulgare)*
Red Alder *(Alnus rubra)*
Red Maple *(Acer rubrum)*
Saltcedar *(Tamarix ramosissima)*
Sassafras *(Sassafras albidum)*
Sourwood *(Oxydendrum arboreum)*
Sumac *(Rhus* spp.)
Sweetgum *(Liquidambar styraciflua)*
Willow *(Salix* spp.)
Yellow poplar *(Liriodendron tulipifera)*

*The higher rates should be used where heavy or well established infestations occur.

**The degree of control is species dependent. Some Rubus species may not be controlled.

OUST

(SULFOMETURON METHYL)

REGISTRATION CODE 0488-000

PACKAGE SIZE
12 - 1 POUND JUGS/CARTON
8 - 3 POUND JUGS/CARTON

OUST®

HERBICIDE

DISPERSIBLE GRANULES

ACTIVE INGREDIENT:	BY WEIGHT
Sulfometuron methyl {Methyl 2-[[[(4,6-dimethyl-2-pyrimidinyl)-amino]carbonyl]amino]sulfonyl]benzoate}	75%
INERT INGREDIENTS	25%
TOTAL	100%

EPA Reg. No. 352-401

U.S. Pat. 4,394,506

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION! MAY IRRITATE EYES, NOSE, THROAT AND SKIN.

Avoid breathing dust or spray mist. Avoid contact with skin, eyes and clothing.

If in eyes, immediately flush with plenty of water and get medical attention.

If on skin, immediately flush with plenty of water and get medical attention if irritation persists.

For medical emergencies involving this product, call toll free 1-800-441-3637.

ENVIRONMENTAL HAZARDS

Do not apply directly to wetlands or any body of water. Do not contaminate water by cleaning of equipment or disposal of wastes.

HERBICIDES

IMPORTANT

DO NOT USE ON FOOD OR FEED CROPS. Injury to or loss of desirable trees or other plants may result from failure to observe the following: Do not apply "Oust" (except as recommended), or drain or flush equipment on or near desirable trees or other plants, or on areas where their roots may extend or in locations where the chemical may be washed or moved into contact with their roots.

Do not use on lawns, walks, driveways, tennis courts or similar areas. Keep from contact with fertilizers, insecticides, fungicides and seeds.

Do not treat powdery, dry soil or light, sandy soils when there is little likelihood of rainfall soon after treatment; in areas where sensitive crops are grown, do not apply "Oust" to steep banks or treat before soil has been settled by rain as off-target movement by wind or water may occur. Do not apply to impervious substrates or when ground is frozen.

Do not apply to any body of water. Do not apply where runoff water may flow onto agricultural land, as injury to crops may result. Do not apply "Oust" during periods of intense rainfall or to soils saturated with water as off-target movement may occur.

Do not apply this product through any type of irrigation system.

Do not allow spray to drift onto adjacent crops or other desirable plants or trees as injury may occur.

Following an "Oust" application, the spray tank used should not be used for other than noncrop applications. This is extremely important, as low rates of "Oust" can kill or severely injure most crops.

GENERAL INFORMATION

Du Pont "Oust" Herbicide is a dispersible granule to be mixed in water and applied as a spray for control of many annual and perennial grasses and broadleaf weeds on noncropland areas. It is noncorrosive, nonflammable, nonvolatile and does not freeze.

"Oust" may be used for general weed control on industrial noncrop sites and for selective weed control in certain types of unimproved turf grasses on noncropland.

"Oust" can also be used for selective weed control in forest site preparation and release of several types of pines.

"Oust" may be applied preemergence or postemergence to weeds; best results are obtained if application is made before or during early stages of weed growth. "Oust" should be used during seasons when rainfall occurs as moisture is required to move "Oust" into the root zone of weeds before they develop an established root system. Preemergence treatments control or suppress weeds through root uptake while postemergence works through root uptake and foliar uptake. Under limited rainfall conditions, "Oust" may not provide satisfactory control of hard-to-kill perennials.

"Oust" is absorbed by both roots and foliage of weeds, resulting in visual effects progressing from growth inhibition to reddish-purplish coloration, chlorosis, necrosis, vein discoloration and death of terminals. Initial effects are usually seen 2 to 3 weeks following application; however, the final effects are evident at about 4 to 6 weeks after application. Warm, moist conditions following treatment promote the activity of "Oust" while cold, dry conditions delay the activity of "Oust". Weeds hardened off by cold weather or drought stress may not be fully controlled.

Degree of control and duration of effect depend on rate used, weed spectrum, weed size, growing conditions at and following time of treatment, soil pH, precipitation, and soil organic matter.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

"Oust" Herbicide should be used only in accordance with recommendations on this label or in separate published Du Pont recommendations available through local dealers.

Du Pont will not be responsible for losses or damages resulting from the use of this product in any manner not specifically recommended by Du Pont. User assumes all risks associated with such nonrecommended use.

Du Pont "Oust" Herbicide is recommended for preemergence and postemergence control of many annual and perennial grasses and broadleaf weeds. "Oust" must be applied in ground equipment as a selective or nonselective spray treatment of noncropland areas such as airports, fencerows, highways, industrial turf, lumberyards, petroleum tank farms, pipeline rights-of-way, plant sites, railroads, roadside turf, storage areas and utility rights-of-way consistent with restrictions under "Important". Treatment of powdery dry soil, steep banks and impervious substrates should be avoided; treated soils should be left undisturbed to reduce the potential for "Oust" movement by soil erosion due to wind or water. Injury to crops may occur if treated soil is washed, blown or moved onto land used to produce crops.

"Oust" is also recommended for conifer site preparation and release (except California). Treatment may be applied by ground equipment or helicopter to these forest sites.

"Oust" may be applied preemergence or postemergence to weeds, but for best results, apply postemergence to young, actively growing weeds under favorable moisture conditions at any time of the year, except when ground is frozen.

Rate selection is based on weed species, weed size and soil texture. Use the higher rates on established plants and on fine textured soils and lower rates on smaller weeds and coarse textured soils.

SELECTIVE WEED CONTROL

For use on unimproved industrial turf, on roadsides, and on other noncropland areas where bermudagrass (common and coastal varieties), bahiagrass, crested wheatgrass and smooth brome are well established, and are desired as ground covers.

BERMUDAGRASS RELEASE

For control of many annual and perennial broadleaf weeds and grasses use the following rates and application timings (do not use surfactant):

Late Spring and Early Summer: Apply 1 to 2 oz of "Oust" per acre for control of Carolina geranium, fescue, foxtail, goldenrod, spotted spurge, and wild carrot after bermudagrass is well established, usually about 30 days after initial spring flush. If regrowth of weeds occurs and additional control is desired, repeat treatment at 1 to 2 oz during late spring and summer. After weeds become established, best results occur when applications are made 1 to 2 weeks following mowing.

Alternatively, in Arkansas, Louisiana and Mississippi, 1 to 2 ounces "Oust" per acre may be tank mixed with 3 to 4 lbs of MSMA per acre and applied to well established bermudagrass during the summer; the combination includes control of additional weeds listed on the MSMA package label. Two or more additional applications of MSMA (without "Oust") at 14-day intervals may be necessary to maintain weed control.

For short-term control of johnsongrass in the U.S., apply 2 to 3 oz per acre after bermudagrass is well established, usually about 30 days after initial spring flush. Re-treat with 2 to 3 oz if additional control is desired or if regrowth occurs.

Late Fall and Early Winter: Apply 1 to 4 oz of "Oust" per acre for control of winter annuals such as Carolina geranium, common chickweed, fescue, little barley and wild blackberry; use the lower rate on small seedling weeds and higher rates on larger weeds.

BAHIAGRASS RELEASE AND SEEDHEAD SUPPRESSION

Apply 1 oz of "Oust" per acre (without surfactant) for control of fescue, goldenrod, spotted spurge and wild carrot. Rates as low as 1/2 oz per acre reduce bahiagrass growth and suppress seedheads when applied before seedhead emergence in the spring or following mowing.

SMOOTH BROME RELEASE AND SUPPRESSION

For control of downy brome, foxtail, goldenrod, kochia, Russian thistle and prickly lettuce in well established stands of smooth brome, apply 1 oz of "Oust" per acre (without surfactant) in the spring at an early stage of plant growth. This application will also result in smooth brome seedhead reduction, as well as growth suppression and reduced plant vigor.

CRESTED WHEATGRASS RELEASE AND SUPPRESSION

For control of downy brome, kochia, Russian thistle and prickly lettuce in well established stands of crested wheatgrass on noncrop sites, apply 1 oz "Oust" per acre (without surfactant) during the rainy season or spring. This application may also result in growth suppression of the crested wheatgrass.

NOTE: Temporary discoloration or top kill of bahiagrass, bermudagrass and smooth brome may result following an application of "Oust".

Browning and degree of stand reduction may increase in areas with warm climates. Do not apply "Oust" to industrial turf that is under stress from drought, insects, disease, cold temperatures or late spring frost, as injury may result. Do not apply "Oust" to grasses within 1 year of planting as stand reduction may occur.

CONIFER SITE PREPARATION AND RELEASE (EXCEPT CALIFORNIA)

"Oust" provides both foliar and residual control of many herbaceous grass and broadleaf weeds in jack pine, loblolly pine, red pine, slash pine and Virginia pine reforestation areas.

When used as described, "Oust" controls many herbaceous plants such as: Crabgrass, dog fennel, fescue, fireweed (willowweed), goldenrod, horseweed, Kentucky bluegrass, nutsedge (yellow), panicums (broadleaf, fall, narrow), pokeweed, ragweed, white snakeroot and yellow sweetclover.

Preplant - Site preparation (trees not present)/Postplant - release (trees present)Make application from spring through late fall; do not apply to frozen ground.

Apply 2-8 ounces of "Oust" per acre (2-4 ounces per acre on red pine) using appropriate ground or air (helicopter only) equipment. Add surfactant at 0.25% by volume for site preparation. Do not use surfactant for pine release (trees present).

NOTE: Do not apply by air within 200 feet of any homestead, agricultural land or other desirable plantings. Extreme care must be taken to prevent drift or runoff to homesteads, desirable plantings, agricultural land or any body of water. Do not apply when weather conditions favor drift from treated areas.

Use extreme care when applying in areas adjacent to any body of water. Keep out of lakes, streams, ponds, reservoirs or any body of water. Do not apply where conifers are suffering from loss of vigor caused by insects, diseases, drought, winter damage or other stresses, as injury may result. "Oust" is not recommended for use on poorly drained or marshy sites, but it may be used where pines have been planted in beds. "Oust" applications may result in damage to Douglas fir and Ponderosa pine. Use the lower rates on coarse textured soils (i.e., loamy sands, sandy loams) and higher rates on fine textured soils (i.e., sandy clay loams and silty clay loams).

NONSELECTIVE WEED CONTROL

"Oust" is recommended for use alone and in certain tank mix combinations for general weed control on noncrop, industrial sites such as airport, fence rows, roadsides and associated rights-of-ways, lumberyards, petroleum tank farms, pipeline and utility rights-of-ways, pumping installations, railroads, storage areas, plant sites and other similar areas. Apply with ground equipment as follows:

PREEMERGENCE TO EARLY POSTEMERGENCE* TREATMENTS

Apply 3 to 5 ounces "Oust" per acre for control of:

Broadleaves

- Bouncingbet
- Burclover
- Carolina geranium
- Common chickweed
- Common dandelion
- Common speedwell
- Common yarrow
- Crimson clover
- Dogfennel
- Hoary cress (whitetop)
- Kochia
- Little mallow
- Mustard
- Ox-eye daisy
- Pepperweed
- Pigweed
- Prickly lettuce
- Purple starthistle
- Ragweed
- Russian thistle
- Sowthistle (annual)
- Sunflower
- Sweet clover
- Tansymustard
- Tansy ragwort
- Tumble mustard
- Vetch
- Wild carrot
- Yellow rocket

Grasses (Up to 6 to 12" In Height)

- Alta fescue
- Annual bluegrass
- Annual ryegrass
- Bahiagrass
- Barnyardgrass
- Downy brome
- Fescue
- Foxtails
- Foxtail barley
- Indiangrass
- Italian ryegrass
- Kentucky bluegrass
- Little barley
- Red brome
- Red fescue
- Reed canarygrass
- Ripgut brome
- Ryegrass
- Smooth brome
- Springletop (annual)
- Wheat (volunteer)

*Add surfactant at 0.25% by volume to improve control of emerged weeds.

EARLY POSTEMERGENCE TREATMENTS

Apply 6 to 12 ounces "Oust" per acre plus surfactant at 0.25% by volume for control of:

Broadleaves

- Bedstraw
- Canada thistle
- Curly dock
- Dewberry
- Fiddleneck (tarweed)
- Redstem filaree
- Fleabane
- Goldenrod
- Groundsel
- Hemlock
- Honeysuckle
- Horsetail (Equisetum)
- Jerusalem artichoke
- Kudzu (use 12 oz. rate)
- Mayweed
- Muskthistle
- Poison ivy
- Spanishneedles
- Turkey mullein
- Virginia pepperweed
- Wild blackberry

Grasses

- Johnsongrass**
- Yellow nutsedge

**For short-term control of johnsongrass of up to 3 months, apply "Oust" at 2 to 5 ounces per acre early postemergence to the johnsongrass. Re-treat when regrowth occurs or if further control of the actively growing johnsongrass is desired.

NOTE: Use the higher level of recommended dosage ranges under the following conditions: Heavy weed growth; on soils containing more than 2 1/2% organic matter; and on high soil moisture areas such as along road edges or railroad shoulders.

For broader spectrum weed control than offered by "Oust" alone, tank mixtures are recommended with Du Pont "Escort" or "Hyvar" X, or "Karmex", or "Telar", or "Velpar" Herbicides; or "Roundup"[2] or 2,4-D. Refer to package labels and determine the weeds controlled that best fit the weed problem.

Apply the "Oust" plus companion herbicide at the rates and timing shown on the package labels for the weeds involved. For application method and other use specifications, use the most restrictive directions for the intended combination.

Do not tank mix "Oust" with Du Pont "Hyvar" XL Herbicide.

SPRAY PREPARATION

Fill the spray tank half full of water, and with agitator running, add the proper amount of "Oust". Finish adding the required amount of water. Continuous agitation is required to keep the product in suspension. Use mechanical or bypass agitation to thoroughly mix the spray solution. After initial mixing, do not use excessive agitation when using a surfactant as foaming problems may result. To avoid foaming problems, use antifoam agents.

"Oust" spray preparations may degrade in acid solutions if not used in 48 hours; they are stable in alkaline solutions. Thoroughly reagitate before using.

"Oust" may be tank mixed with most herbicides (except "Hyvar" XL); to insure compatibility, test the desired mixture prior to use.

For nonselective postemergence applications, a nonionic surfactant of at least 80% active ingredient may be added to improve wetting and/or contact activity on weeds. To minimize drift, a drift control agent may be added at the recommended label rate; a drift control agent must be used when spraying in areas near cropland or desirable vegetation. Follow closely the mixing instructions for a drift control agent; when using cold water, be sure the additive is thoroughly dispersed.

APPLICATION TECHNIQUES

INDUSTRIAL NONCROP WEED CONTROL

Apply with ground equipment using extreme care to prevent spray drift; use coarse spray nozzles, adequate spray volume and avoid excessive application pressure, sprayer speed and application under windy conditions to avoid spray drift. Select a spray volume that will assure thorough coverage and uniform spray pattern. Do not use less than 15 gallons of water per acre. Spray volumes of 20 to 40 gallons per acre are preferred. Spray pressures of 25 to 35 psi are adequate. Before spraying "Oust", calibrate the spray equipment to determine the quantity of water necessary to uniformly cover the vegetation and soil in a measured area to be treated. The properly calibrated sprayer should be operated at the proper speed and rate of delivery during application of "Oust" alone or in tank mixtures. Avoid overlapping and shut off spray booms while starting, turning, slowing or stopping when spraying industrial turf as injury to the desired species may result. Do not apply "Oust" by aircraft.

CONIFER SITE PREPARATION AND RELEASE

"Oust" may be applied by ground equipment (as previously described) or by air (helicopter only) to recommended forest sites. Calibrate the helicopter spray system to insure uniform distribution of liquid over the area to be treated; use 5 to 15 gallons of water per acre. To reduce drift when applying by air, use precise application spray equipment (jet nozzles directed backwards [D4 or larger] or a "Microfoil"[1] boom or equivalent). When compatible with equipment, addition of a spray thickening agent is recommended to further minimize drift.

STORAGE AND DISPOSAL

STORAGE: Store product in original container only, away from other pesticides, fertilizer, food or feed.

PESTICIDE DISPOSAL: Do not contaminate water, food or feed by storage or disposal. Wastes resulting from the use of this product may be disposed of on site or at approved waste disposal facility.

CONTAINER DISPOSAL: Triple rinse (or equivalent) the container. Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

NOTICE TO BUYER: Purchase of this material does not confer any rights under patents of countries outside of the United States.

NOTICE OF WARRANTY

Du Pont warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Injury to adjacent crops, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application, all of which are beyond the control of Du Pont. In no case shall Du Pont be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer. DU PONT MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE NOR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

[1]Trademark of Union Carbide Agricultural Products Company
[2]Trademark of Monsanto Company

AG-2983 8048 4/11/88

SUPPLEMENTAL LABELING
EPA REG. NOS. 352-401

This bulletin contains new or supplemental instructions for use of these products in combination which does not appear on the package label. Follow the instructions carefully.

"OUST" HERBICIDE AND "VELPAR" L HERBICIDE COMBINATIONS FOR CONTROL OF UNDESIRABLE HERBACEOUS PLANTS IN SOUTHERN PINE PLANTATIONS

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

Du Pont "Oust" Herbicide is recommended as a tank mix with Du Pont "Velpar" L Herbicide for herbaceous weed control where loblolly, slash and longleaf pine are grown. Both herbicides provide foliar and residual activity to control many grasses and broadleaf weeds.

HOW TO USE

Apply 2-4 ounces of "Oust" tank mixed with 2-3 pints "Velpar" L per acre by ground or air using spray equipment that has been properly calibrated. Aerial application should be made by helicopter only. To reduce drift, use precise application spray boom and/or a spray thickening agent such as Nalco-Trol. Do not use surfactant. Application should be made with sufficient volume of water to insure thorough coverage of target area, usually 10 gallons (by air) to 25 gallons (by ground) of spray solution per acre.

Make broadcast, band or spot applications from late winter to late spring, either preemergence or early postemergence to weeds. Best results will be obtained when target weeds are small (less than 6" in height) and application is made to warm, moist soil.

When used as directed, the combination of "Oust" and Velpar" L Herbicides control many herbaceous weeds such as: blackberry*, burnweed (fireweed), dewberry*, dog fennel, eupatorium spp., foxtail* (yellow), goldenrod, horseweed, panicums (dichanthelium and panicum spp.*), pineweed, pokeweed*, ragweed (common), sedges* (nutsedge and green flat), white snake root* and sneezeweed* (bitter). See "Oust" and "Velpar" L labeling for other species affected.

*Require the higher dosage rates of each herbicide.

NOTES

1. Do not apply when pines are suffering from insects, diseases, drought, winter damage, animal damage, planting shock or other stresses, as injury may result.

2. "Oust" and "Velpar" L are not recommended for use on poorly drained or marshy sites unless planting has occurred in beds.

3. Use the higher dosage rate of each herbicide when organic matter exceeds 2%, hard-to-control weed species predominate or soil texture is fine (i.e., silt, silty-clay loam or sandy-clay loam). Application to gravelly or rocky soils, exposed subsoils or deep sands may increase pine injury.

4. Applications should not be made within 200 feet of any farm or homestead, as injury to non-target plants may occur from swath and displacement. Similarly, do not treat areas where runoff may occur into agricultural lands, other desirable plantings or any body of water due to slope, drainage or soil erosion. Do not apply when weather conditions favor drift or runoff from treated area.

This labeling must be in the possession of the user at the time of pesticide application.

091587 10/26/87
H-00852

"OUST" HERBICIDE PLUS 2,4-D OR "TORDON" FOR CONTROL OF LEAFY SPURGE ON INDUSTRIAL SITES IN COLORADO, MONTANA, NORTH DAKOTA, SOUTH DAKOTA AND WYOMING

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

Du Pont "Oust" Herbicide plus 2,4-D amine or "Tordon"[1] is recommended for suppression and/or control of leafy spurge on industrial non-cropland sites in CO, MT, ND, SD and WY.

HOW TO USE

Apply 1 1/2 to 2 1/2 ounces "Oust" plus either 1 lb. a.i. 2,4-D amine or 1/3 to 1/2 lb. a.i. "Tordon" per acre.

For best results, apply to leafy spurge during the bloom (flowering) stage.

NON-SELECTIVE WEED CONTROL

Add surfactant at 0.25% by volume.

SELECTIVE WEED CONTROL

If desirable grasses are present, do not add surfactant or apply before or after bloom as severe injury to grasses may occur.

Note: Do not apply "Oust" combinations in pastures, rangeland or areas immediately adjacent to agricultural land.

This labeling must be in the possession of the user at the time of pesticide application.

[1]Registered Trademark of Dow Chemical Company 112587

112587 2/11/88
H-02562

FOR WEED CONTROL UNDERASPHALT AND CONCRETE PAVEMENTSIN THE STATES OF ARIZONA, CALIFORNIA AND NEVADA

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

GENERAL INFORMATION:

Du Pont "Oust" Herbicide is recommended for weed control under asphalt and concrete pavement to extend the useful life of the surfacing material by preventing weeds from emerging through it.

"Oust" should be used only where the area to be treated has been prepared according to good construction practices. If rhizomes, tubers or other vegetative parts are present in the site, they must be removed.

IMPORTANT
BEFORE USING "OUST" IN COMBINATION, READ AND CAREFULLY NOTE THE CAUTIONARY STATEMENTS AND ALL OTHER INFORMATION APPEARING ON THE PRODUCT LABELS.

SUPPLEMENTAL LABELING
EPA REG. NOS. 352-401

This bulletin contains new or supplemental instructions for use of these products in combination which does not appear on the package label. Follow the instructions carefully.

"Oust" will not control woody vegetation such as small trees, or woody vines. Roots of these species must be grubbed and removed from the site prior to application.

HOW TO USE:

"Oust" may be applied to the ground before laying asphalt or concrete such as used on parking lots, highway shoulders, median strips, roadways and other industrial sites. "Oust" must be applied just prior to the asphalt or concrete coating to avoid possible lateral movement of the herbicide by rainfall or mechanical means.

"Oust" should be applied uniformly to the final grade of base rock or native soil just prior to the paving operations. Apply "Oust" at the rate of 10-12 ounces per acre. "Oust" should be applied in sufficient water to insure uniform coverage. Continuous agitation is required to keep "Oust" in suspension.

"Oust" is not recommended for use under pavement in residential properties such as driveways, or in recreational areas, jogging or bike paths, tennis courts, or golf cart paths.

Avoid drift of spray into planters or ornamental bedding areas in or adjacent to the treated area as injury may result. Injury of desirable plants may result if their roots extend into treated areas.

This bulletin contains new or supplemental instructions for use of this product which may not appear on the package label. Follow the instructions carefully.

This labeling must be in the possession of the user at the time of pesticide application.

062587 10/26/87
H-00854

IMPORTANT
BEFORE USING "OUST" IN COMBINATION, READ AND CAREFULLY NOTE THE CAUTIONARY STATEMENTS AND ALL OTHER INFORMATION APPEARING ON THE PRODUCT LABELS.

SPIKE

(TEBUTHIURON)

ELANCO

ID 5955

Herbicide

Spike®

80W

A preemergence and postemergence herbicide for control of brush and weeds in such areas as:

- Airport runways
- Utility substations and rights-of-way
- Tank farms
- Railway roadbeds and ballast
- Railroad rights-of-way
- Road shoulders where no vegetation is desired
- Under asphalt and concrete pavements where no future landscaping is planned
- At the base of highway guardrails, signposts, and markers
- At the base of transmission towers and poles
- Around industrial buildings
- Lumberyards
- Railroad yards
- Ditchbanks
- Firebreaks
- Fence rows

The degree and duration of control may vary with the amount of chemical applied, soil texture, and other conditions.

Active ingredient:
tebuthiuron: *N*[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-*N*,*N*'-dimethylurea..... 80.0%

Inert ingredients:..... 20.0%

Contains 3.2 pounds active ingredient per 4 pound bag. SPIKE® — the registered trademark for Elanco Products tebuthiuron.

CAUTION: KEEP OUT OF REACH OF CHILDREN. See back panel for additional caution statements.

Net Weight 4 Pounds

EPA Reg. No. 1471-97

DIRECTIONS FOR USE: Read All Directions Carefully Before Applying.

Human: Harmful if swallowed. Avoid contact with skin, eyes or clothing. Avoid inhaling dust from product. In case of contact, flush with water.

Environmental: Do not contaminate any body of water, ponds or streams as death or injury may occur to vegetation irrigated by such. Do not contaminate water by cleaning of equipment or disposal of wastes.

Storage and Disposal: The herbicidal properties of SPIKE 80W require caution in handling, storage and transportation of this product. Do not contaminate food or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container. Dispose in an incinerator or land fill approved for pesticide containers or bury in a noncropland area away from desirable plants, trees and water supply.

The manufacturer makes no warranties, express or implied, concerning this product or its use which extend beyond the description on the label. All statements made concerning this product apply only when used as directed. SPIKE 80W must be applied according to Elanco's written instructions, including, but not limited to, recommended rates. Failure to do so may result in poor weed control or plant injury. Elanco expressly disclaims any warranty, either express or implied, for the use of SPIKE 80W, alone or in combination with other products, when that use is not in strict compliance with Elanco's written recommendations.

PRECAUTIONS

SPIKE 80W IS INTENDED FOR NONCROPLAND VEGETATION CONTROL. IT IS AN EXTREMELY ACTIVE HERBICIDE WHICH WILL KILL TREES, SHRUBS AND OTHER FORMS OF DESIRABLE VEGETATION HAVING ROOTS EXTENDING INTO THE TREATED AREA. FEEDER ROOTS OF MANY SPECIES OF DESIRABLE VEGETATION EXTEND MANY FEET BEYOND THE DRIP LINE OF THE BRANCHES, AND A VERY SMALL AMOUNT OF SPIKE 80W IN CONTACT WITH ONE FEEDER ROOT OF A TREE, SHRUB OR OTHER DESIRABLE VEGETATION MAY CAUSE SERIOUS INJURY OR DEATH TO THE ENTIRE PLANT.

AN ARBORICULTURIST (TREE EXPERT) SHOULD BE CONSULTED TO HELP YOU TO DETERMINE IF THE AREA OF PROPOSED APPLICATION IS FREE OF ALL ROOTS OF DESIRABLE VEGETATION. THE EFFECT OF SPIKE 80W ON DESIRABLE VEGETATION MAY BE IRREVERSIBLE AND ITS PRESENCE IN THE SOIL MAY PREVENT GROWTH OF OTHER DESIRABLE VEGETATION FOR SOME YEARS AFTER APPLICATION.

READ THE ENTIRE LABEL BEFORE USING SPIKE 80W TO DETERMINE IF THIS PRODUCT IS SUITABLE FOR THE DESIRED PURPOSE.

Do not use SPIKE 80W on areas such as walks, driveways, streets, lawns, patios, tennis courts, swimming pools, cemeteries, or other landscaped areas, or under asphalt or concrete pavement where future landscaping is planned. Do not apply on field crops. Do not apply on any area into which the roots of field crops or other desirable vegetation may extend. ROOTS OF TREES, SHRUBS, AND OTHER DESIRABLE VEGETATION MAY EXTEND FAR BEYOND THE DRIP LINE OF THE PLANT'S BRANCHES.

AVOID NONTARGET DRIFT OR PRODUCT MOVEMENT. DO NOT APPLY WHEN WINDS ARE GUSTY OR UNDER ANY OTHER CONDITIONS WHICH WILL ALLOW DRIFT OR PRODUCT MOVEMENT. DO NOT APPLY TO AREAS WHERE SOIL MOVEMENT BY WATER EROSION AND/OR NATURAL OR MECHANICAL MEANS IS LIKELY. DO NOT APPLY TO AREAS WHERE WIND IS LIKELY TO CAUSE SOIL MOVEMENT UNLESS A SOIL SEALANT IS USED. DRIFT OR ANY FORM OF PRODUCT MOVEMENT FROM TREATED AREAS MAY CAUSE DAMAGE TO ANY VEGETATION TO WHICH TREATMENT IS NOT INTENDED.

Ditchbank Usage — Do not apply SPIKE 80W to any portion of the ditchbank that will come into direct contact with water as movement of SPIKE 80W in this water to non-target plant species may result in the injury or death of those plants. Do not apply on ditches used to transport irrigation or potable water. Keep from contact with other pesticides and seeds.

Thoroughly clean all traces of SPIKE 80W from application equipment after use. DO NOT EMPTY RESIDUES CLEANED FROM APPLICATION EQUIPMENT ON AREAS WHERE THEY MAY COME IN CONTACT WITH THE ROOTS OF DESIRABLE VEGETATION OR THE WATER SOURCE FOR SUCH VEGETATION.

Woody Plant Control — Grazing is allowed in areas receiving band or individual plant treatments with 5 pounds per acre or less of SPIKE 80W. In areas receiving band or individual plant treatments with 5 pounds per acre or less of SPIKE 80W, grass may be cut for hay one year after application.

SPIKE 80W may injure or suppress certain herbaceous vegetation in the treated area. Therefore, do not apply where such injury cannot be tolerated. Do not apply broadcast applications of SPIKE 80W where forage or maintenance of a grass cover is desired. Injury to most herbaceous perennials is reduced if SPIKE 80W is applied when this vegetation is dormant.

DIRECTIONS FOR USE: Read All Directions Carefully Before Applying.

Total Vegetation Control: SPIKE 80W is a preemergence and postemergence herbicide for total control of vegetation in such noncropland areas as: airport runways, utility substations and rights-of-way, road shoulders where no vegetation is desired, under asphalt and concrete pavements where no future landscaping is planned, at the base of highway guardrails, sign posts and markers, at the base of transmission towers and poles, around industrial buildings, lumberyards, railroad yards, ditchbanks, firebreaks, and fence rows.

For total vegetation control in areas *not treated the previous season* with SPIKE 80W or other residual herbicides, apply SPIKE 80W prior to or just after emergence of plants as follows:

At 5 pounds per acre, SPIKE 80W will control the following:

Alfalfa
Aster, heath
Aster, white heath
Barley, little
Bedstraw
Bluegrass, annual
Bluegrass, Kentucky
Bouncingbet
Bromegrass, downy
Bromegrass, ripgut
Bromegrass, smooth
Broomsedge
Buffelgrass
Burclover
Buttercup, smallflower
Camphorweed
Carrot, wild
Catsear, spotted
Cheat
Chickweed
Clover, red
Cocklebur
Creeper, Virginia
Crowfootgrass
Dock, curly
Dogfennel
Fescue
Fescue, rattail

Fiddleneck, coast
Filaree
Filaree, redstem
Fleabane, annual
Foxtail
Gaillardia, rosering
Geranium, Carolina
Goldenrod
Grape
Gumweed
Hemlock, poison
Henbit
Honeysuckle, Japanese
Horseweed
Knapweed
Kochia
Lambsquarters
Lupine
Medic, black
Morningglory
Mullein, common
Nightshade, silverleaf
Oat, wild
Panicum, Texas
Pepperweed, Virginia
Pigweed
Plantain, buckhorn
Puncturevine
Ragweed, giant
Raspberry, red
Ryegrass, Italian
Sedge, annual
Shepherdspurse
Sida, prickly
Sowthistle, annual
Spikeweed
Spurge
Spurge, spotted
Starthistle, yellow
Strawberry
Sunflower, common
Telegraphplant
Timothy
Trumpetcreeper
Velvetgrass
Vetch
Witchgrass

At 7.5 pounds per acre, SPIKE 80W will control the following:

Awngrass, triple
Barley, foxtail
Bromegrass, Japanese
Canarygrass, reed
Carpetweed
Chicory
Cinquefoil, common
Ivy, poison
Reed, common
Sandbur, field
Smartweed, swamp
Sowthistle, perennial
Spurge, prostrate
Sumac, staghorn
Sweetclover, white

At 10 pounds per acre, SPIKE 80W will control the following:

Barnyardgrass
Crabgrass
Itchgrass
Johnsongrass, seedling
Lovegrass
Orchardgrass
Oxtongue, bristly
Poorjoe
Purslane, common
Ragweed, common
Saltbush
Sedge, bull

At 20 pounds per acre, SPIKE 80W will control the following:

Bermudagrass
Cudweed
Dallisgrass
Lookingglass, Venus
Vaseygrass

For the *maintenance of total vegetation control* in noncropland areas *east of the Rocky Mountains* which were treated the previous season with SPIKE 80W or other residual herbicides, apply SPIKE 80W prior to or just after emergence of plants as follows: (Some of the species listed may show erratic control depending on the time between application and weed germination.)

At 2 pounds per acre, SPIKE 80W will control the following:

Bluegrass, annual
Bluegrass, Kentucky
Carrot, wild
Checkweed, common
Croton
Fleabane, annual
Horseweed
Mullein
Panicum, fall
Parsnip, wild
Pepperweed
Pigweed
Ragweed, common
Smartweed, Pennsylvania
Sweetclover
Thistle, Canada
Woodsorrel, yellow

At 3 pounds per acre, SPIKE 80W will control the following:

Goldenrod
Spurge

In areas of rainfall greater than 25 inches per year, the 3 pounds per acre maintenance rate should be used for all weed species listed above.

For the *maintenance of total vegetation control* in noncropland areas *west of the Rocky Mountains* which were treated the previous season with SPIKE 80W or other residual herbicides, apply SPIKE 80W prior to or just after emergence of plants as follows: (Some of the species listed may show erratic control depending on the time between application and weed germination.)

At. 1.5 pounds per acre, SPIKE 80W will control the following:

Bassia, fivehook
Cheat
Cudweed
Foxtail
Lettuce, prickly
Oat, wild
Oxtongue, bristly
Pigweed
Plantain
Ryegrass, annual
Saltbush
Shepherdspurse
Witchgrass

At 2 pounds per acre SPIKE 80W will control the following:

Buttercup
Canarygrass, reed
Knapweed, Russian
Knotweed
Mallow
Mustard
Ragweed, western
Starthistle, yellow
Telegraphplant

At 3 pounds per acre, SPIKE 80W will control the following:

Barley
Gumweed
Puncturevine
Sida, alkali
Smartweed, swamp

In areas of rainfall greater than 25 inches per year, the 3 pounds per acre maintenance rate should be used for all weed species listed above.

APPLICATION DIRECTIONS

Apply SPIKE 80W in 15 to 150 gallons of water per acre before or during the period of active growth of plants to be controlled. Initial control is enhanced by rainfall.

In areas of low annual rainfall (less than 15 inches per year) SPIKE 80W should be applied prior to the time of year when the predominant portion of that rainfall occurs. A minimum of 1 to 1½ inches of rainfall is required to activate SPIKE 80W and place it in the primary weed seed germination zone.

To maximize performance under a variety of conditions, SPIKE 80W is recommended for use in tank-mix combination with any of the following products: amitrole, Atratol® 80W, Banvel® 720, Banvel® W.S., Karmex® 80W, MSMA, paraquat, Princep® 80W, Roundup®, SURFLAN® 75W, 2,4-D or Oust®. Where applications are made to existing vegetation, the contact or burning properties of paraquat or MSMA provide the rapid top kill while SPIKE 80W gives the residual long-term control desired. Applications to areas which are infested with certain difficult to control perennial weeds (such as johnsongrass, bermudagrass, quackgrass, horsetail, bindweed, dandelion or nutsedge) will benefit from tank-mixing SPIKE 80W with Roundup, amitrole, Banvel, Banvel 720, or 2,4-D. The addition of SURFLAN, Oust, Karmex, Atratol or Princep will improve SPIKE's performance on certain annual broadleaf and grass weeds such as foxtail, kochia, Russian thistle, or seedling johnsongrass.

Banvel® — dicamba, Velsicol Chemical Corporation
Karmex® — diuron, E.I. DuPont De Nemours & Company
Princep® — simazine, Ciba-Geigy
Roundup® — glyphosate, Monsanto Company
Oust® — Sulfometuron methyl, E. I. DuPont De Nemours & Company

SURFLAN® — oryzalin, Elanco Products Company
Atratol® — atrazine and prometon, Ciba-Geigy

Read the SPIKE 80W label and labels of products to be tank-mixed carefully before using. Note all warnings, cautions, precautions, and limitations of warranty on all labels.

Apply with any sprayer that will apply the spray uniformly. Check the sprayer before and during use to insure proper calibration and uniform application.

To mix, fill spray tank half full of water. Start agitation and continue during the entire mixing process. Add required amount of SPIKE 80W and allow to mix when tank mixing. If additional product is a wettable powder, add to tank and allow to mix thoroughly. If additional product is a liquid, add slowly while filling remainder of tank with water. Continuous agitation in the spray tank is required to keep the materials in suspension throughout application. Agitate by mechanical or bypass (hydraulic) means in the spray tank. If bypass or return agitation is used, it should terminate at the bottom of the tank to minimize foaming.

For treating small areas, a tank type hand sprayer or sprinkling can may be used. Before application determine the amount of water and chemical necessary to cover uniformly the area to be treated. Shake or stir frequently.

WOODY PLANT CONTROL

SPIKE 80W is an effective herbicide for the control of brush and vines. SPIKE 80W can be applied either as a broadcast spray, banded application or as an individual plant treatment depending upon the size, density and location of brush to be controlled.

SPIKE is to be applied to the soil (Not the Foliage!) where it is absorbed by the roots of plants. Effects are slow to appear and will not become apparent until sufficient moisture has carried SPIKE 80W into the root zone. The time required to achieve control is dependent on soil type, amount of rainfall and rooting depth of target species. Some species may go through several defoliations and refoliations over a period of approximately two to three years prior to dying.

SPIKE 80W can be applied anytime except when the ground is frozen or the soil is saturated with moisture. For optimum results, applications should be made just prior to the resumption of active seasonal growth in the spring and/or periods of rainfall. For applications made in the late summer or early fall in areas of average annual rainfall of greater than 25 inches, higher rates should be used and inconsistent control may result on densely infested brush areas and hard to control species.

SPIKE 30W may be used on cut brush but for optimum results time should be allowed for the brush to resprout to a height of approximately 5 feet prior to application. SPIKE requires an actively growing plant to be effective. The larger the resprouts the more SPIKE that will be taken up by the plant and the more effective and consistent the control will be.

For the control of woody plants and vines, the following rates of SPIKE 80W are recommended. These rates can vary depending upon soil type, rainfall, time of application and size/density of the woody plants.

SPIKE 80W applied at the rate of 1.25 pounds per acre will control the following species.

Haplopappus tenuisectus	(Burroweed)
Larrea tridentata	(Creosotebush)
Mimosa biuncitera	(Wait-a-minute-bush)

SPIKE 80W applied at the rate of 2.5 pounds per acre will control the following species.

Ailanthus altissima	(Tree-of-heaven)
Aloysia lycioides	(Whitebrush)
Artemisia tridentata	(Big sagebrush)
Carya glabra	(Pignut hickory)
Celtis occidentalis	(Western hackberry)
Datura discolor	(Desert thornapple)
Lycium berlandieri	(Berlandier wolfberry)
Morus rubra	(Red mulberry)
Pinus monticola	(Western white pine)
Pinus spp.	(Pine)
Prunus emarginata	(Bitter cherry)
Rhus glabra	(Smooth sumac)
Robinia pseudoacacia	(Black locust)
Rosa multiflora	(Multiflora rose)
Salvia leucophylla	(Black sage)
Symphoricarpos orbiculatus	(Buckbrush)
Ulmus americana	(American elm)
Vaccinium spp.	(Blueberry)
Gaylussacia spp.	(Huckleberry)

SPIKE 80W applied at the rate of 3.75 pounds per acre will control the following species.

Abies balsamea	(Balsam fir)
Acacia farnesiana	(Huisache)
Acer saccharum	(Sugar maple)
Alnus rugosa	(Speckled alder)
Betula populifolia	(Gray birch)
Carya texana	(Black hickory)
Celtis pallida	(Granjeno)
Condalia obtusifolia	(Lotebush condalia)
Ilex vomitoria	(Yaupon)
Larix laricina	(Tamarack)
Picea glauca	(White spruce)
Populus balsamifera	(Balsam poplar)
Populus deltoides	(Eastern cottonwood)
Quercus douglasii	(Blue Oak)
Quercus marilandica	(Blackjack oak)
Quercus stellata	(Post oak)
Salix spp.	(Willow)
Schaefferia cuneifolia	(Desert yaupon)
Spiraea tomentosa	(Hardhack)
Ulmus alata	(Winged elm)

SPIKE 80W applied at the rate of 5 pounds per acre will control the following species.

Acacia berlandieri	(Guajillo)
Acacia greggii	(Catclaw acacia)
Acacia rigidula	(Blackbrush acacia)
Acacia tortuosa	(Twisted acacia)
Acer negundo	(Boxelder)
Adenostoma fasciculatum	(Chamise)
Alnus rubra	(Red alder)
Campsis radicans	(Trumpetcreeper)
Carya ovata	(Shagbark hickory)
Cercocarpus betuloides	(Birchleaf mountainmahogany)
Colubrina texensis	(Texas colubrina)
Condalia obovata	(Bluewood condalia)
Cornus drummondii	(Roughleaf dogwood)
Crataegus spp.	(Hawthorn)
Eysenhardtia texana	(Texas kidneywood)
Fagus grandifolia	(American beech)
Jatropha dioica	(Leatherstem)
Leucophyllum frutenscens	(Cenizo [Texas silverleaf])
Liquidambar styraciflua	(Sweetgum)
Parthenocissus quinquefolia	(Virginia creeper)
Populus grandidentata	(Bigtooth aspen)
Porlieria angustifolia	(Guayacan)
Prunus virginiana	(Common chokecherry)
Pseudotsuga menziesii	(Douglas fir)

Pueraria lobata	(Kudzu)
Quercus dumosa	(California scrub oak)
Quercus palustris	(Pin oak)
Quercus rubra	(Red oak)
Quercus virginiana	(Live oak)
Rhus typhina	(Staghorn sumac)
Rubus allegheniensis	(Allegheny blackberry)
Salvia ballotaeflora	(Shrubby blue salvia)

SPIKE 80W applied at the rate of 6.25 pounds per acre will control the following species:

Acer macrophyllum	(Bigleaf maple)
Acer platanoides	(Norway maple)
Acer saccharinum	(Silver maple)
Baccharis spp.	(Groundsel tree)
Cornus florida	(Flowering dogwood)
Fraxinus pennsylvanica	(Green ash)
Gaultheria shallon	(Salal)
Juniperus virginiana	(Eastern redcedar)
Lantana camara	(Lantana)
Liriodendron tulipifera	(Tuliptree)
Melaleuca quinquenervia	(Melaleuca)
Pinus banksiana	(Jack pine)
Pinus echinata	(Shortleaf pine)
Pinus resinosa	(Red pine)
Pinus virginiana	(Virginia pine)
Platanus occidentalis	(American sycamore)
Prunus serotina	(Black Cherry)
Quercus alba	(White oak)
Rubus laciniatus	(Evergreen blackberry)
Rubus occidentalis	(Black raspberry)
Schinus terebinthifolius	(Brazilian peppertree)

SPIKE 80W applied at the rate of 7.5 pounds per acre will control the following species.

Acer circinatum	(Vine maple)
Arctostaphylos patula	(Greenleef manzanita)
Ceanothus cuneatus	(Wedgeleaf ceanothus)
Ceanothus leucodermis	(Whitethorn chaparral)
Crataegus crus-galli	(Cockspur hawthorn)
Elaeagnus angustifolia	(Russianolive)
Fraxinus americana	(White ash)
Ligustrum spp.	(Privet)
Rhus laurina	(Laurel sumac)
Sapium sebiferum	(Tallowtree)
Smilax rotundifolia	(Common greenbrier)
Ulmus parvifolia	(Chinese elm)
Ulmus rubra	(Slippery elm)

BROADCAST APPLICATION

Apply SPIKE 80W in 15 to 150 gallons of water per acre with any properly calibrated herbicide sprayer. Check the sprayer before and during use to insure proper calibration and uniform application. Add the recommended amount of SPIKE 80W to clean water in the spray tank during the filling operation. Material must be kept in suspension at all times by constant agitation. Agitate by mechanical or bypass (hydraulic) means in the spray tank. If bypass or return agitation is used it should terminate at the bottom of the tank to minimize foaming.

For treating small areas, a tank type hand sprayer may be used. Before application determine the amount of water and chemical necessary to cover uniformly the area to be treated. Shake or stir frequently.

Do not apply broadcast applications of SPIKE 80W where forage or maintenance of a grass cover is desired.

BANDED APPLICATION

SPIKE 80W is recommended for the control of woody plant species in noncropland areas (such as utility railroad and pipeline rights-of-way ditchbanks and fence rows) by application of a series of parallel bands to the soil surface. Individual bands should be spaced at intervals from 4 to 10 feet and at the currently labeled rate range of 2.5 to 7.5 pounds per acre depending on the woody species to be controlled. Actual herbicide bands should be kept as narrow as possible during application to achieve minimal injury or control of herbaceous vegetation. Apply SPIKE 80W to the soil surface in 5 to 75 gallons of water per acre in a series of parallel bands with spacing between bands ranging from 4 to 10 feet. In areas such as brush infested fence rows on utility rights-of-way a single band may be applied. Control is dependent upon root systems intercepting bands. Therefore larger stems should be *treated individually* when using single bands.

Band spacing should be selected based on the size of the woody plants in the area to be treated and the amount of injury or control of herbaceous vegetation that can be tolerated.

Where control of young or seedling woody plants is desired bands should be spaced closer together. This will achieve maximum exposure to their limited root systems. Where larger more mature woody species are to be controlled, bands should be spaced at the wider end of the recommended spacing range.

In addition to allowing adequate exposure of the more extensive root systems of these larger woody species for control, use of the wider spacings will further reduce injury or control of herbaceous vegetation in the area of treatment.

Within the treated band nearly all vegetation, woody and herbaceous, will be killed. Some herbaceous vegetation close to the treated band with roots extending into it may be severely injured or killed. However, since herbaceous species tend to have restricted root systems, most species outside the treated band will not be affected. Banded applications in areas of steep terrain should be applied across existing slopes in order to prevent soil erosion.

Apply with equipment designed to deliver the spray uniformly in the bands. To maintain the integrity of the individual herbicide bands, straight stream nozzles fitted with internal stabilizing vanes or their equivalent are recommended. Operating pressures should also be kept as low as will provide uniform delivery of the spray solution. Pressures in the range of 10 to 40 psi should be adequate. Pressures in excess of 40 psi will tend to cause the individual bands to break up.

When applications are made in an area where nozzles are elevated above the soil surface more than 5 feet, breakup of the individual spray streams may occur. If conditions do not permit delivery of intact spray streams to the soil surface, this method of application should not be used.

Fill the spray tank half-full of water. Start agitation and continue during entire mixing and spraying operation. Add the required amount of SPIKE 80W and allow it to mix thoroughly while completing the spray tank filling. If hand held or back pack type sprayers are used, shake vigorously after filling and periodically during application to maintain product suspension. A master shut-off switch for the entire spraying system and nozzle check valves are recommended on commercial spray equipment.

Material must be kept in suspension at all times by continuous agitation. Agitate by mechanical or bypass (hydraulic) means in the spray tank. If bypass or return agitation is used it should terminate at the bottom of the tank to minimize foaming. Check the sprayer frequently before and during use to insure proper calibration and uniform application.

INDIVIDUAL (SPOT) APPLICATION

SPIKE 80W may be applied in high or low volumes of water to selectively control individual woody plants. Recommended rates will vary depending upon site conditions with the higher rates needed for difficult to control species, large plants, heavier soils, fall applications and cut brush. Consult your local Elanco SPIKE distributor to determine the best rates for your location.

For high volume applications, mix 1 pound of SPIKE 80W in enough water to make 10 gallons of solution. Apply 10 ounces of material to the soil per every 2 to 4 inches of stem diameter.

For low volume applications, mix 1 pound of SPIKE 80W in enough water to make 1 gallon of solution. Apply 1 ounce of material to the soil per every 2 to 4 inches of stem diameter.

When treating large stems, apply the multiple treatments in even spacing around the stem.

For applying SPIKE 80W in banded or individual plant treatment, two pieces of equipment are suggested; the Solo Model 425 back pack sprayer for both banding and individual plant treatment and the Spot Gun for individual plant treatment.

The Solo sprayer is prepared for spraying by adding the pre-slurried contents of a 4 pound bag of SPIKE 80W and water to the tank. Fill to capacity with additional water and shake vigorously. Equip the Solo sprayer with a 0003-SS straight stream nozzle and the Solo pressure regulator with the green (10 psi) pressure limiting spring. To band SPIKE 80W at 5 pounds per acre, walk at 3 mph (264 feet per minute) with the Solo on continuously and space the bands 5 feet apart. Adjust the rate and walking speed according to the brush species and conditions encountered. For individual plant treatment with the Solo, apply a 1.5 second shot for every 1 to 2 inches of stem diameter at the base of unwanted woody plants.

The Spot Gun is prepared for individual plant treatment by mixing 2 pounds of SPIKE 80W in sufficient water to obtain 1 gallon of spray solution. Set the Spot Gun to deliver 8 milliliters of this solution for every 1 to 2 inches of stem diameter at the base of the unwanted woody plants. For application on steep slopes or other sensitive areas, the Spot Gun can be equipped with a soil probe to allow injection of the SPIKE 80W solution beneath the soil surface. Placement at a soil depth of 2 to 4 inches will eliminate any surface movement and reduce injury to herbaceous vegetation.

At the prescribed rates, a 4 pound bag of SPIKE 80W will treat approximately 950 stems 1 to 2 inches in diameter. Because of its non-volatile nature and low potential for drift this SPIKE application technique can be used for treating unwanted woody plants growing on non-cropland areas adjacent to sensitive crops. (See label precautions.) A white spot should be visible at the base of each treated stem which should aid in inspection of the completed work.

CAUTION: DO NOT USE SPIKE 80W IN THIS MANNER IN ANY AREA WHERE DESIRABLE SPECIES ARE IN THE VICINITY OF THE PLANTS TO BE ELIMINATED. A SMALL AMOUNT OF SPIKE 80W IN CONTACT WITH THE ROOTS OF DESIRABLE TREES OR OTHER WOODY SPECIES MAY CAUSE SEVERE INJURY OR DEATH. THE ROOTS OF SUCH PLANTS MAY EXTEND FAR BEYOND THEIR DRIP LINES.

SPIKE 80W will injure or control other herbaceous vegetation in the treated area. Therefore, do not apply where such injury cannot be tolerated. See the list of herbaceous vegetation controlled by SPIKE 80W under the Total Vegetation Control section of this booklet.

SPIKE® — tebuthiuron, Elanco Products Company

GARLON™ 3A

(TRICLOPYR)

Specimen Label

Garlon* 3A
Herbicide

For the control of Woody Plants and Broadleaf Weeds on Rights-of-Way, Industrial Sites, Non-crop Areas, Non-irrigation Ditch Banks, Forests, and Wildlife Openings, Including Grazed Areas on These Sites

Active Ingredient(s):
Triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid), as the triethylamine salt 44.4%
Inert Ingredients 55.6%
Acid equivalent: Triclopyr - 31.8% - 3 lb/gal
E.P.A. Registration No. 464-546
E.P.A. Est. 464-MI-1

KEEP OUT OF REACH OF CHILDREN

DANGER
PELIGRO:

PRECAUCION AL USUARIO:
Si usted no lee inglés, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

CAUSES EYE DAMAGE AND SKIN IRRITATION • HARMFUL IF SWALLOWED

Do Not Get In Eyes, On Skin Or On Clothing • Wear Goggles Or Face Shield and Rubber Gloves When Handling • Avoid Contamination Of Food • Wash Thoroughly After Handling

STATEMENT OF PRACTICAL TREATMENT: In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention promptly. Flush skin with water and get medical attention if signs of irritation develop. Remove and wash contaminated clothing before reuse. **If swallowed,** promptly drink a large quantity of milk, egg whites, gelatin solution or if these are not available, drink large quantities of water. **Avoid alcohol.** Call a physician.

Physical or Chemical Hazards

Do Not Cut or Weld Container • Do Not Use or Store Near Heat or Open Flame.

Environmental Hazards

Keep out of lakes, streams or ponds. Do not contaminate water by cleaning of equipment or disposal of wastes.

NOTICE

Read and understand the entire label before using. Use only according to label directions.

Before buying or using this product, read "WARRANTY LIMITATIONS AND DISCLAIMER" elsewhere on this label. If terms are not acceptable, return **unopened** package at once to seller for full refund of purchase price paid. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under WARRANTY LIMITATIONS AND DISCLAIMER.

IN CASE OF AN EMERGENCY

endangering life or property involving this product, call collect 517-636-4400

AGRICULTURAL CHEMICAL

Do Not Ship or Store with Food, Feeds, Drugs, or Clothing

See Side Panel for Important Use Precautions

GENERAL INFORMATION

GARLON 3A Herbicide is recommended for the control of unwanted woody plants and annual and perennial broadleaf weeds in forests, and on non-crop areas including industrial manufacturing and storage sites, rights-of-way such as electrical power lines, communication lines, pipelines, roadsides, railroads, fence rows, non-irrigation ditch banks and around farm buildings. Use on these sites may include application to grazed areas as well as establishment and maintenance of wildlife openings.

Garlon* 3A

Among the woody plant species controlled are:

Alder	**Douglas Fir**	**Sassafras**
Arrowwood	**Dogwood**	**Scotch Broom**
Ash	**Elderberry**	**Sumac**
Aspen	**Elm**	**Sweetbay Magnolia**
Beech	**Hazel**	**Sweetgum**
Birch	**Hornbeam**	**Sycamore**
Blackberry	**Locust**	**Tanoak**
Blackgum	**Madrone**	**Thimbleberry**
Cascara	**Maples**	**Tulip Poplar**
Ceanothus	**Mulberry**	**Western Hemlock**
Cherry	**Oaks**	**Willow**
Chinquapin	**Persimmon**	**Winged Elm**
Choke Cherry	**Pine**	
Cottonwood	**Poison Oak**	
Crataegus (Hawthorn)	**Poplar**	
	Salmonberry	

Among the annual and perennial broadleaf weeds controlled are:

Bindweed	**Dandelion**	**Smartweed**
Burdock	**Field Bindweed**	**Tansy Ragwort**
Canada Thistle	**Lambsquarter**	**Vetch**
Chicory	**Plantain**	**Wild Lettuce**
Curly Dock	**Ragweed**	

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Do not use for manufacturing or formulating.

Do not apply this product through any type of irrigation system.

Use GARLON 3A Herbicide at rates of ¼ to 3 gallons per acre to control broadleaf weeds and woody plants. In all cases use the amount specified in enough water to give uniform and complete coverage of the plants to be controlled. Use only water suitable for spraying. The recommended order of addition to the spray tank is water, **Nalco-Trol** (if used), surfactant (if used), additional herbicide (if used), GARLON 3A Herbicide. If combined with emulsifiable concentrate herbicides moderate continuous adequate agitation is required.

Consult the table to determine which rate of application is suggested for a particular use.

Before using any recommended tank mixtures, read the directions and all use precautions on both labels.

For best results applications should be made when woody plants and weeds are actively growing. When hard-to-control species such as ash, blackgum, choke cherry, elm, maples, oaks, pines or winged elm are prevalent and during applications made in late summer when the plants are mature and during drought conditions, use the higher rates of GARLON 3A Herbicide alone or in combinations with TORDON* 101 Mixture weed and brush killer.

TORDON 101 Mixture is a restricted use pesticide, see label.

When using GARLON 3A in combination with 2,4-D 3.8 lb amine or low volatile ester herbicides, generally the higher rates should be used for satisfactory brush control.

Use the higher dosage rates when brush approaches an average of 15 feet in height or when the brush covers more than 60% of the area to be treated. If lower rates are used on hard-to-control species, resprouting may occur the year following treatment.

On sites where easy to control brush species dominate, rates less than those recommended may be effective. Consult State or Local Extension personnel for such information.

HIGH-VOLUME LEAF-STEM TREATMENT WITH GROUND EQUIPMENT

FOLIAGE TREATMENT: For control of woody plants use GARLON 3A Herbicide at the rate of ½ to 1 gallon in water to make 100 gallons of spray solution or GARLON 3A at ¼ to ½ gallon may be tank mixed with ¼ to ½ gallon of 2,4-D 3.8 lb amine or low volatile ester or TORDON 101 Mixture Herbicides and diluted to make 100 gallons of spray solution. Apply at a volume of 100 to 400 gallons of total spray per acre depending on size and density of woody plants. Coverage should be thorough to wet all leaves, stem, and root collars. (See **Use Precautions**).

BROADCAST APPLICATIONS WITH GROUND EQUIPMENT

Make application using equipment that will assure uniform coverage of the spray volumes applied. TO IMPROVE SPRAY COVERAGE, ADD AN AGRICULTURAL SURFACTANT (SUCH AS **ORTHO** X-77 or **TRONIC**) AT A RATE OF ¼ TO 1 PINT PER ACRE. USE THE HIGHER RATES OF SURFACTANT FOR LOWER RATES OF PRODUCT AND LOWER SPRAY VOLUMES.

Woody Plant Control

FOLIAGE TREATMENT: Use 2 to 3 gallons of GARLON 3A Herbicide and ¼ to 1 pt of an agricultural surfactant in enough water to make 20 to 100 gallons of total spray per acre or GARLON 3A at ½ to 1 gallon may be combined with 1 to 2 gallons of 2,4-D 3.8 lb amine or low volatile esters or TORDON 101 Mixture in sufficient water to make 20 to 100 gallons of total spray per acre.

Broadleaf Weed Control

Use GARLON 3A Herbicide at rates of ⅓ to 1½ gallons and ¼ to 1 pt of an agricultural surfactant in a total volume of 20 to 100 gallons per acre as a water spray mixture. Apply any time during the growing season. GARLON 3A at ⅓ to 1 gallon may be tank mixed with ½ to 1 gallon of TORDON K, TORDON 101 Mixture or 2,4-D 3.8 lb amine or low volatile herbicides to improve the spectrum of activity.

AERIAL APPLICATION (Helicopter Only)

Aerial sprays should be applied using suitable drift control. (See **Use Precautions**).

FOLIAGE TREATMENT: (Rights-of-Way) Use 2 to 3 gallons of GARLON 3A Herbicide with ¼ to 1 pint of agricultural surfactant or 1 to 1.5 gallons GARLON 3A in a tank mix combination with 1 to 2 gallons of 2,4-D 3.8 lb amine or low volatile esters or TORDON 101 Mixture, and apply in a total spray volume of 10 to 30 gallons per acre. Use the higher rates and volumes when plants are dense or under drought conditions.

FOREST MANAGEMENT APPLICATIONS

For broadcast applications of GARLON 3A herbicide, use volume rates needed to provide adequate coverage of brush for good control, usually 10-25 gpa by air or 10 to 100 gpa by ground. To improve spray coverage of spray volumes less than 50 gpa, add an agricultural surfactant such as Ortho X-77, or Tronic at a rate of ¼ to 1 pint per acre. Use the higher rates of surfactant for lower rates of product and lower spray volumes. Application systems should be used to prevent hazardous drift to off-target sites. Nozzles or additives that produce larger droplets of spray may require higher spray volumes to maintain brush control.

Forest Site Preparation

FOREST SITE PREPARATION (not for conifer release): Use 2 to 3 gallons of GARLON 3A Herbicide and ¼ to 1 pt of an agricultural surfactant and apply in a total spray volume of 10 to 30 gallons per acre or GARLON 3A at 1 to 1½ gallons may be used with 1 to 2 gallons of TORDON 101 Mixture 2,4-D 3.8 lb low volatile ester in a tank mix combination in a total spray volume of 10 to 30 gallons per acre.

NOTE: Conifers planted sooner than one month after treatment with GARLON 3A at less than 1⅓ gallon per acre or sooner than two months after treatment at 1⅓ to 3 gallons per acre may be injured. When tank mixtures of herbicides are used for forest site preparation, labels for all products in the mixture should be consulted and the longest recommended waiting period observed.

Directed Spray Applications for Conifer Release

To release conifers from competing hardwoods such as red maple, sugar maple, striped maple, sweetgum, red and white oaks, ash, hickory, alder, birch, aspen, and pin cherry, mix 1 to 5 gallons of GARLON 3A Herbicide in enough water to make 100 gallons of spray mixture. To improve spray coverage, add an agricultural surfactant such as Ortho X-77, or Tronic. This spray mixture should be directed onto foliage of competitive hardwoods using knapsack or backpack sprayers with flat fan nozzles or equivalent any time after hardwoods have reached full leaf size, but before autumn coloration. The majority of treated hardwoods should be less than 6 feet in height to ensure adequate spray coverage. Care should be taken to direct spray away from contact with conifer foliage, particularly foliage of desirable pines.

Note: Spray may cause temporary damage and growth suppression where contact with conifers occurs; however, injured conifers should recover and grow normally. Over-the-top spray applications can kill pines.

Broadcast Application for Conifer Release in the Northeastern United States

To release spruce, fir, red pine and white pine from competing hardwoods, such as red maple, sugar maple, striped maple, alder, birch (white, yellow or grey), aspen, ash, pin cherry and rubus spp. and perennial and annual broadleaf weeds, use GARLON 3A herbicide at rates of 2 to 4 quarts per acre alone or plus 2,4-D amine or 2,4-D ester to provide no more than 4 pounds acid equivalent per acre from both products. Applications should be made in late summer or early fall after conifers have formed their overwintering buds and hardwoods are in full leaf and prior to autumn coloration.

Cut Surface Treatment

In rights-of-way, other non-crop areas, and forests to control unwanted trees of hardwood species such as elm, maple, oak and conifers, apply GARLON 3A Herbicide, either undiluted or diluted in a 1 to 1 ratio with water, as directed below:

WITH TREE INJECTOR METHOD: Applications should be made by injecting ½ milliliter of undiluted GARLON 3A or 1 milliliter of the diluted solution through the bark at intervals of 3-4 inches between centers of the injector wound. The injections should completely surround the tree at any convenient height.

WITH FRILL OR GIRDLE METHOD: Make a single girdle through the bark completely around the tree at a convenient height. Wet the cut surface with undiluted or diluted solution.

Both of the above methods may be used successfully at any season except during periods of heavy sap flow of certain species - for example maples.

STUMP TREATMENT: Spray or paint the cut surfaces of freshly cut stumps and stubs with undiluted GARLON 3A. The cambium area next to the bark is the most vital area to wet.

NOTE: Cut surface methods may be used to treat susceptible woody species on range and permanent pasture land provided that no more than 2 quarts of GARLON 3A Herbicide are applied per acre.

SUGGESTED USE RATES

APPLICATION SITE	GAL PRODUCT PER 100 GAL WATER	GALLONS PER ACRE OF PRODUCT		
				AERIAL
	HIGH VOLUME[1] 100-400 gal/A Total Spray Volume	LOW VOLUME BROADCAST[2] 20-100 gal/A Total Spray Volume		Helicopter 10-30 gal/A Total Spray Volume
	Weeds and Brush	**Weeds**	**Brush**	**Brush**
Utility & Pipeline Rights-of-Way	½-1	⅓-1½	2-3	2-3[3]
Roadsides	½-1	⅓-1½	2-3	
Railroads	½-1	⅓-1½	2-3	
Industrial Sites	½-1	⅓-1½	2-3	
Forest Site Preparation	½-1	⅓-1½	2-3	2-3[4]

[1] ¼-½ 2 gal may be tank mixed with ¼ to ½ gal 2,4-D 3.8 lb amine or low volatile ester or TORDON 101 Mixture.

[2] ⅓-1 gal may be tank mixed with ½-1 gal 2,4-D 3.8 lb amine or low volatile ester or TORDON 101 Mixture **for weed control**; or ½-1 gal GARLON 3A with 1-2 gal of the aforementioned products **for brush control.**

[3] 1-1½ gal may be tank mixed with 1-2 gal 2,4-D 3.8 lb amine or low volatile ester or TORDON 101 Mixture.

[4] 1-1½ gal may be tank mixed with 1-2 gal of 2,4-D 3.8 lb low volatile esters or TORDON 101 Mixture.

USE PRECAUTIONS

Apply this product only as specified on this label.

Before using any recommended tank mixtures, read the directions and all use precautions on both labels.

Do not apply GARLON 3A Herbicide directly to, or otherwise permit it to come into direct contact with grapes, tobacco, vegetable crops, flowers or other desirable broadleaf plants and do not permit spray mists containing it to drift into them.

AVOID INJURIOUS SPRAY DRIFT: Applications should be made only when there is little or no hazard from spray drift. Very small quantities of spray, which may not be visible may seriously injure susceptible plants. Do not spray when wind is blowing toward susceptible crops or ornamental plants near enough to be injured. It is suggested that a continuous smoke column at or near the spray site or a smoke generator on the spray equipment be used to detect air movement, lapse conditions, or temperature inversions (stable air). If the smoke layers or indicates a potential of hazardous spray drift, do not spray.

Aerial Application: For aerial application on rights-of-way or other areas near susceptible crops, use NALCO-TROL drift control additive as recommended by the manufacturer or apply through the MICROFOIL boom, THRUVALVE boom, or equivalent drift control system. Thickened sprays prepared by using high viscosity invert systems or other drift reducing systems may be utilized if they are made as drift-free as are mixtures containing NALCO-TROL or applications made with the MICROFOIL boom or THRUVALVE boom. If a spray thickening agent is used, follow all use recommendations and

precautions on the product label. Do not use a thickening agent with the MICROFOIL boom, THRUVALVE boom, or other systems that cannot accommodate thick sprays.

With aircraft, drift can be lessened by applying a coarse spray; by using no more than 30 pounds spray pressure at the nozzles; by using a spray boom no longer than 3/4 the rotor length; by spraying only when wind velocities are low; or by using approved drift control system.

Ground Equipment: To aid in reducing spray drift GARLON 3A should be used in thickened (high viscosity) spray mixtures using NALCO-TROL drift control additive, high viscosity invert systems, or equivalent as directed by the manufacturer. With ground equipment, spray drift can be reduced by keeping the spray boom as low as possible; by applying 20 gallons or more of spray per acre; by using no more than 30 pounds spraying pressure with large droplet-producing nozzle tips; and by spraying when wind velocity is low. Do not apply with nozzles that produce a fine-droplet spray.

High Volume Leaf-Stem Treatment: To minimize spray drift, do not use pressure exceeding 50 psi at the spray nozzle and keep sprays no higher than brush tops. NALCO-TROL thickening agent or equivalent may be used to reduce drift.

Do not apply on ditches used to transport irrigation water. Do not apply where runoff or irrigation water may flow onto agricultural land as injury to crops may result.

Do not graze lactating dairy animals or harvest hay from treated areas for one year following treatment.

Do not graze areas treated with more than 2 quarts GARLON 3A per acre for one year following treatment.

Withdraw livestock from forage treated with 2 quarts GARLON 3A herbicide per acre or less at least 3 days before slaughter during the year of treatment.

Be sure that use of this product conforms to all applicable regulations.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store above 28°F or agitate before use.

DISPOSAL:

Prohibitions - Open dumping is prohibited.

Pesticide Disposal - Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container Disposal - Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other approved state and local procedures. Plastic containers may also be disposed of by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

General - Consult federal, state, or local disposal authorities for approved alternative procedures.

WARRANTY LIMITATIONS AND DISCLAIMER

The Dow Chemical Company warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions therein under normal conditions of use. THIS IS THE ONLY WARRANTY MADE ON THIS PRODUCT. NO OTHER EXPRESS AND NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS MADE OUTSIDE OF THIS LABEL. Therefore, neither this warranty nor any other warranty of merchantability or fitness for a particular purpose, express or implied, extends to the use of this product contrary to label instructions (including conditions noted on the label, such as unfavorable temperatures, soil conditions, etc.), under abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes, etc.) or under conditions not reasonably foreseeable to or beyond the control of seller.

When buyer or user suffers losses or damages resulting from the use or handling of this product (including claims based on contract, negligence, strict liability, or other legal theories), buyer or user must promptly notify in writing The Dow Chemical Company of any claims to be eligible to receive either remedy given below. The EXCLUSIVE REMEDY OF THE BUYER OR USER and the LIMIT OF LIABILITY of The Dow Chemical Company or any other seller will be one of the following, at the election of The Dow Chemical Company:

(1) **Refund of purchase price** paid by buyer or user for product bought, **or**

(2) **Replacement** of amount of product used.

The seller **will not be liable for consequential or incidental damages or losses.**

The terms of this Warranty Limitations And Disclaimer cannot be varied by any written or verbal statements or agreements. Any employee or sales agent of the seller is not authorized to vary or exceed the terms of this Warranty Limitations And Disclaimer in any manner.

38321-L6 F788

DOW*

THE DOW CHEMICAL COMPANY
Midland, Michigan 48674 U.S.A.

SPECIMEN LABEL 86-1452 DATE CODE F788
REPLACES 86-1452 DATE CODE E588
DISCARD PREVIOUS SPECIMEN LABELS

REVISIONS INCLUDE:
1) REVISED SUBHEADING USES

APPENDIX C

U. S. EPA DATA REQUIREMENTS FOR REGISTRATION OF PESTICIDES FOR TERESTRIAL NON-FOOD, AQUATIC NON-FOOD, AND FORESTRY USE

U.S. EPA DATA REQUIREMENTS FOR REGISTRATION OF PESTICIDES
FOR TERRESTRIAL NON-FOOD, AQUATIC NON-FOOD,
AND FORESTRY USE

SECTION	GUIDELINE	SUBJECT	RQMNTS	COMMENTS
158.120	Sect D	Product chemistry data		This section renumbered 158.190 in May, 1988.
	63-02	Color	R: T, A, F	
	63-03	State	R: T, A, F	
	63-04	Odor	R: T, A, F	
	63-05	Melting point	R: T, A, F	Required if technical chemical is a solid at room temperature.
	63-06	Boiling point	R: T, A, F	Required if technical chemical is a liquid at room temperature.
	63-07	Density or specific gravity	R: T, A, F	
	63-08	Solubility	R: T, A, F	
	63-09	Vapor pressure	R: T, A, F	
	63-10	Dissociation constant	R: T, A, F	
	63-11	Octanol/water partition coefficient	CR: T, A, F	Required if technical material is organic and non-polar.
	63-12	pH	CR: T, A, F	Required if test substance is water-dispersible.
	63-13	Stability	R: T, A, F	
	63-14	Reducing/oxidizing action	CR: T, A, F	Required if product contains an oxidizing or reducing agent.
	63-15	Flammability	CR: T, A, F	Required if product contains flammable liquids.
	63-16	Explodability	R: T, A, F	Required only if product is potentially explosive.
	63-17	Storage stability	R: T, A, F	
	63-18	Viscosity	CR: T, A, F	Required if product is a liquid.
	63-19	Miscibility	CR: T, A, F	Required if product is an emulsifiable liquid and is to be diluted with petroleum solvents.
	63-20	Corrosion characteristics	R: T, A, F	
	63-21	Dielectric breakdown voltage	CR: T, A, F	Required if end-use product is a liquid and is to be used around electrical equipment.
158.125	Sect O	Residue Chemistry		
	171-2	Chemical identity	R: T, A, F	Same data required as under 158.120, with emphasis on problematical residue impurities.
	171-3	Directions for use	R: T, A, F	
	171-4	Magnitude - crops	NR	
	171-4	Magnitude - fish	R: A	Data on residue in fish are required whenever a pesticide is to be applied directly to water inhabited by fish.
	171-4	Magnitude - irrigated crops	CR: A	Required if pesticide is to be applied directly to irrigation water or irrigation ditches.
	171-4	Magnitude - meat/milk/poultry/eggs	NR	
	171-4	Magnitude - potable water	R: A	Data required whenever a pesticide is to be applied directly to water, unless it can be

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U.S. EPA DATA REQUIREMENTS FOR REGISTRATION OF PESTICIDES
FOR TERRESTRIAL NON-FOOD, AQUATIC NON-FOOD,
AND FORESTRY USE

SECTION	GUIDELINE	SUBJECT	RQMNTS	COMMENTS
				determined that the treated water would not be used (eventually) for drinking purpose, by man or animals.
158.125	171-4	Magnitude - processed food/feed	NR	
	171-4	Magnitude: food handling	NR	
	171-4	Nature of residue - livestock	NR	
	171-4	Nature of residue - plants	NR	
	171-4	Residue method	NR	
158.130	Sect N	Environmental Fate		
	161-1	Hydrolysis	R: T, A, F	
	161-2	Photodegradation - water	R: T, A, F	
	161-3	Photodegradation - soil	CR: F	Not required if application is to be by soil injection or material is to be incorporated into soil upon application.
	161-4	Photodegradation - in air	NR	Required on a case by case basis depending on product use pattern and other factors.
	162-1	Aerobic soil metabolism (lab)	R: T, F	
	162-2	Anaerobic soil metabolism (lab)	R: A, F	Not required if anaerobic aquatic metabolism study (162-3) has been conducted.
	162-3	Anaerobic aquatic metabolism (lab)	R: A, F	
	162-4	Aerobic aquatic metabolism (lab)	R: A	
	163-1	Leaching/mobility	R: T, A, F	
	163-2	Volatility - laboratory	NR	
	163-3	Volatility - field	NR	
	164-1	Field dissipation - soil	R: T	
	164-2	Field dissipation - aqu. (sediment)	R: A	May be combined with 165-5.
	164-3	Field dissipation - forestry	R: F	May be combined with 165-5.
	164-4	Field dissipation - comb/tank mixes	NR	Required on case by case basis depending on product use pattern and other pertinent factors.
	164-5	Field dissipation - long term soil	NR	
	165-1	Rotational crops - confined	NR	
	165-2	Rotational crops - field	NR	
	165-3	Irrigated crops	CR: A	Required if it is reasonably forseeable that water at treated site may be used for irrigation.
	165-4	In fish	CR: T, A, F	Required if significant concentrations of the active ingredient and/or its principal degradation products are likely to occur in aquatic environments and may accumulate in aquatic organisms.
	165-5	In aquatic non-target organisms	CR: A, F	Requirements same as 165-4; also required unless

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SECTION	GUIDELINE	SUBJECT	RQMNTS	COMMENTS
				tolerance or action level for fish has been granted.
158.135	Sect F	Toxicology data		
	81-1	Acute oral	R: T, A, F	
	81-2	Acute dermal	R: T, A, F	
	81-3	Acute inhalation	R: T, A, F	
	81-4	Eye irritation	R: T, A, F	
	81-5	Skin irritation	R: T, A, F	
	81-6	Skin sensitization	R: T, A, F	
	81-7	Acute delayed neurotoxicity	R: T, A, F	
	82-1	Subchronic 90 day - nonrodent	CR: T, A, F	Required if intended use will result in human exposure under certain conditions.
	82-1	Subchronic 90 day - rat	CR: T, A, F	Required if intended use will result in human exposure under certain conditions.
	82-2	Dermal 21 day	CR: T, A, F	Required if intended use will result in human exposure under certain conditions.
	82-3	Dermal 90 day	CR: T, A, F	Required if use involves dermal use or prolonged human skin contact; required if pesticidal use will involve application to skin or comparable human exposure (swimming pools, clothing impregnating).
	82-4	Inhalation 90 day - rat	CR: T, A, F	Required if use may result in repeated inhalation exposure at a concentration likely to be toxic.
	82-5	Neurotoxicity 90 day - hen	CR: T, A, F	Required if acute delayed neurotixicity test showed neuropathy or neurotoxicity or if closely related structurally to a compound which can induce these effects.
	82-5	Neurotoxicity 90 day - mammal	CR: T, A, F	Required if acute oral, dermal, or inhalation studies showed neuropathy or neurotoxicity.
	83-1	Chronic feeding - nonrodent	CR: T, A, F	Required under certain conditions.
	83-1	Chronic feeding - rodent	CR: T, A, F	Required under certain conditions.
	83-2	Oncogenicity - other species	CR: T, A, F	Required under certain conditions.
	83-2	Oncogenicity - (rat preferred)	CR: T, A, F	Required under certain conditions.
	83-3	Teratogenicity - other	CR: T, A, F	Required for products intended for food uses and products for non-food uses if significant exposure of human females of child bearing age may reasonably be expected.
	83-3	Teratogenicity - (rat)	CR: T, A, F	Required for products intended for food uses and products for non-food uses if significant exposure of human females of child bearing age may

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SECTION	GUIDELINE	SUBJECT	RQMNTS	COMMENTS
				reasonably be expected.
158.135	83-4	Reproduction - 2 generation	CR: T, A, F	Required for food uses or if intended non-food use is likely to result in human lifespan exposure which is significant in terms of frequency, magnitude or duration of exposure; required under certain other conditions.
	84-2	Gene mutation	R: T, A, F	
	84-2	Structural chromosomal aberration	R: T, A, F	
	84-4	Genotoxic effects - other	R: T, A, F	
	85-1	General metabolism	CR: T, A, F	Required if chronic feeding or oncogenicity studies are required.
	85-2	Dermal penetration	CR: T, A, F	Required for compounds having a serious toxic effect as identified by oral or inhalation studies, for which a significant route of human exposure is dermal and for which the assumption of 100% absorption does not produce an adequate margin of safety.
	86-1	Domestic animal safety	CR: T, A, F	Required on a case by case basis.
158.140	Sect K	Reentry Protection		
	132-1	Dissipation - folar	CR: T, A, F	Required if certain toxicological criteria are met, depending on use.
	132-1	Dissipation - soil	CR: T, A, F	Required as for Folar dissipation (132-1); required if agricultural practice involves human tasks that would cause substantial exposure to residues sorbed to soil.
	133-3	Dermal exposure	CR: T, A, F	Required as for Folar dissipation (132-1) and under certain other conditions.
	133-4	Inhalation exposure	CR: T, A, F	Required as for Dermal exposure (133-3).
158.142	Sect R	Spray Drift		
	201-1	Droplet size spectrum	CR: T, A, F	Required when aerial applications and mist blower or other methods of ground application are proposed and it is estimated that the detremental effect level of those nontarget organisms expected to be present would be exceeded.
	202-1	Drift field evaluation	CR: T, A, F	Required when aerial applications and mist blower or other methods of ground application are

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SECTION	GUIDELINE	SUBJECT	RQMNTS	COMMENTS
				proposed and it is estimated that the detremental effect level of those nontarget organisms expected to be present would be exceeded.
158.145	Sect E	Wildlife and Aquatic Organisms		
	71-1	Avian oral LD50	R: T, A, F	
	71-2	Avian dietary LC50	R: T, A, F	
	71-3	Wild mammal toxicity	CR: T, A, F	Required on a case by case basis depending on the results of lower tier studies such as acute and subacute testing, intended use pattern, and pertinent environmental fate characteristics.
	71-4	Avian reproduction	CR: T, A, F	Required if birds may be subjected to repeated/continued exposure to the pesticide or its major metabolite degradation products, especially preceding or during breeding season or if data from certain other tests indicate plant/animal accumulation and/or reproductive impact.
	71-5	Simul & act field tests - mamm/brd	CR: T, A, F	Requirements the same as for Wild mammal toxicity (71-3).
	72-1	LC50 - Freshwater fish	R: T, A, F	
	72-2	Acute LC50 - freshwater inverteb.	R: T, A, F	
	72-3	Acute LC50 - estuar/marine organis.	CR: T, A, F	Required if product intended for direct estuarine/marine application or is expected to enter this environment in significant concentrations, or under certain other conditions.
	72-4	Embryolarvae	CR: T, A, F	Required if product is applied directly to water or expected to be transported to water from the intended use site and intended use such that its presence in water is likely to be continuous or recurrent (or if certain other test results occur).
	72-5	Fish life cycle	CR: T, A, F	Required if product is intended to be applied directly to water or expected to transport to water from the intended use site, and when estimated environmental concentration is greater than or equal to 1/10 of the no effect level in 72-4 or 72-5 or fish reproductive physiology may be effected.
	72-6	Accumulation - aquatic organism	CR: T, A, F	Required if significant concentrations of the active ingredient and/or its principal degradation products are likely to occur in aquatic

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SECTION	GUIDELINE	SUBJECT	RQMNTS	COMMENTS
				environments and may accumulate in aquatic organisms.
158.145	72-7	Simul or act field test - aqu. org.	CR: T, A, F	Required on case by case basis depending on the results of lower tier studies such as acute and subacute testing, intended use pattern, and pertinent environmental fate characteristics.
158.150	Sect J	Plant Protection		
	121-1	Target area phytotoxicity	NR	Data are required for Special Review and certain public health situations.
	122-1	Nontarg.area phytotox-seed germin.	R: T, A, F	(TIER 1)
	122-1	Nontarg.area phytotox-vegetat.vigor	R: T, A, F	(TIER 1)
	122-2	Nontarg.area phytotox-aqu.plnt grth	R: T, A, F	(TIER 1)
	123-1	Nontarg.area phytotox-seed germin.	CR: T, A, F	(TIER 2). Required if a 25% or greater detrimental effect was found in 1 or more plant species in the corresponding test (122-1) of Tier 1.
	123-1	Nontarg.area phytotox-vegetat.vigor	CR: T, A, F	(TIER 2). Required if a 25% or greater detrimental effect was found in 1 or more plant species in the corresponding test (122-1) of Tier 1.
	123-2	Nontarg.area phytotox-aqu.plnt grth	CR: T, A, F	(TIER 2). Required if a 50% or greater detrimental effect was found in 1 or more plant species in the corresponding test (122-1) of Tier 1.
	124-1	Nontarg.area phytotox-terr. field	CR: T, A, F	(TIER 3). Required if a 25% or greater detrimental effect was found in 1 or more plant species in the corresponding test (123-1) of Tier 2.
	124-2	Nontarg.area phytotox-aqu. field	CR: T, A, F	(TIER 3). Required if a 25% or greater detrimental effect was found in 1 or more plant species in the corresponding test (123-2) of Tier 2.
158.155	Sect L	Non-target insects		
	141-1	Acute contact LD50 - honey bee	CR T, A, F	Required only if proposed use will result in honey bee exposure.
	141-2	Toxicity of foliage residues - bee	CR T, A, F	Required only if proposed use will result in honey bee exposure or when formulation contains one or more active ingredients having an acute LD50 of less than 1 microgram per bee.
	141-4	Subacute feeding - honey bee	NR	
	141-5	Field testing for pollinators	CR T, A, F	May be required under certain conditions

R=required CR=conditionally required NR=not required
T=terrestrial non-food use A=aquatic non-food use
F=forestry use

U.S. EPA DATA REQUIREMENTS FOR REGISTRATION OF PESTICIDES
FOR TERRESTRIAL NON-FOOD, AQUATIC NON-FOOD,
AND FORESTRY USE

SECTION	GUIDELINE	SUBJECT	RQMNTS	COMMENTS
158.155	142-1	Acute toxicity - aquatic insects	NR	
	142-1	Aquatic insect life-cycle	NR	
	142-3	Simul/actual field test-aq. insects	NR	
	143-1/3	Nontarget insect-predator/parasites	NR	
158.167		Impurities	R: T, A, F	

R=required CR=conditionally required NR=not required
T=terrestrial non-food use A=aquatic non-food use
F=forestry use

APPENDIX D

HERBICIDE USE EVALUATION

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AUTHOR: Anderson, J.J. and J.J. Dulka YEAR: 1985
TITLE: Environmental fate of sulfometuron methyl in aerobic soils

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AUTHOR: Anon. YEAR: 1987
TITLE: Chemical control of tansy ragwort

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AUTHOR: Anthony, R.G. and M.L. Morrison YEAR: 1985
TITLE: Influence of glyphosate herbicide on small mammal populations in western Oregon

JOURNAL: Northwest Science 59(3):159-168

AUTHOR: Appleby, A.P. YEAR: 1979
TITLE: Chemical control of tansy ragwort (Senecio jacobaea)

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TITLE: Herbicidal effects of tebuthiuron and glyphosate

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TITLE: Tebuthiuron for control of woody plants

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AUTHOR: Black, W.N. YEAR: 1976
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TITLE: Evaluation of polymerized herbicides for brush control

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TITLE: Piclorem and dicamba persistence in forest environments

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TITLE: Dissipation of dicamba

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JOURNAL: Aspects of Applied Biology 16:183-188

AUTHOR: Downs, J.P. and R.D. Voth YEAR: 1984
TITLE: Roadside weed control with glyphosate and sulfometuron methyl combinations
JOURNAL: Proceedings - Southern Weed Science Society 37:278-284

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TITLE: Effect of some herbicides on the hatching rate of hen eggs
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TITLE: A watershed study of glyphosate transport in runoff
JOURNAL: J. Environmental Quality 9(4):661-665

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TITLE: Tubuthiuron-environmental concerns
JOURNAL: Rangelands 7(1):14-16

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TITLE: Evaluating total vegetation control materials for fencelines

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TITLE: Tansy ragwort control

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TITLE: The influence of timing of application and formulation type on 2,4-d control of tansy ragwort
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TITLE: Effectiveness and vegetation response to triclopyr tree injection on selected plots in eastern New York
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 40:236-240

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TITLE: Control of speckled alder in lowbush blueberry with selective fall herbicide treatments
JOURNAL: Canadian Journal of Plant Science 67(1):369-372

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JOURNAL: Weed Science 25(5):448-451

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JOURNAL: Weed Science 34(1):25-29

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TITLE: Weed control on noncroplands and ditchbanks with sulfometuron and glyphosate
JOURNAL: Louisiana Agriculture - Louisiana Agriculture Experiment Station 30(4):19-20

AUTHOR: Kreutzweiser, D.P., P.D. Kingsbury and J.C. Feng YEAR: 1989
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JOURNAL: Bulletin of Environmental Contamination and Toxicology 42(3):331-338

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TITLE: Isolation and identification of microorganisms for the degradation of dicamba
JOURNAL: J. Agric. Food Chem. 37(2):534-538

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JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 40:263-264

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TITLE: Herbicide effectiveness in response to season of application and shrub physiology
JOURNAL: Weed Science 30(5):467-475

AUTHOR: Lantagne, D.O. and J.A. Burger YEAR: 1987
TITLE: Comparison of site preparation methods for weed control in loblolly pine (Pinus taeda) plantations
JOURNAL: Weed Science 34(4):590-593

AUTHOR: Li, A.P. and T.J. Long YEAR: 1988
TITLE: An evaluation of the genotoxic potential of glyphosate
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TITLE: Effects of selected herbicides on smolting of coho salmon
JOURNAL: Report: EPA/600/3-79/071, PB-300441. 125 pp.

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TITLE: Efficacy of glyphosate in forest plantations
JOURNAL: The Herbicide Glyphosate. E. Grossbard and D. Atkinson, eds. pp. 328-338 (ISBN 0408111534)

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TITLE: Response of woody species to glyphosate in Northeastern States
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 33:336-342

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TITLE: Triclopyr triethylamine salt toxicity to life stages of the fathead minnow (Pimephales promelas Rafinesque)
JOURNAL: Bulletin of Environmental Contamination and Toxicology 33(3):339-347

AUTHOR: McConnell, J.S. and L. R. Hossner YEAR: 1989
TITLE: X-ray Diffraction and Infrared Spectroscopic Studies of Adsorbed Glyphosate
JOURNAL: J. Agric. Food Chem. 37(2):555-560

AUTHOR: McConnell, J.S. and L.R. Hossner YEAR: 1985
TITLE: pH-dependent adsorption isotherms of glyphosate
JOURNAL: J. Agric. Food Chem. 33:1075-1078

AUTHOR: McCormack, M.L. Jr, E.B. Sprague, T.B. Saviello and R.J. Hendler YEAR: 1982
TITLE: Timing triclopyr and glyphosate treatments on forest brush
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 36:209-214

AUTHOR: McDaniel, K.C. and J.F. Balliette YEAR: 1986
TITLE: Control of big sagebrush (Artemisia tridentata) with pelleted tebuthiuron
JOURNAL: Weed Science 34(2):276-280

AUTHOR: Meeklah, F.A. and R.B. Mitchell YEAR: 1984
TITLE: Evaluation of herbicides for control of Californian thistle
JOURNAL: Proceedings - 37th New Zealand Weed and Pest Control Conference: 20-23

AUTHOR: Michael, J.L. and D.G. Neary YEAR: 1988
TITLE: Environmental fate of sulfometuron methyl in southern forest watersheds
JOURNAL: Proceedings - Southern Weed Science Society 41:219

AUTHOR: Morton, H.L. YEAR: 1984
TITLE: Influence of tebuthiuron formulation on control of woody plants and forage production
JOURNAL: Proceedings - Western Society of Weed Science 37:129-138

AUTHOR: Moshier, L.J. and D. Penner YEAR: 1978
TITLE: Factors influencing microbial degradation of 14C (carbon isotope)-glyphosate to 14CO2 (carbon dioxide) in soil
JOURNAL: Weed Science 26(6):686-691

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TITLE: Environmental update on phenoxy, picloram, and triclopyr
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 36: Supplemental pp. 17-38

AUTHOR: Neal, J.C. and W.A. Skroch YEAR: 1985
TITLE: Effects of timing and rate of glyphosate application on toxicity to selected woody ornamentals
JOURNAL: J. American Society for Horticultural Science 110(6):860-864

AUTHOR: Neary, D.G., L.F. Conde and J.E. Smith YEAR: 1984
TITLE: Effects of sulfometuron methyl on six important competing species in coastal plain flatwoods
JOURNAL: Proceedings - Southern Weed Science Society 37:193-199

AUTHOR: Nir, A. and Z. Arenstein YEAR: 1987
TITLE: Weed control in afforested areas
JOURNAL: Proceedings - British Crop Protection Conference - Weeds 3:787-792

AUTHOR: Nomura, N.S. and H.W. Hilton YEAR: 1977
TITLE: The adsorption and degradation of glyphosate in five Hawaiian sugarcane soils
JOURNAL: Weed Research 17:113-121

AUTHOR: Norris, L.A. and M.L. Montgomery YEAR: 1975
TITLE: Dicamba residues in streams after forest spraying
JOURNAL: Bulletin of Environmental Contamination and Toxicology 13(1):1-8

AUTHOR: Norris, L.A., M.L. Montgomery and L.E. Warren YEAR: 1987
TITLE: Triclopyr persistence in western Oregon hill pastures

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TITLE: Simulation of herbicide concentrations in stormflow from forested watersheds

JOURNAL: Water Resources Bulletin 20(6):851-857

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TITLE: Interaction between glyphosate and various herbicides for broadleaved weed control

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TITLE: Some experiences with dicamba in controlling revegetation of deforested land in West Virginia
JOURNAL: Proceedings - Northeastern Weed Control Conference 24:61-68

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TITLE: Tebuthiuron the total vegetation control herbicide, a progress report

JOURNAL: Proceedings - Southern Weed Science Society 30:326-329

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TITLE: An evaluation of the genotoxic properties of herbicides following plant and animal activation
JOURNAL: Mutation Research 136(3):233-245

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TITLE: Evaluation of herbicides for roadside weed control in New Mexico

JOURNAL: J. Range Management 31(4):270-273

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TITLE: Glyphosate tolerance and utilization by the microflora of soils treated with the herbicide
JOURNAL: Applied Microbiology and Biotechnology 29(5):511-516

AUTHOR: Rahman, A. and P. Sanders YEAR: 1984
TITLE: Selective control of Californian thistle in asparagus

JOURNAL: Proceedings - 37th New Zealand Weed and Pest Control Conference:146-150

AUTHOR: Reynolds, P.E., D.G. Pitt and M.J. Roden YEAR: 1988
TITLE: Weed efficacy and crop tolerance after site prep with sulfometuron-methyl and metsulfuron-methyl
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 42(Suppl.):63-67

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TITLE: One-year results for a coastal British Columbia glyphosate conifer release trial
JOURNAL: Proceedings - Western Society of Weed Science 39:107-117

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TITLE: Triclopyr amine control of large trees on a West Virginia pipeline ROW (right of way)
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 37:279-285

AUTHOR: Ritty, P.M. YEAR: 1981
TITLE: Basal treatment of woody plants with triclopyr
JOURNAL: Proceedings - Western Society of Weed Science 34:62-66

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TITLE: Persistence, movement, and degradation of glyphosate in selected Canadian boreal forest soils
JOURNAL: J. Agric. Food Chem. 37(2):437-440

AUTHOR: Rueppel, M.L., B.B. Brightwell, J. Schaefer and J.T. Marvel YEAR: 1977
TITLE: Metabolism and degradation of glyphosate in soil and water
JOURNAL: J. Agric. Food Chem. 25:517-527

AUTHOR: Salazar, L.C. and A.P. Appleby YEAR: 1982
TITLE: Herbicidal activity of glyphosate in soil
JOURNAL: Weed Science 30:463-466

AUTHOR: Sanders, H.O. YEAR: 1970
TITLE: Toxicities of some herbicides to six species of fresh water crusteceans
JOURNAL: J. Water Pollution Control Federation 42(8)(Part 1):1544-50

AUTHOR: Sauers, R.F. and G. Levitt YEAR: 1984
TITLE: Sulfonylureas: new high potency herbicides (for control of weeds and grasses, chlorsulfuron, sulfometuron methyl, chemical structures)
JOURNAL: ACS Symposium Series - American Chemical Society - (255):21-28

AUTHOR: Saviello, T.B., M.L. McCormack Jr. and J.H. Blanck YEAR: 1981
TITLE: Timing applications of glyphosate to control forest brush
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 35:201-202

AUTHOR: Scherp, L.A. YEAR: 1975
TITLE: A review of some factors affecting the performance of glyphosate
JOURNAL: Proceedings - New Zealand Weed and Pest Control Conference 28:165-168

AUTHOR: Scifres, C.F. and T.J. Allen
TITLE: Dissipation of dicamba from grassland soils of Texas
YEAR: 1973
JOURNAL: Weed Science 21:393-396

AUTHOR: Scifres, C.J., T.J. Allen, C.L. Leinweber and K.H. Pearson
TITLE: Dissipation and phytotoxicity of dicamba residues in water
YEAR: 1973
JOURNAL: J. Environmental Quality 2(2):306-309

AUTHOR: Selleck, G.W.
TITLE: The influence of water quality, volume and surfactant on efficacy of glyphosate on perennial weeds
YEAR: 1980
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 34:281-283

AUTHOR: Selleck, G.W. and D.D. Baird
TITLE: Antagonisms with glyphosate and residual herbicide combinations
YEAR: 1981
JOURNAL: Weed Science 29(2):185-190

AUTHOR: Shipman, R.D.
TITLE: Converting low-grade oak-hickory (Quercus alba, Carya spp.) forests to Japanese larch (Larix leptolepix) with pelleted tebuthiuron
YEAR: 1979
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 33:218-222

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TITLE: Breakdown of the herbicide dicamba and its degradation product 3,6-dichlorosalicylic acid in prairie soils
YEAR: 1974
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YEAR: 1975
JOURNAL: Weed Research 15:59-62

AUTHOR: Smith, C.T. and M.L. McCormack Jr.
TITLE: Watershed losses of triclopyr after aerial application to release spruce-fir
YEAR: 1988
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 42:104-108

AUTHOR: Smith, C.T., J.W. Hornbeck and M.L. McCormack Jr.
TITLE: Changes in nutrient cycling following aerial application of triclopyr to release spruce-fir
YEAR: 1988
JOURNAL: Proceedings - Annual Meeting, Northeastern Weed Science Society 42: 95-99

AUTHOR: Sprankle, P., W.F. Meggitt and D. Penner
TITLE: Adsorption, mobility, and microbial degradation of glyphosate in the soil
YEAR: 1975
JOURNAL: Weed Science 23:229-234

AUTHOR: Sprankle, P., W.F. Meggitt and D. Penner YEAR: 1975
TITLE: Rapid inactivation of glyphosate in soil

JOURNAL: Weed Science 23:224-228

AUTHOR: Stahlman, P.W. and W.M. Phillips YEAR: 1979
TITLE: Effects of water quality and spray volume on glyphosate phytotoxicity

JOURNAL: Weed Science 27(1): 38-41

AUTHOR: Stahlman, P.W. and W.M. Phillips YEAR: 1979
TITLE: Inhibition of glyphosate phytotoxicity

JOURNAL: Weed Science 27(5):575-577

AUTHOR: Stanger, C.E. YEAR: 1985
TITLE: The evaluation of 'Frigate' as a surfactant with reduced rates of Roundup

JOURNAL: Special Report - Oregon State Univ., Agric. Exp. Sta., Corvalis 8/85 (748):160-164

AUTHOR: Steinert, W.G. and J.F. Stritzke YEAR: 1977
TITLE: Uptake and phytotoxicity of tebuthiuron

JOURNAL: Weed Science 25(5):390-395

AUTHOR: Stevenson, J.H. YEAR: 1978
TITLE: The acute toxicity of unformulated pesticides to worker honey bees (Apis mellifera L.)
JOURNAL: Plant Pathology 27(1):38-40

AUTHOR: Todd, G.C., W.R. Gibson and C.C. Kehr YEAR: 1974
TITLE: Oral toxicity of tebuthiuron (1-(5-tert-butyl-1,3,4-thiadiazol-2-yl)-1,3-dimethylurea) in experimental animals
JOURNAL: Food and Cosmetics Toxicology 12(4):461-470

AUTHOR: Todd, G.C., W.R. Gibson and C.C. Kehr YEAR: 1974
TITLE: Oral toxicity of tebuthiuron (1-(5-tert-butyl-1,3,4-thiadiazol-2-yl)-1,3-dimethylurea) in experimental animals
JOURNAL: Food Cosmet. Toxicol. 12(4):461-470

AUTHOR: Torstensson, L. YEAR: 1985
TITLE: Behaviour of glyphosate in soils and its degradation

JOURNAL: The Herbicide Glyphosate. E. Grossbard and D. Atkinson, eds. pp. 137-150 (ISBN 0408111534)

AUTHOR: Torstensson, L. YEAR: 1988
TITLE: Occurrence and persistence of glyphosate in soil. A literature review

JOURNAL: 29th Swedish Weed Conference - Weeds and Weed Control 1:166

AUTHOR: Torstensson, N.T.L. and A. Aamisepp YEAR: 1977
TITLE: Detoxification of glyphosate in soil

JOURNAL: Weed Research 17:209-212

AUTHOR: Tye, R. and D. Engel YEAR: 1967
TITLE: Distribution and excretion of dicamba by rats as determined by radiotracer technique
JOURNAL: J. Agric. Food Chem. 15:837-840

AUTHOR: Voeller, J.E., L.L. Smith and H.A. Holt YEAR: 1976
TITLE: Right of way high volume applications of triclopyr (Dowco 233)

JOURNAL: Proc. So. Weed Sci. Soc. 29:334-336

AUTHOR: Voeller, J.E., L.L. Smith and H.A. Holt YEAR: 1976
TITLE: Right of way high volume applications of triclopyr (Dowco 233)

JOURNAL: Proceedings - Southern Weed Science Society 29:334-336

AUTHOR: Voth, R.D. and J.P. Downs YEAR: 1985
TITLE: Forestry review on glyphosate uses and performance in the southeast

JOURNAL: Proceedings - Southern Weed Science Society 38:136-139

AUTHOR: Wan, M.T., D.J. Moul and R.G. Watts YEAR: 1987
TITLE: Acute toxicity to juvenile Pacific salmonids of Garlon 3A, Garlon 4, triclopyr, triclopyr ester, and their transformation products *
JOURNAL: Bull. Environ. Contam. Toxicol. 39(4):721-728

AUTHOR: Wehtje, G. R., Dickens, J.W. Wilcut and B.F. Hajek YEAR: 1987
TITLE: Sorption and mobility of sulfometuron and imazapyr in five Alabama soils

JOURNAL: Weed Science 35(6):858-864

AUTHOR: Whitson, T.D., Hawkes, B., J. Brown, D. Humphrey and D. Langland YEAR: 1986
TITLE: Effect of herbicide treatments on tansy ragwort control

JOURNAL: Research progress report - Western Society of Weed Science:53-54

AUTHOR: Winfield, R.J. and C.J. Bannister YEAR: 1988
TITLE: Imazapyr for broad-spectrum weed control in forestry

JOURNAL: Aspects of Applied Biology 16: 79-88

AUTHOR: Wyrill, J.B. III and O.C. Burnside YEAR: 1977
TITLE: Glyphosate toxicity to common milkweed and hemp dogbane as influenced by surfactants
JOURNAL: Weed Science 25(3):275-287

AUTHOR: Yates, W.E., N.B. Akesson and D. E. Bayer YEAR: 1978
TITLE: Drift of glyphosate sprays applied with aerial and ground equipment
JOURNAL: Weed Science 26(6):597-604

AUTHOR: Young, F.L. and R.E. Whitesides YEAR: 1987
TITLE: Efficacy of postharvest herbicides on Russian thistle (Salsola iberica) control and seed germination
JOURNAL: Weed Science 35(4):554-559

AUTHOR: Zutter, B.R., G.R. Glover and D.H. Gjerstad YEAR: 1986
TITLE: Effects of herbaceous weed control using herbicides on a young loblolly pine plantation
JOURNAL: Forest Science 32(4):882-899

APPENDIX E

U.S. EPA GLOSSARY OF ENVIRONMENTAL TERMS

DRAFT

United States
Environmental Protection
Agency

Office of
Public Affairs (A-107)
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Glossary of Environmental Terms

DRAFT

Introduction

This glossary of environmental and related terms replaces "Common Environmental Terms," published by the Environmental Protection Agency in 1974 and revised in 1978. It is designed to give the user an explanation of the more commonly used environmental terms appearing in EPA publications, news releases and other Agency documents available to the general public, students, the news media, and Agency employees. The terms and definitions in this publication were selected to give the user a general sense of what a term or phrase means in relatively non-technical language, although it was obviously necessary to use some scientific terminology.

The terms selected for inclusion came from previously published lists, internal glossaries produced by various programs, and specific suggestions made by many Agency programs and offices. The chemicals and pesticides selected for inclusion were those most frequently referred to in Agency publications or which are the subject of major EPA regulatory or program activities.

Definitions or information about substances or program activities not included in this glossary may be found in EPA libraries or scientific/technical reference documents or may be obtained from the various program offices.

The definitions do not constitute the Agency's official use of terms and phrases for regulatory purposes. Nothing in this document should be construed to in any way alter or supplant any other federal document. Official terminology may be found in the laws and related regulations as published in such sources as the Congressional Record and the Federal Register.

Users with suggestions for future editions should write to the Publications Division, Office of Public Affairs, A-107, USEPA Washington DC, 20460.

A

Abatement: Reducing the degree or intensity of, or eliminating, pollution.

Abandoned Well: A well whose use has been permanently discontinued or which is in a state of disrepair such that it cannot be used for its intended purpose.

ABEL: EPA's computer model for analyzing a violator's ability to pay a civil penalty.

Absorption: The passage of one substance into or through another; e.g., an operation in which one or more soluble components of a gas mixture are dissolved in a liquid.

Accelerator: In radiation science, a device that speeds up charged particles such as electrons or protons.

Accident Site: The location of an unexpected occurrence, failure or loss, either at a plant or along a transportation route, resulting in a release of hazardous materials.

Acclimatization: The physiological and behavioral adjustments of an organism to changes in its environment.

Acetylcholine: A substance in the human body having important neurotransmitter effects on various internal systems; often used as a bronchoconstrictor.

Acid Deposition: A complex chemical and atmospheric phenomenon that occurs when emissions of sulfur and nitrogen compounds and other substances are transformed by chemical processes in the atmosphere, often far from the original sources, and then deposited on earth in either a wet or dry form. The wet forms, popularly called "acid rain," can fall as rain, snow, or fog. The dry forms are acidic gases or particulates.

Acid Rain: (See: acid deposition)

Action Levels: 1. Regulatory levels recommended by EPA for enforcement by FDA and USDA when pesticide residues occur in food or feed commodities for reasons other than the direct application of the pesticide. As opposed to "tolerances" which are established for residues occurring as a direct result of proper usage, action levels are set for inadvertent residues resulting from previous legal use or accidental contamination. 2. In the Superfund program, the existence of a contaminant concentration in the environment high enough to warrant action or trigger a response under SARA and the National Oil and Hazardous Substances Contingency Plan. The term can be used similarly in other regulatory programs. (See: tolerances.)

Activated Carbon: A highly adsorbent form of carbon used to remove odors and toxic substances from liquid or gaseous emissions. In waste treatment it is used to remove dissolved organic matter from waste water. It is also used in motor vehicle evaporative control systems.

Activated Sludge: Sludge that results when primary effluent is mixed with bacteria-laden sludge and then agitated and aerated to promote biological treatment. This speeds breakdown of organic matter in raw sewage undergoing secondary waste treatment.

Active Ingredient: In any pesticide product, the component which kills, or otherwise controls, target pests. Pesticides are regulated primarily on the basis of active ingredients.

Acute Exposure: A single exposure to a toxic substance which results in severe biological harm or death. Acute exposures are usually characterized as lasting no longer than a day.

Acute Toxicity: The ability of a substance to cause poisonous effects resulting in severe biological harm or death soon after a single exposure or dose. Also, any severe poisonous effect resulting from a single short-term exposure to a toxic substance. (See: chronic toxicity, toxicity.)

Adaptation: Changes in an organism's structure or habit that help it adjust to its surroundings.

Add-on Control Device: An air pollution control device such as carbon adsorber or incinerator which reduces the pollution in an exhaust gas. The control device usually does not affect the process being controlled and thus is "add-on" technology as opposed to a scheme to control pollution through making some alteration to the basic process.

Adhesion: Molecular attraction which holds the surfaces of two substances in contact.

Administrative Order: A legal document signed by EPA directing an individual, business, or other entity to take corrective action or refrain from an activity. It describes the violations and actions to be taken, and can be enforced in court. Such orders may be issued, for example, as a result of an administrative complaint whereby the respondent is ordered to pay a penalty for violations of a statute.

Administrative Order On Consent: A legal agreement signed by EPA and an individual, business, or other entity through which the violator agrees to pay for correction of violations, take the required corrective or cleanup actions, or refrain from an activity. It describes the actions to be taken, may be subject to a comment period, applies to civil actions, and can be enforced in court.

Administrative Procedures Act: A law that spells out procedures and requirements related to the promulgation of regulations.

Adsorption: 1. Adhesion of molecules of gas, liquid, or dissolved solids to a surface. 2. An advanced method of treating wastes in which activated carbon removes organic matter from wastewater.

Adulterants: Chemical impurities or substances that by law do not belong in a food, or in a pesticide.

Advanced Waste Water Treatment: Any treatment of sewage that goes beyond the secondary or biological water treatment stage and includes the removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids. (See primary, secondary treatment.)

Advisory: A non-regulatory document that communicates risk information to persons who may have to make risk management decisions.

Aeration: A process which promotes biological degradation of organic water. The process may be passive (as when waste is exposed to air), or active (as when a mixing or bubbling device introduces the air).

Aeration Tank: A chamber used to inject air into water.

Aerobic: Life or processes that require, or are not destroyed by, the presence of oxygen. (See: anaerobic.)

Aerobic Treatment: Process by which microbes decompose complex organic compounds in the presence of oxygen and use the liberated energy for reproduction and growth. Types of aerobic processes include extended aeration, trickling filtration, and rotating biological contactors.

Aerosol: A suspension of liquid or solid particles in a gas.

Afterburner: In incinerator technology, a burner located so that the combustion gases are made to pass through its flame in order to remove smoke and odors. It may be attached to or be separated from the incinerator proper.

Agent Orange: A toxic herbicide and defoliant which was used in the Vietnam conflict. It contains 2,4,5-trichlorophenoxyacitic acid (2,4,5-T) and 2-4 dichlorophenoxyacetic acid (2,4-D) with trace amounts of dioxin.

Agglomeration: The process by which precipitation particles grow larger by collision or contact with cloud particles or other precipitation particles.

Agglutination: The process of uniting solid particles coated with a thin layer of adhesive material or of arresting solid particles by impact on a surface coated with an adhesive.

Agricultural Pollution: The liquid and solid wastes from farming, including: runoff and leaching of pesticides and fertilizers; erosion and dust from plowing; animal manure and carcasses; crop residues, and debris.

Airborne Particulates: Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets. Chemical composition of particulates varies widely, depending on location and time of year. Airborne particulates include: windblown dust, emissions from industrial processes, smoke from the burning of wood and coal, and the exhaust of motor vehicles.

Airborne Release: Release of any chemical into the air.

Air Changes Per Hour (ACH): The movement of a volume of air in a given period of time; if a house has one air change per hour, it means that all of the air in the house will be replaced in a one-hour period.

Air Contaminant: Any particulate matter, gas, or combination thereof, other than water vapor or natural air. (See: air pollutant.)

Air Curtain: A method of containing oil spills. Air bubbling through a perforated pipe causes an upward water flow that slows the spread of oil. It can also be used to stop fish from entering polluted water.

Air Mass: A widespread body of air that gains certain meteorological or polluted characteristics—e.g., a heat inversion or smogginess—while set in one location. The characteristics can change as it moves away.

Air Monitoring: (See: monitoring)

Air Pollutant: Any substance in air which could, if in high enough concentration, harm man, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of matter capable of being airborne. They may be in the form of solid particles, liquid droplets, gases, or in combinations of these forms. Generally, they fall into two main groups: (1) those emitted directly from identifiable sources and (2) those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents, with or without photoactivation. Exclusive of pollen, fog, and dust, which are of natural origin, about 100 contaminants

have been identified and fall into the following categories: solids, sulfur compounds, volatile organic chemicals, nitrogen compounds, oxygen compounds, halogen compounds, radioactive compounds, and odors.

Air Pollution: The presence of contaminant or pollutant substances in the air that do not disperse properly and interfere with human health or welfare, or produce other harmful environmental effects.

Air Pollution Episode: A period of abnormally high concentration of air pollutants, often due to low winds and temperature inversion, that can cause illness and death. (See: episode, pollution.)

Air Quality Control Region: An area—designated by the federal government—in which communities share a common air pollution problem. Sometimes several states are involved.

Air Quality Criteria: The levels of pollution and lengths of exposure above which adverse health and welfare effects may occur.

Air Quality Standards: The level of pollutants prescribed by regulations that may not be exceeded during a specified time in a defined area.

Alachlor: A herbicide, marketed under the trade name Lasso, used mainly to control weeds in corn and soybean fields.

Alar: Trade name for daminozide, a pesticide that makes apples redder, firmer, and less likely to drop off trees before growers are ready to pick them. It is also used to a lesser extent on peanuts, tart cherries, concord grapes, and other fruits.

Aldicarb: An insecticide sold under the trade name Temik. It is made from ethyl isocyanate.

Algae: Simple rootless plants that grow in sunlit waters in relative proportion to the amounts of nutrients available. They can affect water quality adversely by lowering the dissolved oxygen in the water. They are food for fish and small aquatic animals.

Algal Blooms: Sudden spurts of algal growth, which can affect water quality adversely and indicate potentially hazardous changes in local water chemistry.

Alpha Particle: A positively charged particle composed of 2 neutrons and 2 protons released by some atoms undergoing radioactive decay. The particle is identical to the nucleus of a helium atom.

Alternate Method: Any method of sampling and analyzing for an air pollutant which is not a reference or equivalent method but which has been demonstrated in specific cases to EPA's satisfaction to produce results adequate for compliance..

Ambient Air: Any unconfined portion of the atmosphere: open air, surrounding air.

Ambient Air Quality Standards: (See: Criteria Pollutants and National Ambient Air Quality Standards)

Anadromous: Fish that spend their adult life in the sea but swim upriver to fresh-water spawning grounds to reproduce.

Anaerobic: A life or process that occurs in, or is not destroyed by, the absence of oxygen.

Antagonism: The interaction of two chemicals having an opposing, or neutralizing effect on each other, or—given some specific biological effect—a chemical interaction that appears to have an opposing or neutralizing effect over what might otherwise be expected.

Antarctic "Ozone Hole": Refers to the seasonal depletion of ozone in a large area over Antarctica.

Antibodies: Proteins produced in the body by immune system cells in response to antigens, and capable of combining with antigens.

Anti-Degradation Clause: Part of federal air quality and water quality requirements prohibiting deterioration where pollution levels are above the legal limit.

Antigen: A substance that causes production of antibodies when introduced into animal or human tissue.

Aquifer: An underground geological formation, or group of formations, containing usable amounts of groundwater that can supply wells and springs.

Arbitration: A process for the resolution of disputes. Decisions are made by an impartial arbitrator selected by the parties. These decisions are usually legally binding. (See: mediation.)

Area of Review: In the UIC program, the area surrounding an injection well that is reviewed during the permitting process to determine whether the injection operation will induce flow between aquifers.

Area Source: Any small source of non-natural air pollution that is released over a relatively small area but which cannot be classified as a point source. Such sources may include vehicles and other small fuel combustion engines.

Asbestosis: A disease associated with chronic exposure to and inhalation of asbestos fibers. The disease makes breathing progressively more difficult and can lead to death.

Asbestos: A mineral fiber that can pollute air or water and cause cancer or asbestosis when inhaled. EPA has banned or severely restricted its use in manufacturing and construction.

Ash: The mineral content of a product remaining after complete combustion.

A-Scale Sound Level: A measurement of sound approximating the sensitivity of the human ear, used to note the intensity or annoyance of sounds.

Assimilation: The ability of a body of water to purify itself of pollutants.

Atmosphere [an]: A standard unit of pressure representing the pressure exerted by a 29.92-inch column of mercury at sea level at 45° latitude and equal to 1000 grams per square centimeter. (the) The whole mass of air surrounding the earth, composed largely of oxygen and nitrogen.

Atomize: To divide a liquid into extremely minute particles, either by impact with a jet of steam or compressed air, or by passage through some mechanical device.

Attainment Area: An area considered to have air quality as good as or better than the national ambient air quality standards as defined in the Clean Air Act. An area may be an attainment area for one pollutant and a non-attainment area for others.

Attenuation: The process by which a compound is reduced in concentration over time, through adsorption, degradation, dilution, and/or transformation.

Attractant: A chemical or agent that lures insects or other pests by stimulating their sense of smell.

Attrition: Wearing or grinding down of a substance by friction. A contributing factor in air pollution, as with dust.

Autotrophic: An organism that produces food from inorganic substances.

B

Background Level: In air pollution control, the concentration of air pollutants in a definite area during a fixed period of time prior to the starting up or on the stoppage of a source of emission under control. In toxic substances monitoring, the average presence in the environment, originally referring to naturally occurring phenomena.

BACT—Best Available Control Technology: A emission limitation based on the maximum degree of emission reduction which (considering energy, environmental, and economic impacts and other costs) is achievable through application of production processes and available methods, systems, and techniques. In no event does BACT permit emissions in excess of those allowed under any applicable Clean Air Act provisions. Use of the BACT concept is allowable on a case by case basis for major new or modified emissions sources in attainment areas and applies to each regulated pollutant.

Bacteria: (Singular: bacterium) Microscopic living organisms which can aid in pollution control by consuming or breaking down organic matter in sewage, or by similarly acting on oil spills or other water pollutants. Bacteria in soil, water or air can also cause human, animal and plant health problems.

Baffle Chamber: In incinerator design, a chamber designed to promote the settling of fly ash and coarse particulate matter by changing the direction and/or reducing the velocity of the gases produced by the combustion of the refuse or sludge.

Baghouse Filter: Large fabric bag, usually made of glass fibers, used to eliminate intermediate and large (greater than 20 microns in diameter) particles. This device operates in a way similar to the bag of an electric vacuum cleaner, passing the air and smaller particulate matter, while entrapping the larger particulates.

Baling: Compacting solid waste into blocks to reduce volume and simplify handling.

Ballistic Separator: A machine that sorts organic from inorganic matter for composting.

Band Application: In pesticides, the spreading of chemicals over, or next to, each row of plants in a field.

Banking: A system for recording qualified air emission reductions for later use in bubble, offset, or netting transactions. (See: emissions trading.)

Bar Screen: In wastewater treatment, a device used to remove large solids.

Barrier Coating(s): A layer of a material that acts to obstruct or prevent passage of something through a surface that is to be protected, e.g. grout, caulk, or various sealing compounds; sometimes used with polyurethane membranes to prevent corrosion or oxidation of metal surfaces, chemical impacts on various materials, or, for example, to prevent soil-gas-borne radon from moving through walls, cracks, or joints in a house.

Basal Application: In pesticides, the application of a chemical on plant stems or tree trunks just above the soil line.

BEN: EPA's computer model for analyzing a violator's economic gain from not complying with the law.

Benthic Organism (Benthos): A form of aquatic plant or animal life that is found on or near the bottom of a stream, lake or ocean.

Benthic Region: The bottom layer of a body of water.

Beryllium: An airborne metal that can be hazardous to human health when inhaled. It is discharged by machine shops, ceramic and propellant plants, and foundries.

Beta Particle: An elementary particle emitted by radioactive decay, that may cause skin burns. It is halted by a thin sheet of paper.

Bioaccumulative: Substances that increase in concentration in living organisms (that are very slowly metabolized or excreted) as they breathe contaminated air, drink contaminated water, or eat contaminated food. (See: biological magnification.)

Bioassay: Using living organisms to measure the effect of a substance, factor, or condition by comparing before-and-after data. Term is often used to mean cancer bioassays.

Biochemical Oxygen Demand (BOD): A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. The greater the BOD, the greater the degree of pollution.

Biodegradable: The ability to break down or decompose rapidly under natural conditions and processes.

Biological Control: In pest control, the use of animals and organisms that eat or otherwise kill or out-compete pests.

Biological Magnification: Refers to the process whereby certain substances such as pesticides or heavy metals move up the food chain, work their way into a river or lake and are eaten by aquatic organisms such as fish which in turn are eaten by large birds, animals or humans. The substances become concentrated in tissues or internal organs as they move up the chain. (See: bioaccumulative.)

Biological Oxidation: The way bacteria and microorganisms feed on and decompose complex organic materials. Used in self-purification of water bodies and in activated sludge wastewater treatment.

Biological Treatment: A treatment technology that uses bacteria to consume waste. This treatment breaks down organic materials.

Biomass: All of the living material in a given area; often refers to vegetation. Also called "biota".

Biomonitoring: 1. The use of living organisms to test the suitability of effluents for discharge into receiving waters and to test the quality of such waters downstream from the discharge. 2. Analysis of blood, urine, tissues, etc., to measure chemical exposure in humans.

Biosphere: The portion of Earth and its atmosphere that can support life.

Biostabilizer: A machine that converts solid waste into compost by grinding and aeration.

Biota: (See: biomass.)

Biotechnology: Techniques that use living organisms or parts of organisms to produce a variety of products (from medicines to industrial enzymes) to improve plants or animals or to develop microorganisms for specific uses such as removing toxics from bodies of water, or as pesticides.

Biotic Community: A naturally occurring assemblage of plants and animals that live in the same environment and are mutually sustaining and interdependent.

Black Lung: A disease of the lungs caused by habitual inhalation of coal dust.

Blackwater: Water that contains animal, human, or food wastes.

Bloom: A proliferation of algae and/or higher aquatic plants in a body of water; often related to pollution, especially when pollutants accelerate growth.

BOD5: The amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter.

Bog: A type of wetland that accumulates appreciable peat deposits. Bogs depend primarily on precipitation for their water source, are usually acidic and rich in plant residue with a conspicuous mat of living green moss.

Boom: 1. A floating device used to contain oil on a body of water. 2. A piece of equipment used to apply pesticides from ground equipment such as a tractor or truck. (See: sonic boom.)

Botanical Pesticide: A pesticide whose active ingredient is a plant produced chemical such as nicotine or strychnine.

Bottle Bill: Proposed or enacted legislation which requires a returnable deposit on beer or soda containers and provides for retail store or other redemption centers. Such legislation is designed to discourage use of throw-away containers.

Bottom Land Hardwoods: Forested freshwater wetlands adjacent to rivers in the southeastern United States. They are especially valuable for wildlife breeding and nesting and habitat areas.

Brackish Water: A mixture of fresh and salt water.

Broadcast Application: In pesticides, the spreading of chemicals over an entire area.

Bubble: A system under which existing emissions sources can propose alternate means to comply with a set of emissions limitations; under the bubble concept, sources can control more than required at one emission point where control costs are relatively low in return for a comparable relaxation of controls at a second emission point where costs are higher.

Bubble Policy: (See: emissions trading.)

Buffer Strips: Strips of grass or other erosion-resisting vegetation between or below cultivated strips or fields.

Burial Ground (Graveyard): A disposal site for radioactive waste materials that uses earth or water as a shield.

By-product: Material, other than the principal product, that is generated as a consequence of an industrial process.

C

Cadmium (CD): A heavy metal element that accumulates in the environment.

Cancellation: Refers to Section 6 (b) of the the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) which authorizes cancellation of a pesticide registration if unreasonable adverse effects to the environment and public health develop when a product is used according to widespread and commonly recognized practice, or if its labeling or other material required to be submitted does not comply with FIFRA provisions.

Cap: A layer of clay, or other highly impermeable material installed over the top of a closed landfill to prevent entry of rainwater and minimize production of leachate.

Capture Efficiency: The fraction of all organic vapors generated by a process that are directed to an abatement or recovery device.

Carbon Adsorber: An add-on control device which uses activated carbon to absorb volatile organic compounds from a gas stream. The VOCs are later recovered from the carbon.

Carbon Dioxide (CO2): A colorless, odorless, non-poisonous gas, which results from fossil fuel combustion and is normally a part of the ambient air.

Carbon Monoxide (CO): A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

Carboxyhemoglobin: Hemoglobin in which the iron is associated with carbon monoxide (CO). The affinity of hemoglobin for CO is about 300 times greater than for oxygen.

Carcinogen: Any substance that can cause or contribute to the production of cancer.

Carcinogenic: Cancer-producing.

Carrying Capacity: 1. In recreation management, the amount of use a recreation area can sustain without deterioration of its quality. 2. In wildlife management, the maximum number of animals an area can support during a given period of the year.

Cask: A thick-walled container (usually lead) used to transport radioactive material. Also called a coffin.

Catanadramous: Fish that swim downstream to spawn.

Catalytic Converter: An air pollution abatement device that removes pollutants from motor vehicle exhaust, either by oxidizing them into carbon dioxide and water or reducing them to nitrogen and oxygen.

Catalytic Incinerator: A control device which oxidizes volatile organic compounds (VOCs) by using a catalyst to promote the combustion process. Catalytic incinerators require lower temperatures than conventional thermal incinerators, with resultant fuel and cost savings.

Categorical Exclusion: A class of actions which either individually or cumulatively would not have a significant effect on the human environment and therefore would not require preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act (NEPA).

Categorical Pretreatment Standard: A technology-based effluent limitation for an industrial facility which discharges into a municipal sewer system. Analogous in stringency to Best Availability Technology (BAT) for direct dischargers.

Cathodic Protection: A technique to prevent corrosion of a metal surface by making that surface the cathode of an electrochemical cell.

Caustic Soda: Sodium hydroxide, a strong alkaline substance used as the cleaning agent in some detergents.

CBOD5: The amount of dissolved oxygen consumed in 5 days from the carbonaceous portion of biological processes breaking down in an effluent. The test methodology is the same as for BOD5, except that nitrogen demand is suppressed.

Cells: 1.In solid waste disposal, holes where waste is dumped, compacted, and covered with layers of dirt on a daily basis. 2. The smallest structural part of living matter capable of functioning as an independent unit.

Centrifugal Collector: A mechanical system using centrifugal force to remove aerosols from a gas stream or to de-water sludge.

Cesium (Cs): A silver-white, soft ductile element of the alkali metal group that is the most electropositive element known. Used especially in photoelectric cells.

Channelization: Straightening and deepening streams so water will move faster, a flood-reduction or marsh-drainage tactic that can interfere with waste assimilation capacity and disturb fish and wildlife habitats.

Characteristic: Any one of the four categories used in defining hazardous waste: ignitability, corrosivity, reactivity, and toxicity.

Chemical Oxygen Demand (COD): A measure of the oxygen required to oxidize all compounds in water, both organic and inorganic.

Chemical Treatment: Any one of a variety of technologies that use chemicals or a variety of chemical processes to treat waste.

Chemosterilant: A chemical that controls pests by preventing reproduction.

Chilling Effect: The lowering of the Earth's temperature because of increased particles in the air blocking the sun's rays. (See: greenhouse effect.)

Chlorinated Hydrocarbons: These include a class of persistent, broad-spectrum insecticides, that linger in the environment and accumulate in the food chain. Among them are DDT, aldrin, dieldrin, heptachlor, chlordane, lindane, endrin, mirex, hexachloride, and toxaphene. Other examples include TCE, used as an industrial solvent.

Chlorinated Solvent: An organic solvent containing chlorine atoms, e.g., methylene chloride and 1,1,1-trichloromethane which are used in aerosol spray containers and in traffic paint.

Chlorination: The application of chlorine to drinking water, sewage, or industrial waste to disinfect or to oxidize undesirable compounds.

Chlorinator: A device that adds chlorine, in gas or liquid form, to water or sewage to kill infectious bacteria.

Chlorine-Contact Chamber: That part of a water treatment plant where effluent is disinfected by chlorine.

Chlorofluorocarbons (CFCs): A family of inert, nontoxic, and easily liquified chemicals used in refrigeration, air conditioning, packaging, insulation, or as solvents and aerosol propellants. Because CFCs are not destroyed in the lower atmosphere they drift into the upper atmosphere where their chlorine components destroy ozone.

Chlorosis: Discoloration of normally green plant parts, that can be caused by disease, lack of nutrients, or various air pollutants.

Chromium: (See: heavy metals.)

Chronic Toxicity: The capacity of a substance to cause long-term poisonous human health effects. (See: acute toxicity.)

Clarification: Clearing action that occurs during wastewater treatment when solids settle out. This is often aided by centrifugal action and chemically induced coagulation in wastewater.

Clarifier: A tank in which solids are settled to the bottom and are subsequently removed as sludge.

Cleanup: Actions taken to deal with a release or threat of release of a hazardous substance that could affect humans and/or the environment. The term "cleanup" is sometimes used interchangeably with the terms remedial action, removal action, response action, or corrective action.

Clear Cut: A forest management technique that involves harvesting all t trees in one area at one time. Under certain soil and slope conditions it can contribute sediment to water pollution.

Cloning: In biotechnology, obtaining a group of genetically identical cells fr a single cell. This term has assumed a more general meaning that inclu making copies of a gene.

Closed-Loop Recycling: Reclaiming or reusing wastewater for non-potable purposes in an enclosed process.

Coagulation: A clumping of particles in wastewater to settle out impurities is often induced by chemicals such as lime, alum, and iron salts.

Coastal Zone: Lands and waters adjacent to the coast that exert an influence on the uses of the sea and its ecology, or, inversely, whose uses and ecology are affected by the sea.

Coefficient of Haze (COH): A measurement of visibility interference in t atmosphere.

Coliform Index: A rating of the purity of water based on a count of fecal bacteria.

Coliform Organism: Microorganisms found in the intestinal tract of huma and animals. Their presence in water indicates fecal pollution and potentially dangerous bacterial contamination by disease-causing microorganisms.

Combined Sewers: A sewer system that carries both sewage and storm-wa runoff. Normally, its entire flow goes to a waste treatment plant, but durin heavy storm, the storm water volume may be so great as to cause overflows. When this happens untreated mixtures of storm water and sewage may flow into receiving waters. Storm-water runoff may also carry toxic chemicals fr industrial areas or streets into the sewer system.

Combustion: Burning, or rapid oxidation, accompanied by release of ener in the form of heat and light. A basic cause of air pollution.

Combustion Product: Substance produced during the burning or oxidation of a material.

Command Post: Facility located at a safe distance upwind from an accid site, where the on-scene coordinator, responders, and technical representatives can make response decisions, deploy manpower and equipment, maintain liaison with news media, and handle communications.

Comment Period: Time provided for the public to review and comment o proposed EPA action or rulemaking after it is published in the Federal Register.

Comminution: Mechanical shredding or pulverizing of waste. Used in b solid waste management and wastewater treatment.

Comminuter: A machine that shreds or pulverizes solids to make waste treatment easier.

Community Relations: The EPA effort to establish two-way communicati with the public to create understanding of EPA programs and related actio to assure public input into decision-making processes related to affect communities, and to make certain that the Agency is aware of and responsive to public concerns. Specific community relations activities are required in relation to Superfund remedial actions.

Community Water System: A public water system which serves at leas service connections used by year-round residents or regularly serves at least 25 year-round residents.

Compaction: Reduction of the bulk of solid waste by rolling and tampin

Compliance Coating: A coating whose volatile organic compound cont does not exceed that allowed by regulation.

Compliance Schedule: A negotiated agreement between a pollution sour and a government agency that specifies dates and procedures by whic source will reduce emissions and, thereby, comply with a regulation.

Compost: A mixture of garbage and degradable trash with soil in which certain bacteria in the soil break down the garbage and trash into organic fertilizer.

Composting: The natural biological decomposition of organic material in presence of air to form a humus-like material. Controlled methods of compo ing include mechanical mixing and aerating, ventilating the materials by dropping them through a vertical series of aerated chambers, or placing the compost in piles out in the open air and mixing it or turning it periodicall

Conditional Registration: Under special circumstances, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) permits registration of pesticide products that is "conditional" upon the submission of additional data. These special circumstances include a finding by the EPA Administrator that a new product or use of an existing pesticide will not significantly increase the risk of unreasonable adverse effects. A product containing a new (previously unregistered) active ingredient may be conditionally registered only if the Administrator finds that such conditional registration is in the public interest, that a reasonable time for conducting the additional studies has not elapsed, and the use of the pesticide for the period of conditional registration will not present an unreasonable risk.

Confined Aquifer: An aquifer in which ground water is confined under pressure which is significantly greater than atmospheric pressure.

Consent Decree: A legal document, approved by a judge, that formalizes an agreement reached between EPA and potentially responsible parties (PRPs) through which PRPs will conduct all or part of a cleanup action at a Superfund site; cease or correct actions or processes that are polluting the environment; or otherwise comply with regulations where the PRP's failure to comply caused EPA to initiate regulatory enforcement actions. The consent decree describes the actions PRP's will take and may be subject to a public comment period.

Conservation: Avoiding waste of, and renewing when possible, human and natural resources. The protection, improvement, and use of natural resources according to principles that will assure their highest economic or social benefits.

Contact Pesticide: A chemical that kills pests when it touches them, rather than by being eaten (stomach poison). Also, soil that contains the minute skeletons of certain algae that scratches and dehydrates waxy-coated insects.

Contaminant: Any physical, chemical, biological, or radiological substance or matter that has an adverse affect on air, water, or soil.

Contingency Plan: A document setting out an organized, planned, and coordinated course of action to be followed in case of a fire, explosion, or other accident that releases toxic chemicals, hazardous wastes, or radioactive materials which threaten human health or the environment. (See: National Oil and Hazardous Substances Contingency Plan.)

Contract Labs: Laboratories under contract to EPA, which analyze samples taken from wastes, soil, air, and water or carry out research projects.

Contrails: Long, narrow clouds caused when high-flying jet aircraft disturb the atmosphere.

Contour Plowing: Farming methods that break ground following the shape of the land in a way that discourages erosion.

Control Technique Guidelines (CTG): A series of EPA documents designed to assist states in defining reasonable available control technology (RACT) for major sources of volatile organic compounds (VOC).

Conventional Pollutants: Statutorily listed pollutants which are understood well by scientists. These may be in the form of organic waste, sediment, acid, bacteria and viruses, nutrients, oil and grease, or heat.

Conventional Systems: Systems that have been traditionally used to collect municipal wastewater in gravity sewers and convey it to a central primary or secondary treatment plant prior to discharge to surface waters.

Coolant: A liquid or gas used to reduce the heat generated by power production in nuclear reactors, electric generators, various industrial and mechanical processes, and automobile engines.

Cooling Tower: A structure that helps remove heat from water used as a coolant; e.g., in electric power generating plants.

Core: The uranium-containing heart of a nuclear reactor, where energy is released.

Corrosion: The dissolving and wearing away of metal caused by a chemical reaction such as between water and the pipes that the water contacts, chemicals touching a metal surface, or contact between two metals.

Corrosive: A chemical agent that reacts with the surface of a material causing it to deteriorate or wear away.

Cost-Effective Alternative: An alternative control or corrective method identified after analysis as being the best available in terms of reliability, permanence, and economic considerations. Although costs are one important consideration, when regulatory and compliance methods are being considered, such analysis does not require EPA to choose the least expensive alternative. For example, when selecting a method for cleaning up a site on the Superfund National Priorities List, the Agency balances costs with the long-term effectiveness of the various methods proposed.

Cost Recovery: A legal process by which potentially responsible parties who contributed to contamination at a Superfund site can be required to reimburse the Trust Fund for money spent during any cleanup actions by the federal government.

Cover: Vegetation or other material providing protection as ground cover.

Cover Material: Soil used to cover compacted solid waste in a sanitary landfill.

Crawl Space: In some types of houses, which are constructed so that the floor is raised slightly above the ground, an area beneath the floor which allows access to utilities and other services. This is in contrast to slab-on-grade or basement construction houses.

Criteria: Descriptive factors taken into account by EPA in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. When issued by EPA, the criteria provide guidance to the states on how to establish their standards.

Criteria Pollutants: The 1970 amendments to the Clean Air Act required EPA to set National Ambient Air Quality Standards for certain pollutants known to be hazardous to human health. EPA has identified and set standards to protect human health and welfare for six pollutants: ozone, carbon monoxide, total suspended particulates, sulfur dioxide, lead, and nitrogen oxide. The term, "criteria pollutants" derives from the requirement that EPA must describe the characteristics and potential health and welfare effects of these pollutants. It is on the basis of these criteria that standards are set or revised.

Cubic Feet Per Minute (CFM): A measure of the volume of a substance flowing through air within a fixed period of time. With regard to indoor air, refers to the amount of air, in cubic feet, that is exchanged with indoor air in a minute's time, or an air exchange rate.

Cultural Eutrophication: Increasing rate at which water bodies "die" by pollution from human activities.

Cumulative Working Level Months (CWLM): The sum of lifetime exposure to radon working levels expressed in total working level months.

Curie: A quantitative measure of radioactivity equal to 3.7 x 1010 disintegrations per second.

Cutie-Pie: An instrument used to measure radiation levels.

Cyclone Collector: A device that uses centrifugal force to pull large particles from polluted air.

D

DDT: The first chlorinated hydrocarbon insecticide (chemical name: Dichloro-Diphsdyl-Trichloromethane). It has a half-life of 15 years and can collect in fatty tissues of certain animals. EPA banned registration and interstate sale of DDT for virtually all but emergency uses in the United States in 1972 because of its persistence in the environment and accumulation in the food chain.

Data Call-In: A part of the Office of Pesticide Programs (OPP) process of developing key required test data, especially on the long-term, chronic effects of existing pesticides, in advance of scheduled Registration Standard reviews. Data Call-In is an adjunct of the Registration Standards program intended to expedite reregistration and involves the "calling in" of data from manufacturers.

Dechlorination: Removal of chlorine from a substance by chemically replacing it with hydrogen or hydroxide ions in order to detoxify the substances involved.

Decibel (dB): A unit of sound measurement. In general, a sound doubles in loudness for every increase of ten decibels.

Decomposition: The breakdown of matter by bacteria and fungi. It changes the chemical makeup and physical appearance of materials.

Degradation: The process by which a chemical is reduced to a less complex form.

Delegated State: A state (or other governmental entity) which has applied for, and received authority to administer, within its territory, its state regulatory program as the federal program required under a particular federal statute. As used in connection with NPDES, UIC, and PWS programs, the term does not connote any transfer of federal authority to a state.

Defoliant: A herbicide that removes leaves from trees and growing plants.

Delist: Use of the petition process to have a facility s toxic designation rescinded.

Denitrification: The anaerobic biological reduction of nitrate nitrogen to nitrogen gas.

Depletion Curve: In hydraulics, a graphical representation of water depletion from storage-stream channels, surface soil, and ground water. A depletion curve can be drawn for base flow, direct runoff, or total flow.

Depressurization: A condition that occurs when the air pressure inside a structure is lower that the air pressure outside. Depressurization can occur when household appliances that consume or exhaust house air, such as fireplaces or furnaces, are not supplied with enough makeup air. Radon-containing soil gas may be drawn into a house more rapidly under depressurized conditions.

Dermal Toxicity: The ability of a pesticide or toxic chemical to poison people or animals by contact with the skin. (See: contact pesticide.)

DES: A synthetic estrogen, diethylstilbestrol is used as a growth stimulant in food animals. Residues in meat are thought to be carcinogenic.

Desalinization: Removing salt from ocean or brackish water.

Desiccant: A chemical agent that absorbs moisture; some desiccants are capable of drying out plants or insects, causing death.

Designated Pollutant: An air pollutant which is neither a criteria nor hazardous pollutant, as described in the Clean Air Act, but for which new sources performance standards exist. The Clean Air Act does require states to control these pollutants, which include acid mist, total reduced sulfur (TRS), and fluorides.

Designer Bugs: Popular term for microbes developed through biotechnology that can degrade specific toxic chemicals at their source in toxic waste dumps or in ground water.

Desulfurization: Removal of sulfur from fossil fuels to reduce pollution.

Designated Uses: Those water uses identified in state water quality standards which must be achieved and maintained as required under the Clean Water Act. Uses can include cold water fisheries, public water supply, agriculture, etc.

Detergent: Synthetic washing agent that helps to remove dirt and oil. Some contain compounds which kill useful bacteria and encourage algae growth when they are in wastewater that reaches receiving waters.

Developer: A person, government unit, or company that proposes to build a hazardous waste treatment, storage, or disposal facility.

Diatomaceous Earth (Diatomite): A chalk-like material (fossilized diatoms) used to filter out solid waste in waste-water treatment plants, also used as an active ingredient in some powdered pesticides.

Diazinon: An insecticide. In 1986, EPA banned its use on open areas such as sod farms and golf courses because it posed a danger to migratory birds who gathered on them in large numbers. The ban did not apply to its use in agriculture, or on lawns of homes and commercial establishments.

Dicofol: A pesticide used on citrus fruits.

Differentiation: The process by which single cells grow into particular forms of specialized tissue, e.g., root, stem, leaf.

Diffused Air: A type of aeration that forces oxygen into sewage by pumping air through perforated pipes inside a holding tank and bubbling it through the sewage.

Digester: In wastewater treatment, a closed tank; in solid waste conversion, a unit in which bacterial action is induced and accelerated in order to break down organic matter and establish the proper carbon to nitrogen ratio.

Digestion: The biochemical decomposition of organic matter, resulting in partial gasification, liquefaction, and mineralization of pollutants.

Dike: A low wall that can act as a barrier to prevent a spill from spreading.

Dilution Ratio: The relationship between the volume of water in a stream and the volume of incoming water. It affects the ability of the stream to assimilate waste.

Dinocap: A fungicide used primarily by apple growers to control summer diseases. EPA, in 1986, proposed restrictions on its use when laboratory tests found it caused birth defects in rabbits.

Dinoseb: A herbicide that is also used as a fungicide and insecticide. It was banned by EPA in 1986 because it posed the risk of birth defects and sterility.

Dioxin: Any of a family of compounds known chemically as dibenzo-p-dioxins. Concern about them arises from their potential toxicity and contaminants in commercial products. Tests on laboratory animals indicate that it is one of the more toxic man-made chemicals known.

Direct Discharger: A municipal or industrial facility which introduces pollution through a defined conveyance or system; a point source.

Disinfectant: A chemical or physical process that kills pathogenic organisms in water. Chlorine is often used to disinfect sewage treatment effluent, water supplies, wells, and swimming pools.

Dispersant: A chemical agent used to break up concentrations of organic material such as spilled oil.

Disposal: Final placement or destruction of toxic, radioactive, or other wastes: surplus or banned pesticides or other chemicals; polluted soils; and drums containing hazardous materials from removal actions or accidental releases. Disposal may be accomplished through use of approved secure landfills, surface impoundments, land farming, deep well injection, ocean dumping, or incineration.

Dissolved Oxygen (DO): The oxygen freely available in water. Dissolved oxygen is vital to fish and other aquatic life and for the prevention of odors. Traditionally, the level of dissolved oxygen has been accepted as the single most important indicator of a water body's ability to support desirable aquatic life. Secondary and advanced waste treatment are generally designed to protect DO in waste-receiving waters.

Dissolved Solids: Disintegrated organic and inorganic material contained in water. Excessive amounts make water unfit to drink or use in industrial processes.

Distillation: The act of purifying liquids through boiling, so that the steam condenses to a pure liquid and the pollutants remain in a concentrated residue.

DNA: Deoxyribonucleic acid, the molecule in which the genetic information for most living cells is encoded. Viruses, too, can contain RNA.

DNA Hybridization: Use of a segment of DNA, called a DNA probe, to identify its complementary DNA; used to detect specific genes. This process takes advantage of the ability of a single strand of DNA to combine with a complimentary strand.

Dose: In radiology, the quantity of energy or radiation absorbed.

Dosimeter: An instrument that measures exposure to radiation.

Dredging: Removal of mud from the bottom of water bodies using a scooping machine. This disturbs the ecosystem and causes silting that can kill aquatic life. Dredging of contaminated muds can expose aquatic life to heavy metals and other toxics. Dredging activities may be subject to regulation under Section 404 of the Clean Water Act.

Dump: A site used to dispose of solid wastes without environmental controls.

Dust: Particles light enough to be suspended in air.

Dustfall Jar: An open container used to collect large particles from the air for measurement and analysis.

Dystrophic Lakes: Shallow bodies of water that contain much humus and/or organic matter, that contain many plants but few fish and are highly acidic.

E

Ecological Impact: The effect that a man-made or natural activity has on living organisms and their non-living (abiotic) environment.

Ecology: The relationship of living things to one another and their environment, or the study of such relationships.

Economic Poisons: Chemicals used to control pests and to defoliate cash crops such as cotton.

Ecosphere: The "bio-bubble" that contains life on earth, in surface waters, and in the air. (See: biosphere.)

Ecosystem: The interacting system of a biological community and its non-living environmental surroundings.

Effluent: Wastewater—treated or untreated—that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters.

Effluent Limitation: Restrictions established by a State or EPA on quantities, rates, and concentrations in wastewater discharges.

Electrodialysis: A process that uses electrical current applied to permeable membranes to remove minerals from water. Often used to desalinize salty or brackish water.

Electrostatic Precipitator (ESP): An air pollution control device that removes particles from a gas stream (smoke) after combustion occurs. The ESP imparts an electrical charge to the particles, causing them to adhere to metal plates inside the precipitator. Rapping on the plates causes the particles to fall into a hopper for disposal.

Eligible Costs: The construction costs for waste-water treatment works upon which EPA grants are based.

Emergency (Chemical): A situation created by an accidental release or spill of hazardous chemicals which poses a threat to the safety of workers, residents, the environment, or property.

Emergency Episode: (See: air pollution episode.)

Eminent Domain: Government taking—or forced acquisition—of private land for public use, with compensation paid to the landowner.

Emission: Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts.

Emission Factor: The relationship between the amount of pollution produced and the amount of raw material processed. For example, an emission factor for a blast furnace making iron would be the number of pounds of particulates per ton of raw materials.

Emission Inventory: A listing, by source, of the amount of air pollutants discharged into the atmosphere of a community. It is used to establish emission standards.

Emission Standard: The maximum amount of air polluting discharge legally allowed from a single source, mobile or stationary.

Emissions Trading: EPA policy that allows a plant complex with several facilities to decrease pollution from some facilities while increasing it from others, so long as total results are equal to or better than previous limits. Facilities where this is done are treated as if they exist in a bubble in which total emissions are averaged out. Complexes that reduce emissions substantially may "bank" their "credits" or sell them to other industries.

Endangered Species: Animals, birds, fish, plants, or other living organisms threatened with extinction by man-made or natural changes in their environment. Requirements for declaring a species endangered are contained in the Endangered Species Act.

Endangerment Assessment: A study conducted to determine the nature and extent of contamination at a site on the National Priorities List and the risks posed to public health or the environment. EPA or the state conduct the study when a legal action is to be taken to direct potentially responsible parties to clean up a site or pay for the cleanup. An endangerment assessment supplements a remedial investigation.

Enforcement: EPA, state, or local legal actions to obtain compliance with environmental laws, rules, regulations, or agreements and/or obtain penalties or criminal sanctions for violations. Enforcement procedures may vary, depending on the specific requirements of different environmental laws and related implementing regulatory requirements. Under CERCLA, for example, EPA will seek to require potentially responsible parties to clean up a Superfund site, or pay for the cleanup, whereas under the Clean Air Act the agency may invoke sanctions against cities failing to meet ambient air quality standards that could prevent certain types of construction or federal funding. In other situations, if investigations by EPA and state agencies uncover willful violations, criminal trials and penalties are sought.

Enforcement Decision Document (EDD): A document that provides an explanation to the public of EPA's selection of the cleanup alternative at enforcement sites on the National Priorities List. Similar to a Record of Decision.

Enrichment: The addition of nutrients (e.g., nitrogen, phosphorus, carbon compounds) from sewage effluent or agricultural runoff to surface water. This process greatly increases the growth potential for algae and aquatic plants.

Environment: The sum of all external conditions affecting the life, development and survival of an organism.

Environmental Assessment: A written environmental analysis which is prepared pursuant to the National Environmental Policy Act to determine whether a federal action would significantly affect the environment and thus require preparation of a more detailed environmental impact statement.

Environmental Audit: 1. An independent assessment of the current status of a party's compliance with applicable environmental requirements. 2. An independent evaluation of a party's environmental compliance policies, practices, and controls.

Environmental Impact Statement: A document required of federal agencies by the National Environmental Policy Act for major projects or legislative proposals significantly affecting the environment. A tool for decision making, it describes the positive and negative effects of the undertaking and lists alternative actions.

Environmental Response Team: EPA experts located in Edison, N.J., and Cincinnati, OH, who can provide around-the-clock technical assistance to EPA regional offices and states during all types of emergencies involving hazardous waste sites and spills of hazardous substances.

EPA: The U.S. Environmental Protection Agency; established in 1970 by Presidential Executive Order, bringing together parts of various government agencies involved with the control of pollution.

Epidemic: Widespread outbreak of a disease, or a large number of cases of a disease in a single community or relatively small area.

Epidemiology: The study of diseases as they affect population, including the distribution of disease, or other health-related states and events in human populations, the factors (e.g. age, sex, occupation, economic status) that influence this distribution, and the application of this study to control health problems.

Episode (Pollution): An air pollution incident in a given area caused by a concentration of atmospheric pollution reacting with meteorological conditions that may result in a significant increase in illnesses or deaths. Although most commonly used in relation to air pollution, the term may also be used in connection with other kinds of environmental events such as a massive water pollution situation.

Equivalent Method: Any method of sampling and analyzing for air pollution which has been demonstrated to the EPA Administrator's satisfaction to be, under specific conditions, an acceptable alternative to the normally used reference methods.

Equilibrium: In relation to radiation, the state at which the radioactivity of consecutive elements within a radioactive series is neither increasing nor decreasing.

Erosion: The wearing away of land surface by wind or water. Erosion occurs naturally from weather or runoff but can be intensified by land-clearing practices related to farming, residential or industrial development, road building, or timber-cutting.

Estuary: Regions of interaction between rivers and nearshore ocean waters, where tidal action and river flow create a mixing of fresh and salt water. These areas may include bays, mouths of rivers, salt marshes, and lagoons. These brackish water ecosystems shelter and feed marine life, birds, and wildlife. (See: wetlands.)

Ethylene Dibromide (EDB): A chemical used as an agricultural fumigant and in certain industrial processes. Extremely toxic and found to be a carcinogen in laboratory animals, EDB has been banned for most agricultural uses in the United States.

Eutrophication: The slow aging process during which a lake, estuary, or bay evolves into a bog or marsh and eventually disappears. During the later stages of eutrophication the water body is choked by abundant plant life as the result of increased amounts of nutritive compounds such as nitrogen and phosphorus. Human activities can accelerate the process.

Eutrophic Lakes: Shallow, murky bodies of water that have excessive concentrations of plant nutrients causing excessive algal production. (See: dystrophic lakes.)

Evaporation Ponds: Areas where sewage sludge is dumped and allowed to dry out.

Evapotranspiration: The loss of water from the soil both by evaporation and by transpiration from the plants growing in the soil.

Exceedance: Violation of environmental protection standards by exceeding allowable limits or concentration levels.

Exclusionary: Any form of zoning ordinance that tends to exclude specific classes of persons or businesses from a particular district or area.

Exempt Solvent: Specific organic compounds that are not subject to requirements of regulation because they have been deemed by EPA to be of negligible photochemical reactivity.

Exempted Aquifer: Underground bodies of water defined in the Underground Injection Control program as aquifers that are sources of drinking water (although they are not being used as such) and that are exempted from regulations barring underground injection activities.

Exposure: The amount of radiation or pollutant present in an environment which represents a potential health threat to the living organisms in that environment.

Extremely Hazardous Substances: Any of 406 chemicals identified by EPA on the basis of toxicity, and listed under SARA Title III. The list is subject to revision.

F

Fabric Filter: A cloth device that catches dust particles from industrial emissions.

Feasibility Study: 1. Analysis of the practicability of a proposal; e.g., a description and analysis of the potential cleanup alternatives for a site or alternatives for a site on the National Priorities List. The feasibility study usually recommends selection of a cost-effective alternative. It usually starts as soon as the remedial investigation is underway; together, they are commonly referred to as the "RI/FS". The term can apply to a variety of proposed corrective or regulatory actions. 2. In research, a small-scale investigation of a problem to ascertain whether or not a proposed research approach is likely to provide useful data.

Fecal Coliform Bacteria: Bacteria found in the intestinal tracts of mammals. Their presence in water or sludge is an indicator of pollution and possible contamination by pathogens.

Feedlot: A relatively small, confined area for the controlled feeding of animals that tends to concentrate large amounts of animal wastes that cannot be absorbed by the soil and, hence, may be carried to nearby streams or lakes by rainfall runoff.

Fen: A type of wetland that accumulates peat deposits. Fens are less acidic than bogs, deriving most of their water from groundwater rich in calcium and magnesium. (See: wetlands.)

Fermentation: Chemical reactions accompanied by living microbes that are supplied with nutrients and other critical conditions such as heat, pressure, and light that are specific to the reaction at hand.

Fertilizer: Materials such as nitrogen and phosphorus that provide nutrients for plants. Commercially sold fertilizers may contain other chemicals or may be in the form of processed sewage sludge.

Filling: Depositing dirt and mud or other materials into aquatic areas to create more dry land, usually for agricultural or commercial development purposes. Such activities often damage the ecology of the area.

Filtration: A treatment process, under the control of qualified operators, for removing solid (particulate) matter from water by passing the water through porous media such as sand or a man-made filter. The process is often used to remove particles that contain pathogenic organisms.

Finding of No Significant Impact: A document prepared by a federal agency that presents the reasons impact: why a proposed action would not have a significant impact on the environment and thus would not require preparation of an Environmental Impact Statement. An FNSI is based on the results of an environmental assessment.

First Draw: The water that immediately comes out when a tap is first opened. This water is likely to have the highest level of lead contamination from plumbing materials.

Floc: A clump of solids formed in sewage by biological or chemical action.

Flocculation: The process by which clumps of solids in water or sewage are made to increase in size by biological or chemical action so that they can be separated from the water.

Floor Sweep: A vapor collection designed to capture vapors which are heavier than air and which collect along the floor.

Flowmeter: A gauge that shows the speed of wastewater moving through a treatment plant. Also used to measure the speed of liquids moving through various industrial processes.

Flue Gas: The air coming out of a chimney after combustion in the burner it is venting. It can include nitrogen oxides, carbon oxides, water vapor, sulfur oxides, particles and many chemical pollutants.

Flue Gas Desulfurization: A technology which uses a sorbent, usually lime or limestone, to remove sulfur dioxide from the gases produced by burning fossil fuels. Flue gas desulfenzation is current the state-of-the art technology in use by major SO2 emitter, e.g., power plants.

Fluorides: Gaseous, solid, or dissolved compounds containing fluorine that result from industrial processes. Excessive amounts in food can lead to fluor

Fluorocarbon (FCs): Any of a number of organic compounds analogous to hydrocarbons in which one or more hydrogen atoms are replaced by fluorine. Once used in the United States as a propellant in aerosols, they are now primarily used in coolants and some industrial processes. FCs containing chlorine are called chlorofluorocarbons (CFCs). They are believed to be modifying the ozone layer in the stratosphere, thereby allowing more harmful solar radiation to reach the Earth's surface.

Fluorosis: An abnormal condition caused by excessive intake of fluorine, characterized chiefly by mottling of the teeth.

Flume: A natural or man-made channel that diverts water.

Flush: 1. To open a cold-water tap to clear out all the water which may have been sitting for a long time in the pipes. In new homes, to flush a system means to send large volumes of water gushing through the unused pipes to remove loose particles of solder and flux. 2. To force large amounts of water through liquid to clean out piping or tubing, storage or process tanks.

Fly Ash: Non-combustible residual particles from the combustion process, carried by flue gas.

Fogging: Applying a pesticide by rapidly heating the liquid chemical so that it forms very fine droplets that resemble smoke or fog. It may be used to destroy mosquitoes, black flies, and similar pests.

Food Chain: A sequence of organisms, each of which uses the next, lower member of the sequence as a food source.

Formaldehyde: A colorless, pungent, irritating gas, CH20, used chiefly as a disinfectant and preservative and in synthesizing other compounds and resins.

Formulation: The substance or mixture of substances which is comprised of all active and inert ingredients in a pesticide.

Fresh Water: Water that generally contains less than 1,000 milligrams-per-liter of dissolved solids.

Fuel Economy Standard: The Corporate Average Fuel Economy Standard (CAFE) which went into effect in 1978. It was meant to enhance the national fuel conservation effort by slowing fuel consumption through a miles-per-gallon requirement for motor vehicles.

Fugitive Emissions: Emissions not caught by a capture system.

Fume: Tiny particles trapped in vapor in a gas stream.

Fumigant: A pesticide that is vaporized to kill pests. Used in buildings and greenhouses.

Functional Equivalent: Term used to describe EPA's decision-making process and its relationship to the environmental review conducted under the National Environmental Policy Act (NEPA). A review is considered functionally equivalent when it addresses the substantive components of a NEPA review.

Fungi: (Singular, Fungus) Molds, mildews, yeasts, mushrooms, and puffballs, a group organisms that lack chlorophyll (i.e., are not photosynthetic) and which are usually non-mobile, filamentous, and multicellular. Some grow in the ground, others attach themselves to decaying trees and other plants, getting their nutrition from decomposing organic matter. Some cause disease, others stabilize sewage and break down solid wastes in composting.

Fungicide: Pesticides which are used to control, prevent, or destroy fungi.

G

Game Fish: Species like trout, salmon, or bass, caught for sport. Many of them show more sensitivity to environmental change than "rough" fish.

Gamma Radiation: Gamma rays are true rays of energy in contrast to alpha and beta radiation. The properties are similar to x-rays and other electromagnetic waves. They are the most penetrating waves of radiant nuclear energy but can be blocked by dense materials such as lead.

Gasification: Conversion of solid material such as coal into a gas for use as a fuel.

Geiger Counter: An electrical device that detects the presence of certain types of radioactivity.

Gene: A length of DNA that directs the synthesis of a protein.

Gene Library: A collection of DNA fragments from cells or organisms. So far, no simple way for sorting the contents of gene libraries has been developed. However, DNA pieces can be moved into bacterial cells where sorting according to gene function becomes feasible.

General Permit: A permit applicable to a class or category of discharges.

Generator: A facility or mobile source that emits pollutants into the air or releases hazardous wastes into water or soil.

Genetic Engineering: A process of inserting new genetic information into existing cells in order to modify any organism for the purpose of changing one of its characteristics.

Germicide: Any compound that kills disease-causing microorganisms.

Grain Loading: The rate at which particles are emitted from a pollution source. Measurement is made by the number of grains per cubic foot of gas emitted.

Granular Activated Carbon Treatment: A filtering system often used in small water systems and individual homes to remove organics. GAC can be highly effective in removing elevated levels of radon from water.

Gray Water: The term given to domestic wastewater composed of washwater from sinks, kitchen sinks, bathroom sinks and tubs, and laundry tubs.

Greenhouse Effect: The warming of the Earth's atmosphere caused by a build-up of carbon dioxide or other trace gases; it is believed by many scientists that this build-up allows light from the sun's rays to heat the Earth but prevents a counterbalancing loss of heat.

Grinder Pump: A mechanical device which shreds solids and raises the fluid to a higher elevation through pressure sewers.

Gross Alpha Particle Activity: Total activity due to emission of alpha particles. Used as the screening measurement for radioactivity generally due to naturally-occurring radionuclides. Activity is commonly measured in picocuries.

Gross Beta Particle Activity: Total activity due to emission of beta particles. Used as the screening measurement for radioactivity from man-made radionuclides since the decay products of fission are beta particle and gamma ray emitters. Activity is commonly measured in picocuries.

Ground Cover: Plants grown to keep soil from eroding.

Ground Water: The supply of fresh water found beneath the Earth's surface, usually in aquifers, which is often used for supplying wells and springs. Because ground water is a major source of drinking water there is growing concern over areas where leaching agricultural or industrial pollutants or substances from leaking underground storage tanks are contaminating ground water.

H

Habitat: The place where a population (e.g., human, animal, plant, microorganism) lives and its surroundings, both living and non-living.

Half-Life: 1. The time required for a pollutant to lose half its affect on the environment. For example, the half-life of DDT in the environment is 15 years, of radium, 1,580 years. 2. The time required for half of the atoms of a radioactive element to undergo decay. 3. The time required for the elimination of one half a total dose from the body.

Halogen: Any of a group of 5 chemically-related nonmetallic elements that includes bromine, fluorine, chlorine, iodine, and astatine.

Halon: Bromine-containing compounds with long atmospheric lifetimes whose breakdown in the stratosphere cause depletion of ozone. Halons are used in fire-fighting.

Hammermill: A high-speed machine that hammers and cutters to crush, grind chip, or shred solid wastes.

Hard Water: Alkaline water containing dissolved salts that interfere with some industrial processes and prevent soap from lathering.

Hazardous Air Pollutants: Air pollutants which are not covered by ambient air quality standards but which, as defined in the Clean Air Act, may reasonably be expected to cause or contribute to irreversible illness or death. Such pollutants include asbestos, beryllium, mercury, benzene, coke oven emissions, radionuclides, and vinyl chloride.

Hazardous Ranking System: The principle screening tool used by EPA to evaluate risks to public health and the environment associated with abandoned or uncontrolled hazardous waste sites. The HRS calculates a score based on the potential of hazardous substances spreading from the site through the air, surface water, or ground water and on other factors such as nearby population. This score is the primary factor in deciding if the site should be on the National Priorities List and, if so, what ranking it should have compared to other sites on the list.

Hazardous Substance: 1. Any material that poses a threat to human health and/or the environment. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive. 2. Any substance designated by EPA to be reported if a designated quantity of the substance is spilled in the waters of the United States or if otherwise emitted to the environment.

Hazardous Waste: By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or appears on special EPA lists.

Hazards Analysis: The procedures involved in (1) identifying potential sources of release of hazardous materials from fixed facilities or transportation accidents; (2) determining the vulnerability of a geographical area to a release of hazardous materials; and (3) comparing hazards to determine which present greater or lesser risks to a community.

Hazards Identification: Porviding information on which facilities have extremely hazardous substances, what those chemicals are, and how much there is at each facility. The Process also provides information on how the chemicals are stored and whether they are used at high temperatures.

Heat Island Effect: A "dome" of elevated temperatures over an urban area caused by structural and pavement heat fluxes, and pollutant emissions from the area below the dome.

Heavy Metals: Metallic elements with high atomic weights, e.g., mercury, chromium, cadmium, arsenic, and lead. They can damage living things at low concentrations and tend to accumulate in the food chain.

Heptachlor: An insecticide that was banned on some food products in 1975 and all of them 1978. It was allowed for use in seed treatment until in 1983. More recently it was found in milk and other dairy products in Arkansas and Missouri, as a result of illegally feeding treated seed to dairy cattle.

Herbicide: A chemical pesticide designed to control or destroy plants, weeds, or grasses.

Herbivore: An animal that feeds on plants.

Heterotrophic Organisms: Consumers such as humans and animals, and decomposers—chiefly bacteria and fungi—that are dependent on organic matter for food.

High-Density Polyethylene: A material that produces toxic fumes when burned. Used to make plastic bottles and other products.

High-Level Radioactive Waste (HLW): Waste generated in the fuel of a nuclear reactor, found at nuclear reactors or nuclear fuel reprocessing plants. It is a serious threat to anyone who comes near the wastes without shielding. (See Low-Level Radioactive Waste).

Holding Pond: A pond or reservoir, usually made of earth, built to store polluted runoff.

Hood Capture Efficiency: The emissions from a process which are captured by hood and directed into the control device, expressed as a percent of all emissions.

Host: 1. In genetics, the organism, typically a bacterium, into which a gene from another organism is transplanted. 2. In medicine, an animal infected by or parasitized by another organism.

Humus: Decomposed organic material.

Hybrid: A cell or organism resulting from a cross between two unlike plant or animal cells or organisms.

Hybridoma: A hybrid cell that produces monoclonal antibodies in large quantities.

Hydrocarbons (HC): Chemical compounds that consist entirely of carbon and hydrogen.

Hydrogen Sulfide (HS): Gas emitted during organic decomposition. Also a byproduct of oil refining and burning. It smells like rotten eggs and, in heavy concentration, can cause illness.

Hydrogeology: The geology of ground water, with particular emphasis on the chemistry and movement of water.

Hydrology: The science dealing with the properties, distribution, and circulation of water.

I

Ignitable: Capable of burning or causing a fire.

Impoundment: A body of water or sludge confined by a dam, dike, floodgate, or other barrier.

Immediately Dangerous to Life and Health (IDLH): The maximum level to which a healthy individual can be exposed to a chemical for 30 minutes and escape without suffering irreversible health effects or impairing symptons. Used as a "level of concern." (See: level of concern.)

In Vitro: 1. "In glass", a test-tube culture. 2. Any laboratory test using living cells taken from an organism.

In Vivo: In the living body of a plant or animal. In vivo tests are those laboratory experiments carried out on whole animals or human volunteers.

Incineration: 1. Burning of certain types of solid, liquid or gaseous materials. 2. A treatment technology involving destruction of waste by controlled burning at high temperatures, e.g., burning sludge to remove the water and reduce the remaining residues to a safe, non-burnable ash which can be disposed of safely on land, in some waters or in underground locations.

Incineration at Sea: Disposal of waste by burning at sea on specially-designed incinerator ships.

Incinerator: A furnace for burning wastes under controlled conditions.

Indicator: In biology, an organism, species, or community whose characteristics show the presence of specific environmental conditions.

Indirect Discharge: Introduction of pollutants from a non-domestic source into a publicly owned waste treatment system. Indirect dischargers can be commercial or industrial facilities whose wastes go into the local sewers.

Indoor Air: The breathing air inside a habitable structure or conveyance.

Indoor Air Pollution: Chemical, physical, or biological contaminants in indoor air.

Indoor Climate: Temperature, humidity, lighting and noise levels in a habitable structure or conveyance. Indoor climate can affect indoor air pollution.

Inert Ingredient: Pesticide components such as solvents, carriers, and surfactants that are not active against target pests. Not all inert ingredients are innocuous.

Inertial Separator: A device that uses centrifugal force to separate waste particles.

Infiltration: 1. The penetration of water through the ground surface into sub-surface soil or the penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls. 2. A land application technique where large volumes of waste water are applied to land, allowed to penetrate the surface and percolate through the underlying soil. (See: percolation)

Inflow: Entry of extraneous rain water into a sewer system from sources other than infiltration, such as basement drains, manholes, storm drains, and street washing.

Influent: Water, wastewater, or other liquid flowing into a reservoir, basin, or treatment plant.

Information File: In the Superfund program, a file that contains accurate, up-to-date documents on a Superfund site. The file is usually located in a public building such as a school, library, or city hall that is convenient for local residents.

Injection Well: A well into which fluids are injected for purposes such as waste disposal, improving the recovery of crude oil, or solution mining.

Injection Zone: A geological formation, group of formations, or part of a formation receiving fluids through a well.

Inoculum: 1. Bacterium placed in compost to start biological action. 2. A medium containing organisms which is introduced into cultures or living organisms,

Inorganic Chemicals: Chemical substances of mineral origin, not of basically carbon structure.

Insecticide: A pesticide compound specifically used to kill or control the growth of insects.

Inspection and Maintenance (I/M): 1. Activities to assure proper emissions-related operation of mobile sources of air pollutants, particularly automobile emissions controls. 2. Also applies to to wastewater treatment plants and other anti-pollution facilities and processes.

Instream Use: Water use taking place within a stream channel, e.g., hydroelectric power generation, navigation, water-quality improvement, fish propagation, recreation.

Integrated Pest Management (IPM): A mixture of pesticide and non-pesticide methods to control pests.

Interceptor Sewers: Large sewer lines that, in a combined system, control the flow of the sewage to the treatment plant In a storm, they allow some of the sewage to flow directly into a receiving stream, thus preventing an overload by a sudden surge of water into the sewers. They are also used in separate systems to collect the flows from main and trunk sewers and carry them to treatment points

Interim (Permit) Status: Period during which treatment, storage and disposal facilities coming under RCRA in 1980 are temporarily permitted to operate while awaiting denial or issuance of a permanent permit Permits issued under these circumstances are usually called "Part A" or "Part B" permits

Interstate Carrier Water Supply: A source of water for drinking and sanitary use on planes, buses, trains, and ships operating in more than one state These sources are federally regulated.

Interstate Waters: Waters that flow across or form part of state or international boundaries, e.g., the Great Lakes, the Mississippi River, or coastal waters.

Interstitial Monitoring: The continuous surveillance of the space between the walls of an underground storage tank.

Inventory: TSCA inventory of chemicals produced pursuant to Section 8 (b) of the Toxic Substances Control Act.

Inversion: An atmospheric condition caused by a layer of warm air preventing the rise of cooling air trapped beneath it. This prevents the rise of pollutants that might otherwise be dispersed and can cause an air pollution episode.

Ion: An electrically charged atom or group of atoms which can be drawn from waste water during the electrodialysis process.

Ion Exchange Treatment: A common water softening method often found on a large scale at water purification plants that remove some organics and radium by adding calcium oxide or calcium hydroxide to increase the ph to a level where the metals will precipitate out.

Ionization Chamber: A device that measures the intensity of ionizing radiation.

Ionizing Radiation: Radiation that can remove electrons from atoms, i.e. alpha, beta, and gamma radiation.

Irradiated Food: Food that has been subject to brief radioactivity, usually by gamma rays, to kill insects, bacteria, and mold, and preserve it without refrigeration or freezing.

Irradiation: Exposure to radiation of wavelengths shorter than those of visible light (gamma, x-ray, or ultraviolet), for medical purposes, the destruction of bacteria in milk or other foodstuffs, or for inducing polymerization of monomers or vulcanization of rubber.

Irrigation: Technique for applying water or wastewater to land areas to supply the water and nutrient needs of plants.

Isotope: A variation of an element that has the same atomic number but a different weight because of its neutrons. Various isotopes of the same element may have different radioactive behaviors.

K

Kinetic Rate Coefficient: A number that describes the rate at which a water constituent such as a biochemical oxygen demand or dissolved oxygen increases or decreases.

L

Lagoon: (1) A shallow pond where sunlight, bacterial action, and oxygen work to purify wastewater; also used to storage of wastewaters or spent nuclear fuel rods. (2) Shallow body of water, often separated from the sea by coral reefs or sandbars.

Land Application: Discharge of wastewater onto the ground for treatment or reuse. (See: irrigation.)

Land Farming (of waste): A disposal process in which hazardous waste deposited on or in the soil is naturally degraded by microbes.

Landfills: 1. Sanitary landfills are land disposal sites for non-hazardous solid wastes at which the waste is spread in layers, compacted to the smallest practical volume, and cover material applied at the end of each operating day. 2. Secure chemical landfills are disposal sites for hazardous waste. They are selected and designed to minimize the chance of release of hazardous substances into the environment.

Lateral Sewers: Pipes that run under city streets and receive the sewage from homes and businesses.

LC50/Lethal Concentration: Median level concentration, a standard measure of toxicity. It tells how much of a substance is needed to kill half of a group of experimental organisms at a specific time of observation. (See LD50.)

Leachate: A liquid that results from water collecting contaminants as it trickles through wastes, agricultural pesticides or fertilizers. Leaching may occur in farming areas, feedlots, and landfills, and may result in hazardous substances entering surface water, ground water, or soil.

Leachate Collection System: A system that gathers leachate and pumps it to the surface for treatment.

Leaching: The process by which soluble constituents are dissolved and carried down through the soil by a percolating fluid (See: leachate.)

Lead (PE): A heavy metal that is hazardous to health if breathed or swallowed. Its use in gasoline, paints, and plumbing compounds has been sharply restricted or eliminated by federal laws and regulations. (See: heavy metals.)

Leaded Gasoline: Gasoline to which lead has been added to raise the octane level.

LD 50/ Lethal Dose: The dose of a toxicant that will kill 50 percent of the test organisms within a designated period of time. The lower the LD 50, the more toxic the compound.

LD 0: The highest concentration of a toxic substance at which none of the test organisms die.

LD L0: The lowest concentration and dosage of a toxic substance which kills test organisms.

Level of Concern (LOC): The concentration in air of an extremely hazardous substance above which there may be serious immediate health effects to anyone exposed to it for short periods of time.

Lift: In a sanitary landfill, a compacted layer of solid waste and the top layer of cover material.

Lifting Station: (See: pumping station.)

Limestone Scrubbing: Process in which sulfur gases moving towards a smokestack are passed through a limestone and water solution to remove sulfur before it reaches the atmosphere.

Limiting Factor: A condition, whose absence, or excessive concentration, is incompatible with the needs or tolerance of a species or population and which may have a negative influence on their ability to grow or even survive.

Limnology: The study of the physical, chemical, meteorological, and biological aspects of fresh water.

Liner: 1. A relatively impermeable barrier designed to prevent leachate from leaking from a landfill. Liner materials include plastic and dense clay. 2. An insert or sleeve for sewer pipes to prevent leakage or infiltration.

Lipid Solubility: The maximum concentration of a chemical that will dissolve in fatty substances; lipid soluble substances are insoluble in water. If a substance is lipid soluble it will very selectively disperse through the environment via living tissue.

Liquefaction: Changing a solid into a liquid.

List: Shorthand term for EPA list of violating facilities or list of firms debarred from obtaining government contracts because they violated certain sections of the Clean Air or Clean Water Acts. The list is maintained by The Office of Enforcement and Compliance Monitoring.

Listed Waste: Wastes listed as hazardous under RCRA but which have not been subjected to the Toxic Characteristics Listing Process because the dangers they present are considered self-evident.

Local Emergency Planning Committee (LEPC): A committee appointed by the state emergency response commission, as required by SARA Title III, to formulate a comprehensive emergency plan for its jurisdiction.

Lower Explosive Limit (LEL): The concentration of a compound in air below which a flame will not propagate if the mixture is ignited.

Lowest Achievable Emission Rate: Under the Clean Air Act, this is the rate of emissions which reflects (a) the most stringent emission limitation which is contained in the implementation plan of any state for such source unless the owner or operator of the proposed source demonstrates such limitations are not achievable; or (b) the most stringent emissions limitation achieved in practice, which ever is more stringent. Application of this term does not permit a proposed new or modified source to emit pollutants in excess of existing new source standards.

Low-Level Radioactive Waste (LLRW): Wastes less hazardous than most of those generated by a nuclear reactor. Usually generated by hospitals, research laboratories, and certain industries. The Department of Energy, Nuclear Regulatory Commission, and EPA share responsibilities for managing them. (See: high-level radioactive wastes.)

M

Marine Sanitation Device: Any equipment installed on board a vessel to receive, retain, treat, or discharge sewage and any process to treat such sewage.

Major Modification: This term is used to define modifications with respect to Prevention of Significant Deterioration and New Source Review under the Clean Air Act and refers to modifications to major stationary sources of emissions and provides significant pollutant increase levels below which a modification is not considered major.

Major Stationary Sources: Term used to determine to applicability of Prevention of Significant Deterioration and new source regulations. In a nonattainment area, any stationary pollutant source that has a potential to emit more than 100 tons per year is considered a major stationary source. In PSD areas the cutoff level may be either 100 or 250 tons, depending upon the type of source.

Manufacturers Formulation: A list of substances or component parts as described by the maker of a coating, pesticide or other product containing chemicals or other substances.

Marsh: A type of wetland that does not accumulate appreciable peat deposits and is dominated by herbaceous vegetation. Marshes may be either fresh or saltwater and tidal or non-tidal. (See: wetlands.)

Metabolite: Any substance produced in or by biological processes and derived from a pesticide.

Material Safety Data Sheet (MSDS): A compilation of information required under the OSHA Communication Standard on the identity of hazardous chemicals, health, and physical hazards, exposure limits, and precautions. Section 311 of SARA requires facilities to submit MSDSs under certain circumstances.

Maximum Contaminant Level: The maximum permissible level of a contaminant in water delivered to any user of a public water system. MCLs are enforceable standards.

Mechanical Aeration: Use of mechanical energy to inject air into water to cause a waste stream to absorb oxygen.

Mechanical Turbulence: Random irregularities of fluid motion in air caused by buildings or mechanical, non-thermal, processes.

Media: Specific environments—air, water, soil—which are the subject of regulatory concern and activities.

Mercury: A heavy metal that can accumulate in the environment and is highly toxic if breathed or swallowed. (See: heavy metals.)

Methane: A colorless, nonpoisonous, flammable gas created by anaerobic decomposition of organic compounds.

Method 18: An EPA test method which uses gas chromatographic techniques to measure the concentration of individual volatile organic compounds in a gas stream.

Method 24: An EPA reference method to determine density, water content and total volatile content (water and VOC) of coatings.

Method 25: An EPA reference method to determine the VOC concentration in a gas stream.

Million-gallons Per Day (MGD): A measure of water flow.

Microbes: Microscopic organisms such as algae, animals, viruses, bacteria, fungus, and protozoa, some of which cause diseases. (See: microorganism.)

Microbial Pesticide: A microorganism that is used to control a pest. They are of low toxicity to man.

Microorganism: Living organisms so small that individually they can usually only be seen through a microscope.

Mist: Liquid particles measuring 500 to 40 microns, that are formed by condensation of vapor. By comparison, "fog" particles are smaller than 40 microns.

Mitigation: Measures taken to reduce adverse impacts on the environment.

Mixed Liquor: A mixture of activated sludge and water containing organic matter undergoing activated sludge treatment in an aeration tank.

Mobile Source: A moving producer of air pollution, mainly forms of transportation such as cars, trucks, motorcycles, airplanes.

Modeling: An investigative technique using a mathematical or physical representation of a system or theory that accounts for all or some its known properties. Models are often used to test the effect of changes of system components on the overall performance of the system.

Model Plant: A description of a typical but theoretical plant used for developing economic, environmental impact and energy impact analyses as support for regulations or regulatory guidelines. It is an imaginary plant, with features of existing or future plants used to estimate the cost of incorporating air pollution control technology as the first step in exploring the economic impact of a potential NSPS.

Monitoring: Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, animals, and other living things.

Monitoring Wells: Wells drilled at a hazardous waste management facility or Superfund site to collect ground-water samples for the purpose of physical, chemical, or biological analysis to determine the amounts, types, and distribution of contaminants in the ground water beneath the site.

Monoclonal Antibodies: (Also called MABs and MCAs) Molecules of living organisms that selectively find and attach to other molecules to which their structure conforms exactly. This could also apply to equivalent activity by chemical molecules.

Muck Soils: Earth made from decaying plant materials.

Mulch: A layer of material (wood chips, straw, leaves, etc.) placed around plants to hold moisture, prevent weed growth, protect the plants, and enrich the soil.

Multiple Use: Use of land for more than one purpose: i.e., grazing of livestock, wildlife production, recreation, watershed, and timber production. Could also apply to use of bodies of water for recreational purposes, fishing, and water supply.

Mutagen: Any substance that can cause a change in genetic material.

Mutate: To bring about a change in the genetic constitution of a cell by altering its DNA. In turn, "mutagenesis" is any process by which cells are mutated.

N

National Ambient Air Quality Standards (NAAQS): Air quality standards established by EPA that apply to outside air throughout the country. (See: criteria pollutants, state implementation plans, emissions trading.)

National Emissions Standards For Hazardous Air Pollutants (NESHAPS): Emissions standards set by EPA for an air pollutant not covered by NAAQS that may cause an increase in deaths or in serious, irreversible, or incapacitating illness. Primary standards are designed to protect human health, secondary standards to protect public welfare.

National Oil and Hazardous Substances Contingency Plan (NOHSCP/NCP): The federal regulation that guides determination of the sites to be corrected under the Superfund program and the program to prevent or control spills into surface waters or other portions of the environment.

National Pollutant Discharge Elimination System (NPDES): A provision of the Clean Water Act which prohibits discharge of pollutants into waters of the United States unless a special permit is issued by EPA, a state, or (where delegated) a tribal government on an Indian reservation.

National Priorities List (NPL): EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. A site must be on the NPL to receive money from the Trust Fund for remedial action. The list is based primarily on the score a site receives from the Hazard Ranking System. EPA is required to update the NPL at least once a year.

National Response Center: The federal operations center that receives notifications of all releases of oil and hazardous substances into the environment. The Center, open 24 hours a day, is operated by the U.S. Coast Guard, which evaluates all reports and notifies the appropriate agency.

National Response Team (NRT): Representatives of 13 federal agencies that, as a team, coordinate federal responses to nationally significant incidents of pollution and provide advice and technical assistance to the responding agency(ies) before and during a response action.

Natural Gas: A natural fuel containing primarily methane and ethane that occurs in certain geologic formations.

Natural Selection: The process of survival of the fittest, by which organisms that adapt to their environment survive and those that do not disappear.

Navigable Waters: Traditionally, waters sufficiently deep and wide for navigation by all, or specified sizes of vessels; such waters in the United States come under federal jurisdiction and are included in certain provisions of the Clean Water Act.

Necrosis: Death of plant or animal cells. In plants, necrosis can discolor areas on the plant or kill it entirely.

Nematocide: A chemical agent which is destructive to nematodes (round worms or threadworms.)

Neutralization: Decreasing the acidity or alkalinity of a substance by adding to it alkaline or acidic materials respectively.

New Source: Any stationary source which is built or modified after publication of final or proposed regulations that prescribe a standard of performance which is intended to apply to that type of emission source.

New Source Performance Standards (NSPS): Uniform national EPA air emission and water effluent standards which limit the amount of pollution allowed from new sources or from existing sources that have been modified.

Nitrate: A compound containing nitrogen which can exist in the atmosphere or as a dissolved gas in water and which can have harmful effects on humans and animals. Nitrates in water can cause severe illness in infants and cows.

Nitric Oxide (NO): A gas formed by combustion under high temperature and high pressure in an internal combustion engine. It changes into nitrogen dioxide in the ambient air and contributes to photochemical smog.

Nitrification: The process whereby ammonia in wastewater is oxidized to nitrite and then to nitrate by bacterial or chemical reactions.

Nitrilotriacetic Acid (NTA): A compound being used to replace phosphates in detergents.

Nitrite: 1. An intermediate in the process of nitrification. 2. Nitrous oxide salts used in food preservation.

Nitrogen Dioxide (NO2): The result of nitric oxide combining with oxygen in the atmosphere. A major component of photochemical smog.

Nitrogenous Wastes: Animal or vegetable residues that contain significant amounts of nitrogen.

Nitrogen Oxide (NOx): Product of combustion from transportation and stationary sources and major a contributor to the formation of ozone in the troposphere and acid deposition.

Non-Attainment Area: Geographic area which does not meet one or more of the National Ambient Air Quality Standards for the criteria pollutants designated in the Clean Air Act.

Non-Community Water System: A public water system that is not a community water system, e.g., the water supply at a camp site or national park.

Non-Conventional Pollutant: Any pollutant which is not a statutorily listed or which is poorly understood by the scientific community.

Non-ionizing Electromagnetic Radiation: 1. Radiation that does not change the structure of atoms but does heat tissue and may cause harmful biological effects. 2. Microwaves, radio waves, and low-frequency electromagnetic fields from high-voltage transmission lines.

Non-Point Source: Pollution sources which are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. The pollutants are generally carried off the land by stormwater runoff. The commonly used categories for non-point sources are: agriculture, forestry, urban, mining, construction, dams and channels, land disposal, and saltwater intrusion.

Nuclear Power Plant: A facility that converts atomic energy into usable power; heat produced by a reactor makes steam to drive turbines which produce electricity.

Nuclear Winter: Prediction by some scientists that smoke and debris rising from massive fires resulting from a nuclear war could enter the atmosphere and block out sunlight for weeks or months. The scientists making this prediction project a cooling of the earth's surface, and changes in climate which could, for example, negatively effect world agricultural and weather patterns.

Nutrient: Any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

O

Off-Site Facility: A hazardous waste treatment, storage or disposal area that is located at a place away from the generating site.

Oil Spill: An accidental or intentional discharge of oil which reaches bodies of water. Can be controlled by chemical dispersion, combustion, mechanical containment, and/or adsorption.

Oil Fingerprinting: A method that identifies sources of oil and allows spills to be traced back to their source.

Oligotrophic Lakes: Deep clear lakes with low nutrient supplies. They contain little organic matter and have a high dissolved-oxygen level.

Oncogenic: A substance that causes tumors, whether benign or malignant.

On-Scene Coordinator (OSC): The predesignated EPA, Coast Guard, or Department of Defense official who coordinates and directs Superfund removal actions or Clean Water Act oil-or hazardous-spill corrective actions.

On-Site Facility: A hazardous waste treatment, storage or disposal area that is located on the generating site.

Opacity: The amount of light obscured by particulate pollution in the air; clear window glass has a zero opacity, a brick wall has 100 percent opacity. Opacity is used as an indicator of changes in performance of particulate matter pollution control systems.

Open Burning: Uncontrolled fires in an open dump.

Open Dump: An uncovered site used for disposal of waste without environmental controls. (See: dump.)

Operable Unit: Term for each of a number of separate activities undertaken as part of a Superfund site cleanup. A typical operable unit would be removing drums and tanks from the surface of a site.

Operation And Maintenance: 1. Activities conducted at a site after a Superfund site action is completed to ensure that the action is effective and operating properly. 2. Actions taken after construction to assure that facilities constructed to treat waste water will be properly operated, maintained,and managed to achieve efficiency levels and prescribed effluent limitations in an optimum manner.

Organic: 1. Referring to or derived from living organisms. 2. In chemistry, any compound containing carbon.

Organic Chemicals/Compounds: Animal or plant-produced substances containing mainly carbon, hydrogen, and oxygen.

Organic Matter: Carbonaceous waste contained in plant or animal matter and originating from domestic or industrial sources.

Organism: Any living thing.

Organophosphates: Pesticide chemicals that contain phosphorus; used to control insects. They are short-lived, but some can be toxic when first applied.

Organotins: Chemical compounds used in anti-foulant paints to protect the hulls of boats and ships, buoys, and dock pilings from marine organisms such as barnacles.

Osmosis: The tendency of a fluid to pass through a permeable membrane such as the wall of a living cell into a less concentrated solution so as to equalize the concentrations on both sides of the membrane.

Outfall: The place where an effluent is discharged into receiving waters.

Overburden: The rock and soil cleared away before mining.

Overfire Air: Air forced into the top of an incinerator or boiler to fan the flames.

Overland Flow: A land application technique that cleanses waste water by allowing it to flow over a sloped surface. As the water flows over the surface, the contaminants are removed and the water is collected at the bottom of the slope for reuse.

Overturn: The period of mixing (turnover), by top to bottom circulation, of previously stratified water masses. This phenomenon may occur in spring and/or fall, or after storms. It results in a uniformity of chemical and physical properties of the water at all depths.

Oxidant: A substance containing oxygen that reacts chemically in air to produce a new substance. The primary ingredient of photochemical smog.

Oxidation: 1. The addition of oxygen which breaks down organic waste or chemicals such as cyanides, phenols, and organic sulfur compounds in sewage by bacterial and chemical means. 2. Oxygen combining with other elements. 3. The process in chemistry whereby electrons are removed from a molecule.

Oxidation Pond: A man-made lake or body of water in which waste is consumed by bacteria. It is used most frequently with other waste-treatment processes. An oxidation pond is basically the same as a sewage lagoon.

Oxygenated Solvent: An organic solvent containing oxygen as part of the molecular structure. Alcohols and ketones are oxygenated compounds often used as paint solvents.

Ozonator: A device that adds ozone to water.

Ozone (O3): Found in two layers of the atmosphere, the stratosphere and the troposphere. In the stratosphere (the atmospheric layer beginning 7 to 10 miles above the earth's surface) ozone is a form of oxygen found naturally which provides a protective layer shielding the earth from ultraviolet radiation's harmful health effects on humans and the environment.In the troposphere (the layer extending up 7 to 10 miles from the earth's surface), ozone is a chemical oxidant and major component of photochemical smog. Ozone can seriously affect the human respiratory system and is one of the most prevalent and widespread of all the criteria pollutants for which the Clean Air Act required EPA to set standards. Ozone in the troposphere is produced through complex chemical reactions of nitrogen oxides, which are among the primary pollutants emitted by combustion sources; hydrocarbons, released into the atmosphere through the combustion, handling and processing of petroleum products; and sunlight.

Ozone Depletion: Destruction of the stratospheric ozone layer which shields the earth from ultraviolet radiation harmful to biological life. This destruction of ozone is caused by the breakdown of certain chlorine and/or-bromine containing compounds (chlorofluorocarbons or halons) which break down when they reach the stratosphere and catalytically destroy ozone molecules.

P

Packed Tower: A pollution control device that forces dirty air through a tower packed with crushed rock or wood chips while liquid is sprayed over the packing material. The pollutants in the air stream either dissolve or chemically react with the liquid.

Pandemic: Widespread throughout an area, nation or the world.

Part A Permit, Part B Permit: (See Interim Permit Status.)

Paraquat: A standard herbicide used to kill various types of crops, including marijuana.

Particulates: Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in air or emissions.

Particulate Loading: The mass of particulates per unit volume of air or water

Pathogenic: Capable of causing disease.

Pathogens: Microorganisms that can cause disease in other organisms or in humans, animals and plants. They may be bacteria, viruses, or parasites and are found in sewage, in runoff from animal farms or rural areas populated with domestic and/or wild animals, and in water used for swimming. Fish and shellfish contaminated by pathogens, or the contaminated water itself, can cause serious illnesses.

PCBs: A group of toxic, persistent chemicals (polychlorinated biphenyls) used in transformers and capacitators for insulating purposes and in gas pipeline systems as a lubricant. Further sale of new use was banned by law in 1979.

Percolation: The movement of water downward and radially through the sub-surface soil layers, usually continuing downward to the ground water.

Permeability: The rate at which liquids pass through soil or other materials in a specified direction.

Permit: An authorization, license, or equivalent control document issued by EPA or an approved state agency to implement the requirements of an environmental regulation; e.g., a permit to operate a wastewater treatment plant or to operate a facility that may generate harmful emissions.

Persistence: Refers to the length of time a compound, once introduced into the environment, stays there. A compound may persist for less than a second or indefinitely.

Persistent Pesticides: Pesticides that do not break down chemically or break down very slowly and that remain in the environment after a growing season.

Pest: An insect, rodent, nematode, fungus, weed or other form of terrestrial or aquatic plant or animal life or virus, bacterial or microorganism that is injurious to health or the environment.

Pesticide: Substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant. Pesticides can accumulate in the food chain and/or contaminate the environment if misused.

Pesticide Tolerance: The amount of pesticide residue allowed by law to remain in or on a harvested crop. By using various safety factors, EPA sets these levels well below the point where the chemicals might be harmful to consumers.

pH: A measure of the acidity or alkalinity of a liquid or solid material.

Phenols: Organic compounds that are by products of petroleum refining, tanning, and textile, dye, and resin manufacturing. Low concentrations cause taste and odor problems in water; higher concentrations can kill aquatic life and humans.

Pheromone: Hormonal chemical produced by female of a species to attract a mate.

Phosphates: Certain chemical compounds containing phosphorus.

Phosphorus: An essential chemical food element that can contribute to the eutrophication of lakes and other water bodies. Increased phosphorus levels result from discharge of phosphorus-containing materials into surface waters.

Photochemical Oxidants: Air pollutants formed by the action of sunlight on oxides of nitrogen and hydrocarbons.

Photochemical Smog: Air pollution caused by chemical reactions of various pollutants emitted from different sources.

Photosynthesis: The manufacture by plants of carbohydrates and oxygen from carbon dioxide and water in the presence of chlorophyll, using sunlight as an energy source.

Physical and Chemical Treatment: Processes generally used in large-scale waste-water treatment facilities. Physical processes may involve air-stripping or filtration. Chemical treatment includes coagulation, chlorination, or ozone addition. The term can also refer to treatment processes, treatment of toxic materials in surface waters and ground waters, oil spills, and some methods of dealing with hazardous materials on or in the ground.

Phytoplankton: That portion of the plankton community comprised of tiny plants, e.g., algae, diatoms.

Phytotoxic: Something that harms plants.

Picocurie: Measurement of radioactivity. A picocurie is one million millionth, or a trillionth, of a curie, and represents about 2.2 radioactive particle disintegrations per minute.

Picocuries Per Liter pCi/L): A unit of measure used for expressing levels of radon gas. (See picocurie.)

Pig: A container, usually lead, used to ship or store radioactive materials.

Pile: 1. The fuel element in a nuclear reactor. 2. A heap of waste.

Plankton: Tiny plants and animals that live in water

Plasmid: A circular piece of DNA that exists apart from the chromosome and replicates independently of it. Bacterial plasmids carry information that renders the bacteria resistant to antibiotics. Plasmids are often used in genetic engineering to carry desired genes into organisms.

Plastics: Non-metallic compounds that result from a chemical reaction, and are molded or formed into rigid or pliable construction materials or fabrics.

Plugging: 1. The act or process of stopping the flow of water, oil, or gas into or out of a formation through a borehole or well penetrating that formation. 2. Stopping a leak or sealing off a pipe or hose.

Plume: 1. A visible or measurable discharge of a contaminant from a given point of origin. Can be visible or thermal in water, or visible in the air as, for example, a plume of smoke. 2 The area of measurable and potentially harmful radiation leaking from a damaged reactor. 3. The distance from a toxic release considered dangerous for those exposed to the leaking fumes.

Plutonium: A radioactive metallic element similar chemically to uranium.

Point Source: A stationery location or fixed facility from which pollutants are discharged or emitted. Also, any single identifiable source of pollution, e.g., a pipe, ditch, ship, ore pit, factory smokestack.

Pollen: 1. A fine dust produced by plants. 2.The fertilizing element of flowering plants. 3. A natural or background air pollutant.

Pollutant: Generally, any substance introduced into the environment that adversely affects the usefulness of a resource.

Pollutant Standard Index (PSI): Measure of adverse health effects of air pollution levels in major cities.

Pollution: Generally, the presence of matter or energy whose nature, location or quantity produces undesired environmental effects Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, and radiological integrity of water.

Polyelectrolytes: Synthetic chemicals that help solids to clump during sewage treatment.

Polymer: Basic molecular ingredients in plastic.

Polyvinyl Chloride (PVC): A tough, environmentally indestructible plastic that releases hydrochloric acid when burned.

Population: A group of interbreeding organisms of the same kind occupying a particular space. Generically, the number of humans or other living creatures in a designated area.

Post-Closure: The time period following the shutdown of a waste management or manufacturing facility. For monitoring purposes, this is often considered to be 30 years.

Potable Water: Water that is safe for drinking and cooking.

Potentially Responsible Party (PRP): Any individual or company—including owners, operators, transporters or generators—potentially responsible for, or contributing to, the contamination problems at a Superfund site. Whenever possible, EPA requires PRPs, through administrative and legal actions, to clean up hazardous waste sites they have contaminated.

PPM/ PPB: Parts per million/ parts per billion, a way of expressing tiny concentrations of pollutants in air, water, soil, human tissue, food, or other products.

Precipitate: A solid that separates from a solution because of some chemical or physical change.

Precipitation: Removal of solids from liquid waste so that the hazardous solid portion can be disposed of safely; removal of particles from airborne emissions.

Precipitators: Air pollution control devices that collect particles from an emission.

Precursor: In photochemical terminology, a compound such as a volatile organic compound (VOC) that "precedes" an oxidant Precursors react in sunlight to form ozone or other photochemical oxidants.

Preliminary Assessment: The process of collecting and reviewing available information about a known or suspected waste site or release

Pressure Sewers: A system of pipes in which water, wastewater, or other liquid is transported to a higher elevation by use of pumping force.

Pretreatment: Processes used to reduce, eliminate, or alter the nature of wastewater pollutants from non-domestic sources before they are discharged into publicly owned treatment works.

Prevention: Measures taken to minimize the release of wastes to the environment

Prevention of Significant Deterioration (PSD): EPA program in which state and/or federal permits are required that are intended to restrict emissions for new or modified sources in places where air quality is already better than required to meet primary and secondary ambient air quality standards.

Primary Drinking Water Regulation: Applies to public water systems and specifies a contaminant level, which, in the judgement of the EPA Administrator, will have no adverse effect on human health.

Primary Waste Treatment: First steps in wastewater treatment; screens and sedimentation tanks are used to remove most materials that floats or will settle. Primary treatment results in the removal of about 30 percent of carbonaceous biochemical oxygen demand from domestic sewage.

Process Weight: Total weight of all materials, including fuel, used in a manufacturing process. It is used to calculate the allowable particulate emission rate from the process.

Proteins: Complex nitrogenous organic compounds of high molecular weight that contain amino acids as their basic unit and are essential for growth and repair of animal tissue. Many proteins are enzymes.

Protoplast: A membrane-bound cell from which the outer cell wall has been partially or completely removed. The term often is applied to plant cells.

Public Water System: A system that provides piped water for human consumption to at least 15 service connections or regularly serves 25 individuals.

Publicly Owned Treatment Works: A waste-treatment works owned by a state, unit of local government, or Indian tribe, usually designed to treat domestic wastewaters.

Pumping Station: Mechanical devices installed in sewer or water systems or other liquid-carrying pipelines that move the liquids to a higher level.

Putrescible: Able to rot quickly enough to cause odors and attract flies.

Pyrolysis: Decomposition of a chemical by extreme heat.

Q

Quality Assurance/Quality Control: A system of procedures, checks, audits, and corrective actions to ensure that all EPA research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

Quench Tank: A water-filled tank used to cool incinerator residues or hot materials during industrial processes.

R

RAD (Radiation Absorbed Dose): A unit of absorbed dose of radiation. One RAD of absorbed dose is equal to .01 joules per kilogram.

Radiation: Any form of energy propagated as rays, waves, or streams of energetic particles. The term is frequently used in relation to the emission of rays from the nucleus of an atom.

Radiation Standards: Regulations that set maximum exposure limits for protection of the public from radioactive materials.

Radioactive Substances: Substances that emit radiation.

Radiobiology: The study radiation effects on living things.

Radio Frequency Radiation: (See Non-ionizing Radiation.)

Radionuclide: Radioactive element characterized according to its atomic mass and atomic number which can be man-made or naturally occurring. Radioisotopes can have a long life as soil or water pollutants, and are believed to have potentially mutagenic effects on the human body.

Radius of Vulnerable Zone: The maximum distance from the point of release of a hazardous substance in which the airborne concentration could reach the level of concern under specified weather conditions.

Radon: A colorless naturally occurring, radioactive, inert gaseous element formed by radioactive decay of radium atoms in soil or rocks

Radon Decay Products: A term used to refer collectively to the immediate products of the radon decay chain. These include Po-218, Pb-214, Bi-214, and Po-214, which have an average combined half-life of about 30 minutes.

Rasp: A machine that grinds waste into a manageable material and helps prevent odor

Raw Sewage: Untreated wastewater.

Reasonably Available Control Technology (RACT): The lowest emissions limit that a particular source is capable of meeting by the application of control technology that is both reasonably available, as well as technologically and economically feasible. RACT is usually applied to existing to existing sources in nonattainment areas and most cases is less stringent than new source performance standards.

Receiving Waters: A river, lake, ocean, stream or other watercourse into which wastewater or treated effluent is discharged.

Recharge: The process by which water is added to a zone of saturation, usually by percolation from the soil surface, e.g., the recharge of an aquifer.

Recharge Area: A land area in which water reaches to the zone of saturation from surface infiltration, e.g., an area where rainwater soaks through the earth to reach an aquifer.

Recombinant Bacteria: A type of microorganism whose genetic makeup has been altered by deliberate introduction of new genetic elements. The offspring of these altered bacteria also contain these new genetic elements.

Recombinant DNA (rDNA): The new DNA that is formed by combining pieces of DNA from different organisms or cells.

Recommended Maximum Contaminant Level (RMCL): The maximum level of a contaminant in drinking water at which no known or anticipated adverse affect on human health would occur, and which includes an adequate margin of safety. Recommended levels are nonenforceable health goals. (See: maximum contaminant level.)

Reconstructed Source: An existing facility in which components are replaced to such an extent that the fixed capital cost of the new components exceed 50 percent of the capital cost that would be required to construct a comparable entirely new facility. New source performance standards may be applied to sources which are reconstructed after the proposal of the standard if it is technologically and economically feasible to meet the standard.

Record of Decision (ROD): A public document that explains which cleanup alternative(s) will be used at National Priorities List sites where, under CERCLA, Trust Funds pay for the cleanup.

Recycle/Reuse: The process of minimizing the generation of waste by recovering usable products that might otherwise become waste. Examples are the recycling of aluminum cans, wastepaper, and bottles.

Red Border: An EPA document that is undergoing final review before being submitted for final management decision.

Red Tide: A proliferation of a marine plankton that is toxic and often fatal to fish. This natural phenomenon may be stimulated by the addition of nutrients. A tide can be called red, green or brown, depending on the coloration of the plankton.

Reentry Interval: The period of time immediately following the application of a pesticide during which unprotected workers should not enter a field.

Refuse: (See: solid waste.)

Refuse Reclamation: Conversion of solid waste into useful products, e.g., composting organic wastes to make soil conditioners or separating aluminum and other metals for melting and recycling.

Regeneration: Manipulation of individual cells or masses of cells to cause them to develop into whole plants.

Regional Response Team (RRT): Representatives of federal, local, and state agencies who may assist in coordination of activities at the request of the On-Scene Coordinator before and during a Superfund response action.

Registrant: Any manufacturer or formulator who obtains registration for a pesticide active ingredient or product.

Registration: Formal listing with EPA of a new pesticide before it can be sold or distributed in intra- or inter-state commerce. The product must be registered under the Federal Insecticide, Fungicide, and Rodenticide Act. EPA is responsible for registration (pre-market licensing) of pesticides on the basis of data demonstrating that they will not cause unreasonable adverse effects on human health or the environment when used according to approved label directions.

Registration Standards: Published reviews of all the data available on pesticide active ingredients.

REM (Roentgen Equivalent Man): The unit of dose equivalent from ionizing radiation to the human body, used to measure the amount of radiation to which a person or a part of a human has been exposed.

Remedial Action (RA): The actual construction or implementation phase of a Superfund site cleanup that follows remedial design.

Remedial Design: A phase of remedial action that follows the remedial investigation/feasibility study and includes development of engineering drawings and specifications for a site cleanup.

Remedial Investigation: An in-depth study designed to gather the data necessary to determine the nature and extent of contamination at a Superfund site; establish criteria for cleaning up the site; identify preliminary alternatives for remedial actions; and support the technical and cost analyses of the alternatives. The remedial investigation is usually done with the feasibility study. Together they are usually referred to as the "RI/FS".

Remedial Project Manager (RPM): The EPA or state official responsible for overseeing remedial action at a site.

Remedial Response: A long-term action that stops or substantially reduces a release or threat of a release of hazardous substances that is serious but not an immediate threat to public health.

Removal Action: Short-term immediate actions taken to address releases of hazardous substances that require expedited response. (See: cleanup.)

Reportable Quantity (RQ): The quantity of a hazardous substance that triggers reports under CERCLA. If a substance is released in amounts exceeding its RQ, the release must be reported to the National Response Center, the SERC, and community emergency coordinators for areas likely to be affected.

Reregistration: The reevaluation and relicensing of existing pesticides originally registered prior to current scientific and regulatory standards. EPA reregisters pesticides through its Registration Standards Program.

Reservoir: Any natural or artificial holding area used to store, regulate, or control water.

Residual: Amount of a pollutant remaining in the environment after a natural or technological process has taken place, e.g., the sludge remaining after initial wastewater treatment, or particulates remaining in air after the air passes through a scrubbing or process.

Resistance: For plants and animals, the ability to withstand poor environmental conditions and/or attacks by chemicals or disease. The ability may be inborn or developed.

Resource: A person, thing, or action needed for living or to improve the quality of life.

Response Action: A CERCLA-authorized action involving either a short-term removal action or a long-term removal response that may include but is not limited to: removing hazardous materials from a site to an EPA-approved hazardous waste facility for treatment, containment, or destruction; containing the waste safely on-site; destroying or treating the waste on-site; and identifying and removing the source of ground-water contamination and halting further migration of contaminants. (See: cleanup.)

Resource Recovery: The process of obtaining matter or energy from materials formerly discarded.

Restoration: Measures taken to return a site to pre-violation conditions.

Restricted Use: When a pesticide is registered, some or all of its uses may be classified (under FIFRA regulations) for restricted use if the pesticide requires special handling because of its toxicity. Restricted-use pesticides may be applied only by trained, certified applicators or those under their direct supervision.

Restriction Enzymes: Enzymes that recognize certain specific regions of a long DNA molecule and then cut the DNA into smaller pieces.

Reverse Osmosis: A water treatment process used in small water systems by adding pressure to force water through a semi-permeable membrane. Reverse osmosis removes most drinking water contaminants. Also used in wastewater treatment. Large-scale reverse osmosis plants are now being developed.

Ribonucleic Acid (RNA): A molecule that carries the genetic message from DNA to a cell's protein-producing mechanisms; similar to, but chemically different from, DNA.

Ringlemann Chart: A series of shaded illustrations used to measure the opacity of air pollution emissions. The chart ranges from light grey through black and is used to set and enforce emissions standards.

Riparian Habitat: Areas adjacent to rivers and streams that have a high density, diversity, and productivity of plant and animal species relative to nearby uplands.

Riparian Rights: Entitlement of a land owner to the water on or bordering his property, including the right to prevent diversion or misuse of upstream waters. Generally, a matter of state law.

Risk Assessment: The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific pollutants.

Risk Communication: The exchange of information about health or environmental risks between risk assessors, risk managers, the general public, news media, interest groups, etc.

Risk Management: The process of evaluating alternative regulatory and non-regulatory responses to risk and selecting among them. The selection process necessarily requires the consideration of legal, economic and social factors.

River Basin: The land area drained by a river and its tributaries.

Rodenticide: A chemical or agent used to destroy rats or other rodent pests, or to prevent them from damaging food, crops, etc.

Rough Fish: Those fish, not prized for eating, such as gar and suckers. Most are more tolerant of changing environmental conditions than game species.

Rubbish: Solid waste, excluding food waste and ashes, from homes, institutions, and work-places.

Run-Off: That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface-water. It can carry pollutants from the air and land into the receiving waters.

S

Salinity: The degree of salt in water.

Salts: Minerals that water picks up as it passes through the air, over and under the ground, and as it is used by households and industry.

Salt Water Intrusion: The invasion of fresh surface or ground water by salt water. If the salt water comes from the ocean it may be called sea water intrusion.

Salvage: The utilization of waste materials.

Sanitation: Control of physical factors in the human environment that could harm development, health, or survival.

Sand Filters: Devices that remove some suspended solids from sewage. Air and bacteria decompose additional wastes filtering through the sand so that cleaner water drains from the bed.

Sanitary Landfill: (See: landfill, sanitary.)

Sanitary Sewers: Underground pipes that carry off only domestic or industrial waste, not storm water.

Sanitary Survey: An on-site review of the water sources, facilities, equipment, operation and maintenance of a public water system to evaluate the adequacy of those elements for producing and distributing safe drinking water.

Saturated Zone: A subsurface area in which all pores and cracks are filled with water under pressure equal to or greater than that of the atmosphere.

Scrap: Materials discarded from manufacturing operations that may be suitable for reprocessing.

Screening: Use of screens to remove coarse floating and suspended solids from sewage.

Scrubber: An air pollution device that uses a spray of water or reactant or a dry process to trap pollutants in emissions.

Secondary Drinking Water Regulations: Unenforceable regulations which apply to public water systems and which specify the maximum contamination levels which, in the judgement of EPA, are required to protect the public welfare. These regulations apply to any contaminants that may adversely affect the odor or appearance of such water and consequently may cause people served by the system to discontinue its use.

Secondary Treatment: The second step in most publicly owned waste treatment systems in which bacteria consume the organic parts of the waste. It is accomplished by bringing together waste, bacteria, and oxygen in trickling filters or in the activated sludge process. This treatment removes floating and settleable solids and about 90 percent of the oxygen-demanding substances and suspended solids. Disinfection is the final stage of secondary treatment. (See: primary, tertiary treatment.)

Secure Chemical: (See: landfills.)

Secure Maximum Contaminant Level: Maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of a water supply, the consumer, or of contamination resulting from corrosion of piping and plumbing caused by water quality.

Sediments: Soil, sand, and minerals washed from land into water usually after rain. They pile up in reservoirs, rivers and harbors, destroying fish nesting areas and holes of water animals, and clouding the water so that needed sunlight might not reach aquatic plants. Careless farming, mining, and building activities will expose sediment materials, allowing them to be washed off the land after rainfalls.

Sedimentation: Letting solids settle out of wastewater by gravity during wastewater treatment.

Sedimentation Tanks: Holding areas for wastewater where floating wastes are skimmed off and settled solids are removed for disposal.

Selective Pesticide: A chemical designed to affect only certain types of pests, leaving other plants and animals unharmed.

Semi-Confined Aquifer: An aquifer that is partially confined by a soil layer (or layers) of low permeability through which recharge and discharge can occur.

Senescence: Term for the aging process. Sometimes used to describe lakes or other bodies of water in advanced stages of eutrophication.

Septic Tank: An underground storage tank for wastes from homes having no sewer line to a treatment plant. The waste goes directly from the home to the tank, where the organic waste is decomposed by bacteria and the sludge settles to the bottom. The effluent flows out of the tank into the ground through drains; the sludge is pumped out periodically.

Service Connector: The pipe that carries tap water from the public water main to a building.

Settleable Solids: Material heavy enough to sink to the bottom of a wastewater treatment tank.

Settling Chamber: A series of screens placed in the way of flue gases to slow the stream of air, thus helping gravity to pull particles out of the emission into a collection area.

Settling Tank: A holding area for wastewater, where heavier particles sink to the bottom for removal and disposal.

Sewage: The waste and wastewater produced by residential and commercial establishments and discharged into sewers.

Sewage Lagoon: (See: lagoon.)

Sewage Sludge: Sludge produced at a Publicly Owned Treatment Works, the disposal of which is regulated under the Clean Water Act.

Sewer: A channel or conduit that carries wastewater and stormwater runoff from the source to a treatment plant or receiving stream. Sanitary sewers carry household, industrial, and commercial waste. Storm sewers carry runoff from rain or snow. Combined sewers are used for both purposes.

Sewerage: The entire system of sewage collection, treatment, and disposal.

Shotgun: Non-scientific term for the process of breaking up the DNA derived from an organism and then moving each separate and unidentified DNA fragment into a bacterium.

Signal Words: The words used on a pesticide label—Danger, Warning, Caution—to indicate the level of toxicity of the chemicals.

Significant Deterioration: Pollution resulting from a new source in previously "clean" areas. (See: prevention of significant deterioration.)

Significant Municipal Facilities: Those publicly owned sewage treatment plants that discharge a million gallons per day or more and are therefore considered by states to have the potential for substantial effect on the quality of receiving waters.

Significant Violations: Violations by point source dischargers of sufficient magnitude and/or duration to be a regulatory priority.

Silt: Fine particles of sand or rock that can be picked up by the air or water and deposited as sediment.

Silviculture: Management of forest land for timber. Sometimes contributes to water pollution, as in clear-cutting.

Sinking: Controlling oil spills by using an agent to trap the oil and sink it to the bottom of the body of water where the agent and the oil are biodegraded.

Site Inspection: The collection of information from a Superfund site to determine the extent and severity of hazards posed by the site. It follows and is more extensive than a preliminary assessment. The purpose is to gather information necessary to score the site, using the Hazard Ranking System, and to determine if the site presents an immediate threat that requires prompt removal action.

Siting: The process of choosing a location for a facility.

Skimming: Using a machine to remove oil or scum from the surface of the water.

Slow Sand Filtration: Treatment process involving passage of raw water through a bed of sand at low velocity which results in the substantial removal of chemical and biological contaminants.

Sludge: A semi-solid residue from any of a number of air or water treatment processes. Sludge can be a hazardous waste.

Slurry: A watery mixture of insoluble matter that results from some pollution control techniques.

Smelter: A facility that melts or fuses ore, often with an accompanying chemical change, to separate the metal. Emissions are known to cause pollution. Smelting is the process involved.

Smog: Air pollution associated with oxidants. (See: photochemical smog.)

Smoke: Particles suspended in air after incomplete combustion of materials.

Soft Detergents: Cleaning agents that break down in nature.

Soft Water: Any water that is not "hard," i.e., does not contain a significant amount of dissolved minerals such as salts containing calcium or magnesium.

Soil Adsorption Field: A sub-surface area containing a trench or bed with clean stones and a system of distribution piping through which treated sewage may seep into the surrounding soil for further treatment and disposal.

Soil Conditioner: An organic material like humus or compost that helps soil absorb water, build a bacterial community, and distribute nutrients and minerals.

Soil Gas: Gaseous elements and compounds that occur in the small spaces between particles of the earth and soil. Such gases can move through or leave the soil or rock, depending on changes in pressure.

Solder: A metallic compound used to seal the joints between pipes. Until recently, most solder ocontained 50 percent lead.

Sole Source Aquifer: An aquifer that supplies 50 percent or more of the drinking water of an area.

Solid Waste: Non-liquid., non-soluble materials ranging from municipal garbage to industrial wastes that contain complex, and sometimes hazardous, substances. Solid wastes also include sewage sludge, agricultural refuse, demolition wastes, and mining residues. Technically, solid waste also refers to liquids and gases in containers.

Solid Waste Disposal: The final placement of refuse that is not salvaged or recycled.

Solid Waste Management: Supervised handling of waste materials from their source through recovery processes to disposal.

Solidification and Stabilization: Removal of wastewater from a waste or changing it chemically to make the waste less permeable and susceptible to transport by water.

Solvent: Substance (usually liquid) capable of dissolving or dispersing one or more other substances.

Soot: Carbon dust formed by incomplete combustion.

Sorption: The action of soaking up or attracting substances. A process used in many pollution control systems.

Special Review: Formerly known as Rebuttable Presumption Against Registration (RPAR), this is the regulatory process through which existing pesticides suspected of posing unreasonable risks to human health, non-target organisms, or the environment are referred for review by EPA. The review requires an intensive risk/benefit analysis with opportunity for public comment. If the risk of any use of a pesticide is found to outweigh social and economic benefits, regulatory actions—ranging from label revisions and use-restriction to cancellation or suspended registration—can be initiated.

Species: A reproductively isolated aggregate of interbreeding populations of organisms.

Spill Prevention Control and Countermeasures Plan (SPCC): Plan covering the release of hazardous substances as defined in the Clean Water Act.

Sprawl: Unplanned development of open land.

Spoil: Dirt or rock that has been removed from its original location, destroying the composition of the soil in the process, as with strip-mining or dredging.

Stabilization: Conversion of the active organic matter in sludge into inert, harmless material.

Stabilization Ponds: (See: lagoon.)

Stable Air: A mass of air that is not moving normally, so that it holds rather than disperses pollutants.

Stack: A chimney or smokestack; a vertical pipe that discharges used air.

Stack Effect: Used air, as in a chimney, that moves upward because it is warmer than the surrounding atmosphere.

Stack Gas: (See: flue gas.)

Stagnation: Lack of motion in a mass of air or water, which tends to hold pollutants.

Standards: Prescriptive norms which govern action and actual limits on the amount of pollutants or emissions produced. EPA, under most of its responsibilities, establishes minimum standards. States are allowed to be stricter.

State Emergency Response Commission (SERC): Commission apointed by each state governor according to the requirements of SARA Title III. The SERC's designate emergency planning districts, appoint local emergency planning committees, and supervise and coordinate their activities.

State Implementation Plans (SIP): EPA-approved state plans for the establishment, regulation, and enforcement of air pollution standards.

Stationary Source: A fixed, non-moving producer of pollution, mainly power plants and other facilities using industrial combustion processes.

Sterilization: 1. In pest control, the use of radiation and chemicals to damage body cells needed for reproduction. 2. The destruction of all living organisms in water or on the surface of various materials. In contrast, disinfection is the destruction of *most* living organisms in water or on surfaces.

Storage: Temporary holding of waste pending treatment or dispcsal. Storage methods include containers, tanks, waste piles, and surface impoundments.

Storm Sewer: A system of pipes (separate from sanitary sewers) that carry only water runoff from building and land surfaces.

Stratification: Separating into layers.

Stratosphere: The portion of the atmosphere that is 10-to-25 miles above the earth's surface.

Strip-Cropping: Growing crops in a systematic arrangement of strips or bands which serve as barriers to wind and water erosion.

Strip-Mining: A process that uses machines to scrape soil or rock away from mineral deposits just under the earth's surface.

Sulfur Dioxide (SO2): A heavy, pungent, colorless, gaseous air pollutant formed primarily by the combustion of fossil plants.

Sump: A pit or tank that catches liquid runoff for drainage or disposal.

Sump Pump: A mechanism for removing water or wastewater from a sump or wet well.

Superfund: The program operated under the legislative authority of CERCLA and SARA that funds and carries out the EPA solid waste emergency and long-term removal remedial activities. These activities include establishing the National Priorities List, investigating sites for inclusion on the list, determining their priority level on the list, and conducting and/or supervising the ultimately determined cleanup and other remedial actions.

Surface Impoundment: Treatment, storage, or disposal of liquid hazardous wastes in ponds.

Surface Water: All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors which are directly influenced by surface water.

Surfactant: A surface-active agent used in detergents to cause lathering.

Surveillance System: A series of monitoring devices designed to determine environmental quality.

Suspended Solids: Small particles of solid pollutants that float on the surface of, or are suspended in sewage or other liquids. They resist removal by conventional means. (See: Total Suspended Solids.)

Suspension: The act of suspending the use of a pesticide when EPA deems it necessary to do so in order to prevent an imminent hazard resulting from continued use of the pesticide. An emergency suspension takes effect immediately; under an ordinary suspension a registrant can request a hearing before the suspension goes into effect. Such a hearing process might take six months.

Suspension Culture: Individual cells or small clumps of cells growing in a liquid nutrient medium.

Swamp: A type of wetland that is dominated by woody vegetation and does not accumulate appreciable peat deposits. Swamps may be fresh or salt water and tidal or non-tidal. (See: Wetlands.)

Synergism: The cooperative interaction of two or more chemicals or other phenomena producing a greater total effect than the sum of their individual effects.

Synthetic Organic Chemicals (SOCs): Man-made organic chemicals. Some SOCs are volatile, others tend to stay dissolved in water rather than evaporate out of it.

Systemic Pesticide: A chemical that is taken up from the ground or absorbed through the surface and carried through the system of the organism being protected, making the organism toxic to pests.

T

Tailings: Residue of raw materials or waste separated out during the processing of crops or mineral ores

TBT Paints (Trybutilin): (See: organotins.)

Technology-Based Standards: Effluent limitations applicable to direct and indirect sources which are developed on a category-by-category basis using statutory factors, not including water-quality effects

Teratogen: Substance that causes malformation or serious deviation from normal development of embryos and fetuses.

Terracing: Diking, built along the contour of sloping agricultural land, that holds runoff and sediment to reduce erosion.

Tertiary Treatment: Advanced cleaning of wastewater that goes beyond the secondary or biological stage. It removes nutrients such as phosphorus and nitrogen and most BOD and suspended solids.

Thermal Pollution: Discharge of heated water from industrial processes that can affect the life processes of aquatic organisms.

Threshold Limit Value (TLV): Represents the air concentrations of chemical substances to which it is believed that workers may be daily exposed without adverse effect.

Threshold Planning Quantity: A quantity designated for each chemical on the list of extremely hazardous substances that triggers notification by facilities to the state emergency response commission that such facilities are subject to emergency planning under SARA Title III

Tidal Marsh: Low, flat marshlands traversed by channels and tidal hollows and subject to tidal inundation; normally, the only vegetation present are salt-tolerant bushes and grasses. (See: wetlands.)

Tolerances: The permissible residue levels for pesticides in raw agricultural produce and processed foods. Whenever a pesticide is registered for use on a food or a feed crop, a tolerance (or exemption from the tolerance requirement) must be established. EPA establishes the tolerance levels, which are enforced by the Food and Drug Administration and the Department of Agriculture.

Topography: The physical features of a surface area including relative elevations and the position of natural and man-made features.

Total Suspended Solids (TSS): A measure of the suspended solids in wastewater, effluent, or water bodies, determined by using tests for "total suspended non-filterable solids." (See: suspended solids.)

Toxic: Harmful to living organisms.

Toxic Pollutants: Materials contaminating the environment that cause death, disease, birth defects in organisms that ingest or absorb them. The quantities and length of exposure necessary to cause these effects can vary widely.

Toxic Chemical Release Form: Information form required to be submitted by facilities that manufacture, process, or use (in quantities above a specific amount) chemicals listed under SARA Title III.

Toxic Cloud: Airborne mass of gases, vapors, fumes, or aerosols containing toxic materials.

Toxic Substance: A chemical or mixture that may present an unreasonable risk of injury to health or the environment.

Toxicant: A poisonous agent that kills or injures animal or plant life.

Toxicity: The degree of danger posed by a substance to animal or plant life. (See: acute, chronic toxicity.)

Toxicology: The science and study of poisons control.

Transformation: The process of placing new genes into a host cell, thereby inducing the host cell to exhibit functions encoded by the DNA.

Transpiration: The process by which water vapor is lost to the atmosphere from living plants. The term can also be applied to the quantity of water thus dissipated.

Trash-to-Energy Plan: A plan for putting waste back to work by burning trash to produce energy.

Treatment, Storage, and Disposal Facility: Site where a hazardous substance is treated, stored, or disposed. TSD facilities are regulated by EPA and states under RCRA.

Trichloroethylene TCE): A stable, low-boiling colorless liquid, toxic by inhalation. TCE is used as a solvent, metal degreasing agent, and in other industrial applications.

Trickling Filter: A coarse, biological treatment system in which wastewater is trickled over a bed of stones or other material covered with bacterial growth The bacteria break down the

Trihalomethane (THM): One of a family of organic compounds, named as derivatives of methane. THM's are generally the by-product from chlorination of drinking water that contains organic material.

Troposphere: The lower atmosphere, the portion of the atmosphere between seven and ten miles from the Earth's surface where clouds are formed.

Trust Fund (CERCLA): A fund set up under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) to help pay for cleanup of hazardous waste sites and for legal action to force those responsible for the sites to clean them up.

Tundra: A type of ecosystem dominated by lichens, mosses, grasses, and woody plants. Tundra is found at high latitudes (arctic tundra) and high altitudes (alpine tundra). Arctic tundra is underlain by permafrost and is usually very wet. (See: wetlands.)

Turbidimeter: A device that measures the amount of suspended solids in a liquid.

Turbidity: 1. Haziness in air caused by the presence of particles and pollutants. 2. A similar cloudy condition in water due to suspended silt or organic matter.

U

Ultra Clean Coal (UCC): Coal that has been washed, ground into fine particles, then chemically treated to remove sulfur, ash, silicone, and other substances; usually briquetted and coated with a sealant made from coal

Ultraviolet Rays: Radiation from the sun that can be useful or potentially harmful. UV rays from one part of the spectrum enhance plant life and are useful in some medical and dental procedures; UV rays from other parts of the spectrum to which humans are exposed (e.g., while getting a sun tan) can cause skin cancer or other tissue damage. The ozone layer in the atmosphere provides a protective shield that limits the amount of ultraviolet rays that reach the Earth's surface.

Underground Injection Control (UIC): The program under the Safe Drinking Water Act that regulates the use of wells to pump fluids into the ground.

Underground Sources of Drinking Water: As defined in the UIC program, this terms refers to aquifers that are currently being used as a source of drinking water, and those that are capable of supplying a public water system. They have a total dissolved solids content of 10,000 milligrams per liter or less, and are not "exempted aquifers." (See: exempted aquifer.)

Underground Storage Tank: A tank located all or partially under ground that is designed to hold gasoline or other petroleum products or chemical solutions.

Unsaturated Zone: The area above the water table where the soil pores are not fully saturated, although some water may be present.

Uranium: A radioactive heavy metal element used in nuclear reactors and the production of nuclear weapons. Term refers usually to U-238, the most abundant radium isotope, although a small percentage of naturally-occurring uranium is U-235.

Urban Runoff: Stormwater from city streets and adjacent domestic or commercial properties that may carry pollutants of various kinds into the sewer systems and/or receiving waters.

V

Vaccine: Dead or partial or modified antigen used to induce immunity to certain infectious diseases.

Vapor: The gaseous phase of substances that are liquid or solid at atmospheric temperature and pressure, e.g., steam.

Vapor Capture System: Any combination of hoods and ventilation system that captures or contains organic vapors in order that they may be directed to an abatement or recovery device.

Vapor Dispersion: The movement of vapor clouds in air due to wind, gravity spreading, and mixing.

Vapor Plumes: Flue gases that are visible because they contain water droplets.

Vaporization: The change of a substance from a liquid to a gas.

Variance: Government permission for a delay or exception in the application of a given law, ordinance, or regulation.

Vector: 1. An organism, often an insect or rodent that carries disease. 2. An object that is used to transport genes into a host cell (vectors can be plasmids, viruses, or other bacteria). A gene is placed in the vector; the vector then "infects" the bacterium.

Ventilation/Suction: The act of admitting fresh air into a space in order to replace stale or contaminated air, achieved by blowing air into the space. Similarly, suction represents the admission of fresh air into an interior space by lowering the pressure outside of the space, thereby drawing the contaminated air outward.

Vinyl Chloride: A chemical compound, used in producing some plastics, that is believed to be carcogenic.

Virus: The smallest form of microorganisms capable of causing disease.

Volatile: Description of any substance that evaporates readily.

Volatile Organic Compound (VOC): Any organic compound which participates in atmospheric photochemical reactions except for those designated by the EPA Administrator as having negligible photochemical reactivity.

Volatile Synthetic Organic Chemicals: Chemicals that tend to volatilize or evaporate from water.

Vulnerability Analysis: Assessment of elements in the community that are susceptible to damage should a release of hazardous materials occur.

Vulnerable Zone: An area over which the airborne concentration of a chemical involved in an accidental release could reach the level of concern.

W

Waste: 1. Unwanted materials left over from a manufacturing process. 2. Refuse from places of human or animal habitation.

Waste Load Allocation: The maximum load of pollutants each discharger of waste is allowed to release into a particular waterway. Discharge limits are usually required for each specific water quality criterion being, or expected to be, violated.

Waste Treatment Stream: The continuous movement of waste from generator to treater and disposer.

Waste Treatment Plant: A facility containing a series of tanks, screens, filters and other processes by which pollutants are removed from water.

Wastewater: The spent or used water from individual homes, a community, a farm, or an industry that contains dissolved or suspended matter.

Wastewater Operations and Maintenance: Actions taken after construction to assure that facilities constructed to treat wastewater will be properly operated, maintained, and managed to achieve efficiency levels and prescribed effluent levels in an optimum manner.

Water Pollution: The presence in water of enough harmful or objectionable material to damage the water's quality.

Water Quality Criteria: Specific levels of water quality which, if reached, are expected to render a body of water suitable for its designated use. The criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

Water Quality Standards: State-adopted and EPA-approved ambient standards for water bodies. The standards cover the use of the water body and the water quality criteria which must be met to protect the designated use or uses.

Watershed: The land area that drains into a stream.

Water Supplier: A person who owns or operates a public water system.

Water Supply System: The collection, treatment, storage, and distribution of potable water from source to consumer.

Water Solubility: The maximum concentration of a chemical compound which can result when it is dissolved in water. If a substance is water soluble it can very readily disperse through the environment.

Water Table: The level of ground water.

Well: A bored, drilled, or driven shaft, or a dug hole, whose depth is greater than the largest surface dimension and whose purpose is to reach underground water supplies or oil, or to store or bury fluids below ground.

Well Injection: The subsurface emplacement of fluids in a well.

Well Monitoring: The measurement, by on-site instruments or laboratory methods, of the quality of water in a well.

Well Plug: A watertight and gastight seal installed in a bore hole or well to prevent movement of fluids.

Wetlands: An area that is regularly saturated by surface or ground water and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions. Examples include: swamps, bogs, fens, marshes, and estuaries.

Wildlife Refuge: An area designated for the protection of wild animals, within which hunting and fishing are either prohibited or strictly controlled.

Wood-Burning Stove Pollution: Air pollution caused by emissions of particulate matter, carbon monoxide, total suspended particulates, and polycyclic organic matter from wood-burning stoves.

Working Level (WL): A unit of measure for documenting exposure to radon decay products. One working level is equal to approximately 200 picocuries per liter.

Working Level Month (WLM): A unit of measure used to determine cumulative exposure to radon.

X, Y, Z

Xenobiotic: Term for non-naturally occurring man-made substances found in the environment (i.e., synthetic material solvents, plastics.).

Zooplankton: Tiny aquatic animals eaten by fish.

APPENDIX F

WASHINGTON PARK WILDERNESS

ACT OF 1988

(PUBLIC LAW 100-668)

TITLE II—NORTH CASCADES NATIONAL PARK SERVICE COMPLEX WILDERNESS

SEC. 201. DESIGNATION.

(a) WILDERNESS.—In furtherance of the purposes of the Wilderness Act (16 U.S.C. 1131 et seq.; 78 Stat. 890), certain lands in the North Cascades National Park, Ross Lake National Recreation Area, and Lake Chelan National Recreation Area, Washington, which—

(1) comprise approximately six hundred and thirty-four thousand six hundred and fourteen acres of wilderness, and approximately five thousand two hundred and twenty-six acres of potential wilderness additions, and

(2) are depicted on a map entitled "Wilderness Boundary, North Cascades National Park Service Complex, Washington", numbered 168–60–186 and dated August 1988,

are hereby designated as wilderness and therefore as components of the National Wilderness Preservation System. Such lands shall be known as the Stephen Mather Wilderness.

SEC. 202. HYDROELECTRIC PROJECTS.

Section 505 of the Act of October 2, 1968 (82 Stat. 930; 16 U.S.C. 90d–4) is amended as follows: strike "in the recreation areas", and insert in lieu thereof "in the lands and waters within the Skagit River Hydroelectric Project, Federal Energy and Regulatory Commission Project 553, including the proposed Copper Creek, High Ross, and Thunder Creek elements of the Project; and the Newhalem Project, Federal Energy and Regulatory Commission Project 2705, within the Ross Lake National Recreation Area; the lands and waters within the Lake Chelan Project, Federal Energy and Regulatory Commission Project 637; the Company Creek small hydroelectric project at Stehekin within the Lake Chelan National Recreation Area; and existing hydrologic monitoring stations necessary for the proper operation of the hydroelectric projects listed herein".

SEC. 203. LAND ACQUISITION FOR ADMINISTRATIVE FACILITIES.

Section 301(a) of the Act of October 2, 1968 (82 Stat. 927; 16 U.S.C. 90b) is hereby amended to add a new subsection as follows:

"(b) The Secretary is hereby authorized to acquire, with the consent of the owner, lands outside of the authorized boundaries of North Cascades National Park Service Complex for the purpose of

construction and operation of a backcountry information center not to exceed five acres. The Secretary of the Interior is further authorized to acquire with the consent of the owner, lands for the construction of a headquarters and administrative site or sites, for the North Cascades National Park, Ross Lake National Recreation Area, and Lake Chelan National Recreation Area not to exceed ten acres. The lands so acquired shall be managed as part of the park.".

SEC. 204. AUTHORIZATION OF APPROPRIATIONS.

There are hereby authorized to be appropriated to the Secretary of the Interior such sums as may be necessary to complete the land acquisitions authorized pursuant to section 203 of this Act.

SEC. 205. RENEWABLE NATURAL RESOURCE USE IN RECREATION AREAS.

Section 402(a) of the Act of October 2, 1968 (82 Stat. 928; 16 U.S.C. 90c-1) is hereby amended to read as follows:

"The Secretary shall administer the recreation areas in a manner which in his judgment will best provide for (1) public outdoor recreation benefits and (2) conservation of scenic, scientific, historic, and other values contributing to public enjoyment. Within that portion of the Lake Chelan National Recreation Area which is not designated as wilderness, such management, utilization, and disposal of renewable natural resources and the continuation of existing uses and developments as will promote, or are compatible with, or do not significantly impair public recreation and conservation of the scenic, scientific, historic, or other values contributing to public enjoyment, are authorized. In administering the recreation areas, the Secretary may utilize such statutory authorities pertaining to the administration of the national park system, and such statutory authorities otherwise available to him for the conservation and management of natural resources as he deems appropriate for recreation and preservation purposes and for resource development compatible therewith. Within the Ross Lake National Recreation Area the removal and disposal of trees within power line rights-of-way are authorized as necessary to protect transmission lines, towers, and equipment;": *Provided*, That to the extent practicable, such removal and disposal of trees shall be conducted in such a manner as to protect scenic viewsheds.".

SEC. 206. MINERAL RESOURCE USE IN RECREATION AREAS.

Section 402(b) of the Act of October 2, 1968 (82 Stat. 928; 16 U.S.C. 90c-1b) is hereby amended to read as follows:

"The lands within the recreation areas, subject to valid existing rights, are hereby withdrawn from all forms of appropriation or disposal under the public land laws, including location, entry, and patent under the United States mining laws, and disposition under the United States mineral leasing laws: *Provided, however,* That within that portion of the Lake Chelan National Recreation Area which is not designated as wilderness, sand, rock and gravel may be made available for sale to the residents of Stehekin for local use so long as such sale and disposal does not have significant adverse effects on the administration of the Lake Chelan National Recreation Area.".

APPENDIX G

PROXIMITY TO OVERHEAD POWER LINES

(WAC 296-24-960)

WAC 296-24-960 Proximity to overhead power lines. (1) General requirements – high voltage lines.

(a) Minimum clearance.

(i) No work shall be performed, no material shall be piled, stored or otherwise handled, no scaffolding, commercial signs, or structures shall be erected or dismantled, nor any tools, machinery or equipment operated within the specified minimum distances from any energized high voltage electrical conductor capable of energizing the material or equipment; except where the electrical distribution and transmission lines have been deenergized and visibly grounded at point of work, or where insulating barriers not a part of or an attachment to the equipment have been erected, to prevent physical contact with the lines, equipment shall be operated proximate to, under, over, by, or near powerlines only in accordance with the following:

(ii) For lines rated 50 kv. or below, minimum clearance between the lines and any part of the equipment or load shall be 10 feet.

(iii) For lines rated over 50 kv. minimum, clearance between the lines and any part of the equipment or load shall be 10 feet plus 0.4 inch for each 1 kv. over 50 kv., or twice the length of the line insulator but never less than 10 feet.

(b) Overhead electric lines. Where overhead electric conductors are encountered in proximity to a work area, the employer shall be responsible for:

(i) Ascertaining the voltage and minimum clearance distance required, and

(ii) Maintaining the minimum clearance distance, and

(iii) Ensuring that the requirements of subsection (1) of this section are complied with.

(c) Not covered: Employees working under chapters 296-32 and 296-45 WAC.

(2) Low voltage lines. When work is being carried out in proximity to energized electrical service conductors operating at 750 volts or less, such work shall be performed in a manner to prevent contact by any worker with the energized conductors.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 82-13-045 (Order 82-22), § 296-24-960, filed 6/11/82; 82-02-003 (Order 81-32), § 296-24-960, filed 12/24/81.]

APPENDIX H

SAFETY STANDARDS FOR

ELECTRICAL CONSTRUCTION CODE

(WAC 296-44-21230)

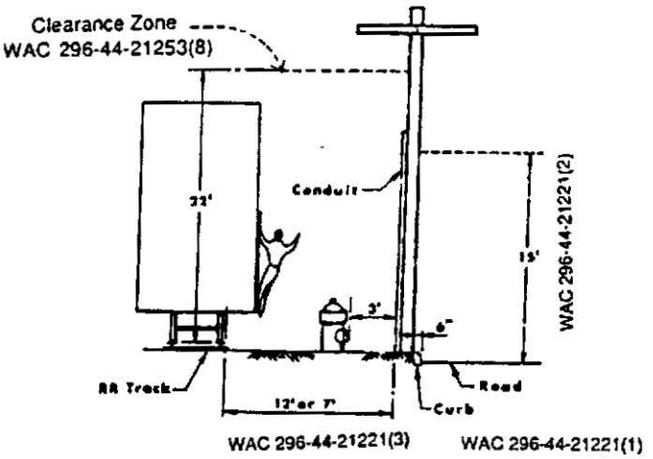

Fig. 212-1

Clearances to Other Objects

[Statutory Authority: RCW 49.17.040 and 49.17.050. 86-16-007 (Order 86-26), § 296-44-21221, filed 7/25/86.]

WAC 296-44-21230 Vertical clearance of wires, conductors, cables, and live parts of equipment above ground, rails, or water. The vertical clearance of all wires, conductors, cables, and live parts of equipment above ground in generally accessible places, or above the top of the rails or water, shall not be less than the following:

(1) Basic clearances for wires, conductors, and cables. The clearances in Table 212-1 apply under the following conditions:

(a) Conductor temperature of 60°F, no wind, with final unloaded sag in the wire, conductors, or cables, or with initial unloaded sag in cases where these facilities are maintained approximately at initial unloaded sags.

(b) Span lengths not greater than the following:

Loading District	Span Lengths (feet)
Heavy	[1]175
Medium	[1]250
Light	350

[1] One hundred fifty feet in heavy-loading district and two hundred twenty-five feet in medium-loading district for three-stand conductors, each wire of which is 0.09 inches or less in diameter.

Table 212-1 Minimum Vertical Clearance of Wires, Conductors, and Cables Above Ground, Rails, or Water (Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly deenergizing the faulted section, both initially and following subsequent breaker operations. See the definition section for voltages of other systems.)

Nature of Surface underneath wires, conductors, or cables	Communication conductors and cables, guys, messengers, surge protection wires, neutral conductors meeting WAC 296-44-21209 (5)(a), supply cables meeting WAC 296-44-21209 (3)(a) and supply cables of 0 to 750 V meeting WAC 296-44-21209 (3)(b) or 296-44-21209 (3)(c)[11] (ft)	Open supply line conductors of 0 to 750 V and supply cables over 750 V meeting WAC 296-44-21209 (3)(b) or 296-44-21209 (3)(c) (ft)	Open supply line conductors		Trolley and electrified railroad contact conductors and associated span or messenger wires[1]	
			750 V to 22 kV (ft)	22 to 50 kV (ft)	0 to 750 V to ground (ft)	750 V to 50 kV to ground (ft)
Where wires, conductors, or cables cross over or overhang						
1. Track rails of railroads (except electrified railroads using over-head trolley conductors) [2 16 20]	[3 15]27	[3]27	[3]28	29	[4]22	[4]22
2. Roads, streets, alleys; nonresidential driveways, parking lots, and other areas subject to truck traffic [21 22]	[6 13 23]18	18	20	21	[5]18	[5]20
3. Residential driveways; commercial areas not subject to truck traffic [21 22]	[24]12	[25]15	20	21	[5]18	[5]20

4. Other land traversed by vehicles such as cultivated, grazing, forest, orchard, etc.	18	18	20	21	—	—
5. Spaces or ways accessible to pedestrians only [9]	[6 7]15	[8a 14]15	15	16	16	18
6. Water areas not suitable for sailboating or where sailboating is prohibited [19]	15	15	17	17	—	—
7. Water areas suitable for sailboating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with an unobstructed surface area of: [17 18 19]						
(a) Less than 20 acres	18	18	20	21	—	—
(b) 20 to 200 acres	26	26	28	29	—	—
(c) 200 to 2000 acres	32	32	34	35	—	—
(d) Over 2000 acres	38	38	40	41	—	—
8. Public or private land and water areas posted for rigging or launching sailboats	Clearance above ground shall be 5 ft greater than in 7 above, for the type of water areas served by the launching site					
	Where wires, conductors, or cables run along and within the limits of highways or other road rights-of-way but do not overhang the roadway					
9. Roads, streets, or alleys	[13 23 25]18	18	20	21	[5]18	[5]20
10. Roads in rural districts where it is unlikely that vehicles will be crossing under the line	[10 12]14	[10]15	18	19	[5]18	[5]20

1 Where subways, tunnels, or bridges require it, less clearances above ground or rails than required by Table 232-1 may be used locally. The trolley and electrified railroad contact conductor should be graded very gradually from the regular construction down to the reduced elevation.

2 For wire, conductors, or cables crossing over mine, logging, and similar railways which handle only cars lower than standard freight cars, the clearance may be reduced by an amount equal to the difference in height between the highest loaded car handled and twenty feet, but the clearances shall not be reduced below that required for street crossings.

3 These clearances may be reduced to twenty-five feet where paralleled by trolley-contact conductor on the same street or highway.

4 In communities where twenty-one feet has been established, this clearance may be continued if carefully maintained. The elevation of the contact conductor should be the same in the crossing and next adjacent spans. (See WAC 296-44-31792 (4)(b) for conditions which must be met where uniform height above rail is impractical.)

5 In communities where sixteen feet has been established for trolley and electrified railroad contact conductors 0 to 750 V to ground, or eighteen feet for trolley and electrified railroad contact conductors exceeding 750 V, or where local conditions make it impractical to obtain the clearance given in the table, these reduced clearances may be used if carefully maintained.

6 If a communication service drop or a guy which is effectively grounded or is insulated against the highest voltage to which it is exposed, up to 8.7 kV, crosses residential streets and roads, the clearance may be reduced to sixteen feet at the side of the traveled way provided the clearance at the center of the traveled way is at least eighteen feet. This reduction in clearance does not apply to arterial streets and highways which are primarily for through traffic, usually on a continuous route.

7 This clearance may be reduced to the following values:

	feet
(a) For insulated communication conductors and communication cables	8
(b) For conductors of other communication circuits	10
(c) For guys	8
(d) For supply cables meeting WAC 296-44-21209 (3)(a).	10

8 This clearance may be reduced to the following values:

(a) Twelve feet for supply conductors limited to 300 V to ground

(b) Ten feet for drip loops of service drop conductors limited to 150 V to ground and meeting WAC 296-44-21209 (3)(b) or (c) and the portion of the associated service drop span located within fifteen feet of the service entrance to buildings.

9 Spaces and ways accessible to pedestrians only are areas where vehicular traffic is not normally encountered or not reasonably anticipated.

10 Where a supply or communication line along a road is located relative to fences, ditches, embankments, etc., so that the ground under the line would not be expected to be traveled except by pedestrians, this clearance may be reduced to the following values:

	feet
(a) Insulated communication conductor and communication cables	8
(b) Conductors of other communication circuits	10
(c) Supply cables of any voltage meeting WAC 296-44-21209 (3)(a) and supply cables limited to 150 V to ground meeting WAC 296-44-21209 (3)(b) or (c)	10

(d) Supply conductors limited to 300 V to ground	12
(e) Guys.	8

11 No clearance from ground is required for anchor guys not crossing track rails, streets, driveways, roads, or pathways.

12 This clearance may be reduced to thirteen feet for communication conductors.

13 Where this construction crosses over or runs along alleys, driveways, or parking lots, this clearance may be reduced to fifteen feet for spans limited to one hundred fifty feet.

14 Where supply circuits of 600 V or less, with transmitted power of 5000 W or less, are run along fenced (or otherwise guarded) private rights-of-way in accordance with the provisions specified in WAC 296-44-19409 (2)(b) this clearance may be reduced to ten feet.

15 The value may be reduced to twenty-five feet for guys, for cables carried on messengers, and for supply cables meeting WAC 296-44-21209 (3)(a). This value may be reduced to twenty-five feet for conductors effectively grounded throughout their length and associated with supply circuits of 0 to 22 kV, only if such conductors are stranded, are of corrosion-resistant material, and conform to the strength and tension requirements for messengers given in WAC 296-44-27821(9).

16 Adjacent to tunnels and overhead bridges which restrict the height of loaded rail cars to less than twenty feet, these clearances may be reduced by the difference between the highest loaded rail car handled and twenty feet, if mutually agreed to by the parties at interest.

17 For controlled impoundments, the surface area and corresponding clearances shall be based upon the design high water level. For other waters, the surface area shall be that enclosed by its annual high water mark, and clearances shall be based on the normal flood level. The clearance over rivers, streams, and canals shall be based upon the largest surface area of any one mile long segment which includes the crossing. The clearance over a canal, river, or stream normally used to provide access for sailboats to a larger body of water shall be the same as that required for the larger body of water.

18 Where an overwater obstruction restricts vessel height to less than the following:

For a surface area in acres of	A reference vessel height in feet of
less than 20	16
20 to 200	24
200 to 2000	30
over 2000	36

the required clearance may be reduced by the difference between the reference vessel height given above and the overwater obstruction height, except that the reduced clearance shall not be less than that required for the surface area on the line crossing side of the obstruction.

19 Where the United States Army Corps of Engineers, or the state, or a surrogate thereof has issued a crossing permit, clearances of that permit shall govern.

20 See WAC 296-44-21253(8) for the required horizontal and diagonal clearances to rail cars.

21 These clearances do not allow for the future road resurfacing.

22 For the purpose of this rule, trucks are defined as any vehicle exceeding eight feet in height. Areas not subject to truck traffic are areas where truck traffic is not normally encountered or not reasonably anticipated.

23 For communications cables supported on a messenger, and with span lengths not exceeding one hundred fifty feet, the clearance may be reduced to seventeen feet above or along local streets or roads. This reduction does not apply for arterial streets or highways which are primarily for through traffic, usually on a continuous route.

24 This clearance may be reduced to ten feet for communication conductors and cables, guys, messengers and supply cables meeting WAC 296-44-21209 (3)(a).

25 Communication cables supported on a steel messenger may have a 60°F clearance of fifteen feet where span lengths do not exceed one hundred fifty feet and poles are back of curbs or other deterrents to vehicular traffic.

(2) Additional clearances for wires, conductors and cables. Greater clearances than specified in Table 212-1, (subsection (1) of this section) shall be provided where required by (a) and (b) of this subsection. Increases are cumulative where more than one apply.

Note 1: Additional clearances are not required for guys.

Note 2: Additional clearances are not required for communication cables supported on messengers and communication wires which do not overhang the traveled way, but run along and within the limits of public highways or other public rights-of-way for traffic.

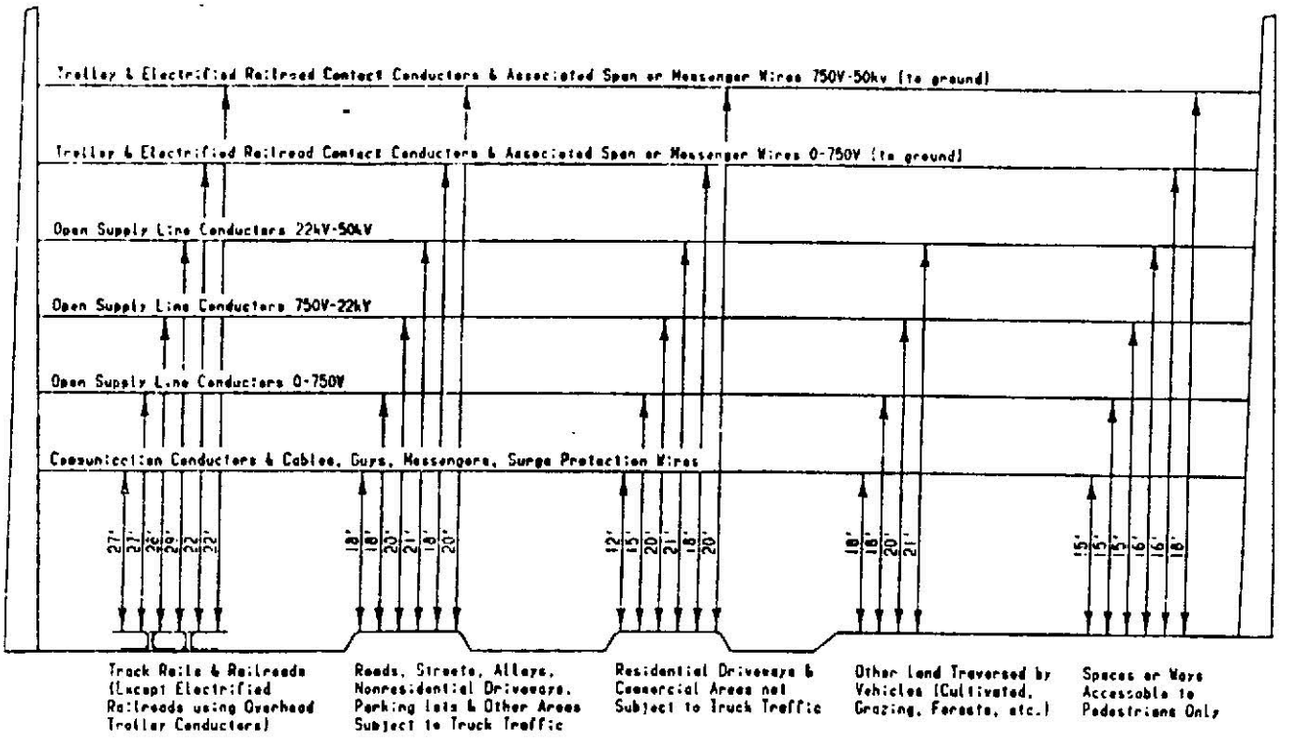

Fig 212-2a
Minimum Vertical Clearance Above Ground or Rails
(Re: Table 212-1)

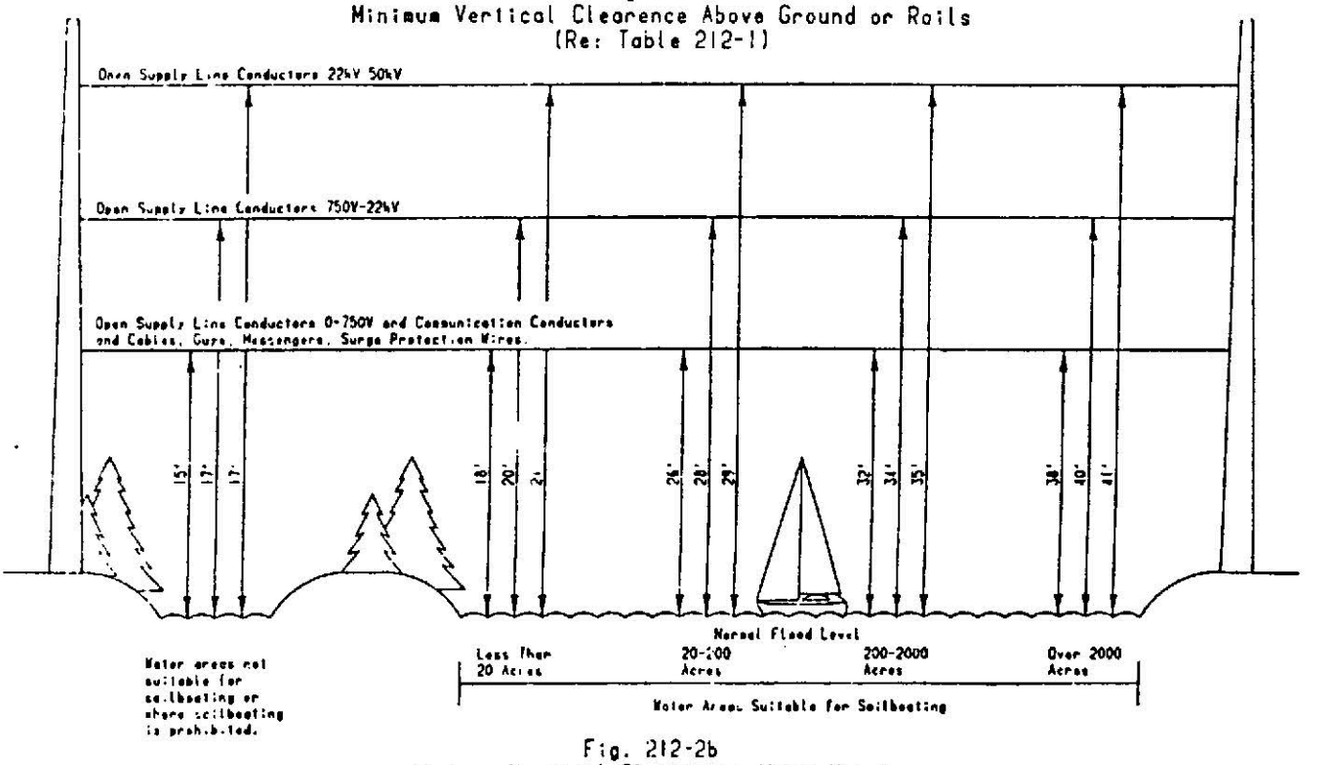

Fig. 212-2b
Minimum Vertical Clearances Above Water
(Re: Table 212-1)

(a) Voltages exceeding 50 kilovolts.

(i) For voltages between 50 and 470 kilovolts, the clearance specified in Table 212-1, (subsection (1) of this section) shall be increased at the rate of 0.4 in per kilovolt in excess of 50 kilovolts. For voltages exceeding 470 kV, the clearance shall be determined by the alternate method given by subsection (4) of this section. All clearances for lines over 50 kV shall be based on the maximum operating voltage.

Note: For voltages exceeding 98 kV alternating current to ground or 139 kV direct current to ground, clearances less than those required above are permitted for systems with known maximum switching surge factors (see subsection (4) of this section).

(ii) The additional clearance for voltages exceeding 50 kV specified in (a)(i) of this subsection shall be increased three percent for each one thousand feet in excess of thirty-three hundred feet (1000 m) above mean sea level.

(iii) For voltages exceeding 98 kV alternating current to ground, or 139 kV direct current to ground, either the clearances shall be increased or the electric field, or the effects thereof, shall be reduced by other means, as required, to limit the current due to electrostatic effects to 5.0 milliamperes, rms, if the largest anticipated truck, vehicle, or equipment under the line were shortcircuited to ground. For this determination, the conductors shall be at a final unloaded sag at 120°F.

(b) Sag increase.

(i) No additional clearance is required for trolley and electrified railroad contact conductors.

(ii) No additional clearance is required where span lengths are less than those listed in subsection (1)(b) of this section, and the maximum conductor temperature for which the supply line is designed to operate is 120°F or less.

(iii) Where supply lines are designed to operate at or below a conductor temperature of 120°F and spans are longer than specified in subsection (1)(b) of this section, the minimum clearance at midspan shall be increased by the following amounts.

(A) General.

For spans exceeding the limits specified in WAC 296-44-21230 (1)(b), the clearance specified in Table 212-1 shall be increased by 0.1 foot for each ten feet of the excess of span length over such limits. See (b)(iii)(C) of this subsection.

(B) Railroad crossings.

For spans exceeding the limits specified in subsection (1)(b) of this section, the clearance specified in Table 212-1 shall be increased by the following amounts for each ten feet by which the crossing span length exceeds such limits. See (b)(iii)(C) of this subsection.

Loading district	Amount of increase per 10 feet: Large conductors (ft)	[1] Small conductors (ft)
Heavy and medium	0.15	0.30
Light	0.10	0.15

[1] A small conductor is a conductor having an overall diameter of metallic material equal to or less than the following values:

Material	Outside diameter of conductor: Solid (inches)	Stranded (inches)
All copper	0.160	0.250
Other than all copper	0.250	0.275

(C) Limits.

The maximum additional clearance need not exceed the arithmetic difference between final unloaded sag at a conductor temperature of 60°F (15°C), no wind, and final sag at the following conductor temperature and condition, whichever difference is greater, computed for the crossing span.

(I) 32°F no wind, with radial thickness of ice, if any, specified in WAC 296-44-26309(2) for the loading district concerned.

(II) 120°F (50°C), no wind.

(iv) Where supply lines are designed to operate at conductor temperature above 120°F regardless of span length, the minimum clearance at midspan specified in subsections (1) and (2)(a) of this section shall be increased by the difference between final unloaded sag at a conductor temperature of 60°F no wind, and final sag at the following conductor temperature and condition, whichever difference is greater, computed for the crossing span.

(A) 32°F no wind, with radial thickness of ice, if any, specified in WAC 296-44-26309(2) for the loading district concerned.

(B) The maximum conductor temperature for which the supply line is designed to operate, with no horizontal displacement.

Note: The phase and neutral conductors of a supply line should be considered separately when determining the sag increases of each due to temperature rise.

(v) Where minimum clearance is not at midspan, the additional clearances specified in (b)(iii) and (iv) of this subsection may be reduced by multiplying by the following factors:

Distance from nearer support of crossing span to point of crossing in percentage of crossing span length	Factors[1]
5	0.19
10	0.36
15	0.51
20	0.64
25	0.75
30	0.84
35	0.91
40	0.96
45	0.99
50	1.00

[1] Interpolate for intermediate values

In applying this rule, the "point of crossing" is the location under the conductors of any topographical feature which is the determinant of the clearance.

(3) Clearance to live parts of equipment mounted on structures.

(a) Basic clearances. The vertical clearance above ground for unguarded live parts such as potheads, transformer bushings, surge arresters, and short lengths of supply conductors connected thereto, which are not subject to variation in sag, shall be as shown in Table 212-2.

Table 212-2. Minimum Vertical Clearance of Rigid Live Parts Above Ground

(Voltages are phase to ground for effectively grounded circuits and those other circuits where all ground faults are cleared by promptly de-energizing the faulted section, both initially and following subsequent breaker operations. See the definition section for voltages of other systems.)

Nature of surface below live parts	0 to 750 V	750 V to 22 kV	22 to 50 kV
1. Where live parts overhang:			
a. Roads, streets, alleys; nonresidential driveways; parking lots and other areas subject to truck traffic [4,5]	16	18	19
b. Residential driveways; commercial areas not subject to truck traffic [4,5]	[1]13	18	19
c. Other land traversed by vehicles such as cultivated land, grazing land, forest, orchard, etc.	16	18	19
d. Spaces and ways accessible to pedestrians only. [6]	[3,4]13	13	14
2. Where live parts are along and within the limits of highways or other road rights-of-way but do not overhang the roadway:			
a. Roads, streets, and alleys	[2]16	18	19
b. Roads in rural districts where it is unlikely that vehicles will be crossing under the line.	[2]13	16	17

1 This clearance may be reduced to the following values:

	feet
(a) Live parts limited to 300 V to ground	12
(b) Live parts limited to 150 V to ground and drip loops of service drop conductors limited to 150 V to ground and meeting WAC 296-44-21209 (3)(b) or (c).	10

2 Where a supply line along a road is limited to 300 V to ground and is located relative to fences, ditches, embankments, etc., so that the ground under the line would not be expected to be traveled except by pedestrians, this clearance may be reduced to twelve feet.

3 Where supply circuits of 600 V or less, with transmitted power of 5000 W or less, are run along fenced (or otherwise guarded) private rights-of-way in accordance with the provisions specified in WAC 296-44-19409 (2)(b), this clearance may be reduced to ten feet.

4 For the purpose of this rule, trucks are defined as any vehicle exceeding eight feet in height.

5 These clearances do not allow for future road resurfacing.

6 Spaces and ways accessible to pedestrians only are areas where vehicular traffic is not normally encountered or not reasonably anticipated.

(b) Additional clearances for voltages exceeding 50 kilovolts.

(i) For voltages between 50 and 470 kilovolts, the clearance specified in Table 212-2 ((a) of this subsection) shall be increased at the rate of 0.4 in per kilovolt in excess of 50 kV. For voltages exceeding 470 kV, the clearances shall be determined by the alternate method given by subsection (4) of this section. All clearances for lines over 50 kV shall be based on the maximum operating voltage.

Note. For voltages exceeding 98 kV alternating current to ground or 139 kV direct current to ground, clearances less than those required above are permitted for systems with known maximum switching surge factors. (See subsection (4) of this section.)

(ii) The additional clearance for voltages exceeding 50 kV specified in (b)(i) of this subsection shall be increased three percent for each one thousand feet in excess of thirty-three hundred feet above mean sea level.

(iii) For voltages exceeding 98 kV alternating current to ground, or 139 kV direct current to ground either the clearances shall be increased or the electric field, or the effects thereof, shall be reduced by other means, as required, to limit the current due to electrostatic effects to 5.0 milliamperes, rms, if the largest anticipated truck, vehicle, or equipment under the line were short-circuited to ground.

(4) Alternate clearances for voltages exceeding 98 kilovolts alternating current to ground or 139 kilovolts direct current to ground. The clearances specified in subsections (1), (2) and (3) of this section may be reduced for circuits with known switching surge factors but shall not be less than the values computed by adding the reference height to the electrical component of clearance.

(a) Sag conditions of line conductors. Minimum vertical clearances shall be maintained under the following conductor temperatures and conditions:

(i) 32°F no wind, with radial thickness of ice specified in WAC 296-44-26309(2) for the loading district concerned.

(ii) 120°F, no wind.

(iii) Maximum conductor temperature, for which the line is designed to operate, if greater than 120°F, with no horizontal displacement.

(b) Reference heights are shown in Table 212-3.

(c) Electrical component of clearance.

(i) The clearance computed by the following equation and listed in Table 212-4 shall be added to the reference heights specified in Table 212-3.

$$D = 3.28\left[\frac{V \cdot (PU) \cdot a}{500\,K}\right]^{1.667} bc \quad \text{(ft)}$$

where

V maximum alternating current crest operating voltage to ground or maximum direct current operating voltage to ground in kilovolts;

PU maximum switching surge factor expressed in per-unit peak voltage to ground and defined as a switching surge level for circuit breakers corresponding to ninety-eight percent probability that the maximum switching surge generated per breaker operation

does not exceed this surge level, or the maximum anticipated switching surge level generated by other means, whichever is greater;

a = 1.15, the allowance for three standard deviations;

b = 1.03, the allowance for nonstandard atmospheric conditions;

c = 1.2, the margin of safety;

K = 1.15, the configuration factor for conductor-to-plane gap.

(ii) The value of D shall be increased three percent for each one thousand feet in excess of fifteen hundred feet above mean sea level.

(iii) Either the clearances shall be increased or the electric field, or the effects thereof, shall be reduced by other means, as required, to limit the current due to electrostatic effects to 5.0 milliamperes, rms, if the largest anticipated truck, vehicle, or equipment under the line were shortcircuited to ground. For this determination, the conductors shall be at a final unloaded sag at 120°F.

(d) Limit. The clearances derived from (b) and (c) of this subsection shall be not less than the clearances given in Tables 212-1 or 212-2 computed for 98 kilovolts alternating current to ground in accordance with subsection (2)(a) or (3)(b) of this section, respectively.

Table 212-3 Reference Heights

	Nature of surface underneath lines	Ft
a	Track rails of railroads (except electrified railroads using overhead trolley conductors) [1]	22
b	Streets, alleys, roads, driveways, and parking lots	14
c	Spaces and ways accessible to pedestrians only [2]	9
d	Other land, such as cultivated, grazing, forest or orchard, which is traversed by vehicles	14
e	Water areas not suitable for sailboating or where sailboating is prohibited	14
f	Water areas suitable for sailboating including lakes, ponds, reservoirs, tidal waters, rivers, streams, and canals with unobstructed surface area [3] [4]	
	(1) less than 20 acres	18
	(2) 20 to 200 acres	26
	(3) 200 to 2000 acres	32
	(4) over 2000 acres	38
g	In public or private land and water areas posted for rigging or launching sailboats, the reference height shall be five feet greater than in f. above, for the type of water areas serviced by the launching site.	

[1] See WAC 296-44-21253(8) for the required horizontal and diagonal clearances to rail cars.

[2] Spaces and ways accessible to pedestrians only are areas where vehicular traffic is not normally encountered or not reasonably anticipated.

[3] For controlled impoundments, the surface area and corresponding clearances shall be based upon the design high water level. For other waters, the surface area shall be that enclosed by its annual high water mark, and clearances shall be based on the normal flood level. The clearance over rivers, streams, and canals shall be based upon the largest surface area of any one mile-long segment which includes the crossing. The clearance over a canal or similar waterway providing access for sailboats to a larger body of water shall be the same as that required for the larger body of water.

[4] Where an overwater obstruction restricts vessel height to less than the following:

For a surface of	A reference vessel height of ft
(1) less than 20 acres	16
(2) 20 to 200 acres	24
(3) 200 to 2000 acres	30
(4) over 2000 acres (800 ha)	36

The required clearance may be reduced by the difference between the reference vessel height given above and the overwater obstruction height, except that the reduced clearance shall not be less than that required for the surface area on the line crossing side of the obstruction.

Table 212-4 Electrical Component of Clearance Above Ground or Rail in (c)(i) of this subsection (Add three percent for each one thousand feet in excess of fifteen hundred feet above mean sea level. Increase clearance to limit electrostatic effects in accordance with (c)(iii) of this subsection.)

Maximum operating voltage phase-to-phase (kV)	Switching surge factor (per unit)	Switching surge (kV)	Electrical component of clearance (ft)
242	4.5 or less	839 or less	[1] 8.6
362	2.8 or less	839 or less	[1] 8.6
550	1.9 or less	839 or less	[1] 8.6
	2.0	898	10.8
	2.2	988	12.7
	2.4	1079	14.6
	2.6	1168	16.7
800	1.6	1045	13.9
	1.8	1176	16.9
	2.0	1306	20.1
	2.1 or more	1372 or more	[2] 21.8

[1] Limited by (d) of this subsection.

[2] Limited by subsections (1) and (2) of this section.

[Statutory Authority: RCW 49.17.049 and 49.17.050. 86-16-007 (Order 86-26), § 296-44-21230, filed 7/25/86.]

WAC 296-44-21241 Clearances between wires, conductors, and cables carried on different supporting structures. (1) General.

Crossings should be made on a common supporting structure, where practical. In other cases, the clearance between any two crossing or adjacent wires, conductors, or cables carried on different supporting structures shall not be any less at any location in the spans than that required by WAC 296-44-21241. The minimum clearance shall be as illustrated by a clearance envelope developed under WAC 296-44-21241 (1)(b) applied at the positions on or within conductor movement envelopes developed under WAC 296-44-21241 (1)(a) at which the two wires, conductors, or cables would be closest together. For purposes of this determination, the relevant positions of the wires, conductors, or cables on or within their respective conductor movement envelopes are those which can occur when (a) both are simultaneously subjected to the same ambient air temperature and wind

APPENDIX I

SEATTLE CITY LIGHT TRANSMISSION ROW PLANT SPECIES INVENTORY

Source: Envirosphere Company. 1985. Report to Seattle City Light Distribution Division for Inventory of Transmission Right-of-Way Vegetation

SEATTLE CITY LIGHT
TRANSMISSION ROW PLANT SPECIES LIST

Trees

Abies amabilis (Silver Fir)
Acer rubrum (Red Maple)
Acer glabrum (Rocky Mountain Maple)
Aesculus hippocastanum (Chestnut)
Acer macrophyllum (Big Leaf Maple)
Abies procera (Noble Fir)
Alnus rubra (Red Alder)
Arbutus menziesii (Madrona)
Betula papyrifera (Paper Birch)
Betula spp.
Fagus sylvatica (European Beech)
Fraxinus latifolia (Oregon Ash)
Gleditsia triacanthos (Honey Locust)
Liriodendron tulipifera (Yellow Poplar, Tulip Tree)
Populus alba (Silver [White] Poplar)
Prunus serotina (Black Cherry)
Prunus emarginata (Bitter Cherry)
Pinus contorta (Lodgepole Pine)
Pseudotsuga menziesii (Douglas Fir)
Populus nigra (Lombardi Poplar)
Prunus pennsilvanica (Wild Cherry)
Populus tremuloides (Quaking Aspen)
Pinus spp. (Pine)
Picea sitchensis (Sitka Spruce)
Populus trichocarpa (Black Cottonwood)
Pinus monticola (Western White Pine)
Picea spp. (Spruce)
Platanus spp. (Sycamore)
Quercus rubra (Red Oak)
Robinia pseudoacacia (Black Locust)
Sorbus aucuparia (European Mountain Ash)
Thuja plicata (Western Red Cedar)
Tsuga heterophylla (Western Hemlock)

Landscape conifer - short
Landscape conifer - tall
Landscape deciduous - tall
Landscape deciduous - short

Trees/Shrubs (depending on size)

Acer circinatum (Vine Maple)
Crataegus douglasii (Hawthorn)
Cornus nuttallii (Pacific Dogwood)
Ilex aquifolium (English Holly)
Sorbus aucuparia (European Mountain Ash)
Sambucus racemosa (Red Elderberry)
Salix spp. (Willow)

Shrubs

Amelanchier alnifolia (Service Berry)
Acer circinatum (Vine Maple)
Arctostaphylos uva-ursi (Kinnikinnik)
Berberis aquifolium (Oregon Grape)
Betula glandulosa (Bog Birch)
Berberis nervosa (long-leaved Oregon Grape)
Cytisus scoparius (Scotch Broom)
Corylus cornuta (Hazelnut)
Crataegus douglasii (Hawthorn)
Cornus stolonifera (Red-osier Dogwood)
Gaultheria shallon (Salal)
Holodiscus discolor (Oceanspray)
Hedera helix (English Ivy)
Kalmia occidentalis (Bog Laurel)
Ledum columbianum (Trapper's Tea)
Lonicera involucrata (Twinberry)
Ledum groenlandicum (Labrador Tea)
Pyrus fusca (Wild Crabapple)
Menziesia ferruginea (False Azalea)
Oemleria cerasiformis (Indian Plum)
Oplopanax horridum (Devil's Club)
Physocarpus capitatus (Ninebark)
Penstemon davidsonii var. menziesii
Pachistima myrsinites (Mountain Box)
Prunus spp. (Cherry)
Ribes sanguineum (Red Flowering Currant)
Rubus discolor (Himilayan Blackberry)
Rhus spp. (Sumac)
Rubus laciniatus (Evergreen Blackberry)
Rhamnus purshiana (Cascara)
Ribes spp. (Gooseberry)
Rubus spectabilis (Salmonberry)
Rubus parviflorus (Thimbleberry)
Rubus ursinus (Trailing Blackberry)
Rosa spp. (Rose)
Rhododendron spp. (Rhododendron)
Sorbus sitchensis (Mountain Ash)
Spiraea douglasii (Hardhack)
Spiraea densiflora (Spirea)
Sambucus racemosa (Red Elderberry)
Symphoricarpus albus (Snowberry)
Salix spp. (Willow)
Vaccinium membranaceum
Vaccinium oxycoccus (Cranberry)
Vaccinium parvifolium (Red Huckleberry)
Vaccinium uliginosum (Bog Blueberry)
Vaccinium spp. (Unidentified Huckleberry)

Sedges/Rushes/Grass/Ferns

Athyrium felix-femina (Lady Fern)
Alopecurus spp. (Foxtail Grass)
Azolla spp. (Water Fern)
Blechnum spicant (Deer Fern)
Pteridium aquilinum (Bracken Fern)
Carex aquatilis (Water Sedge)
Carex obnupta (Slough Sedge)
Carex spp. (Sedge)
Dulichium arundinaceum
Eriophorum chamissonis (Cottongrass)
Equisetum spp. (Horsetail)
Eleocharis spp. (Spikerush)
Glyceria spp. (Manna Grass)
Unknown grass species
Juncus acuminatus (Tapered Rush)
Juncus bufonius (Toad Rush)
Juncus effusus (Common Rush)
Juncus ensifolius (Dagger-leaf Rush)
Juncus oxymeris (Pointed Rush)
Juncus supiniformis (Spreading Rush)
Juncus tenuis (Slender Rush)
Juncus spp. (Rush)
Lemna minor (Duckweed)
Luzula spp. (Wood Rush)
Lycopodium clavatum (Clubmoss)
Marchantia spp. (Liverwort)
Unknown moss species
Phalaris arundinacea (Reed Canary Grass)
Polystichum munitum (Sword Fern)
Sphagnum spp. (Peat moss)
Isoetes spp. (Quillwort)
Ricciocarpus natans (Aquatic Liverwort)
Sparganium emersum (Simplestem Bur-reed)
Scirpus fluviatilis (River Bulrush)
Sparganium eurycarpum (Broadfruited Bur-reed)
Sparganium minimum (Small Bur-reed)
Scirpus maritimus (Seacoast Bulrush)
Scirpus microcarpus (Small-fruited Bulrush)
Scirpus validus (Great Bulrush)
Scirpus spp. (Bulrush)

Herbs

Alisma gramineum (Narrow leaved Water Plantain)
Alisma plantago-aquatica (Water Plantain)
Aruncus sylvester (Goatsbeard)
Brasenia schreberi (Water Shield)
Caltha biflora (Marsh Marigold)
Cornus canadensis (Bunch berry)
Cicuta douglasii (Water Hemlock)
Corallorhiza maculata (Spotted Coral Root)

Herbs

Cuscuta salina (Saltmarsh Dodder)
Chrysanthemum leucanthemum (Oxeye Daisy)
Conium maculatum (Poison Hemlock)
Cirsium arvense (Canada Thistle)
Coptis trifolia (Gold thread)
Clintonia uniflora (Bluebead Lily)
Digitalis purpurea (Foxglove)
Drosera rotundifolia (Sundew)
Distichlis spicata (Salt Grass)
Epilobium angustifolium (Fireweed)
Epilobium spp. (Willow herb)
Elodea nuttallii (Waterweed)
Erythronium spp. (Avalanche Lily)
Fragaria spp. (Wild Strawberry)
Galium spp. (Bedstraw)
Geum macrophyllum (Large-leaved Yellow Geum)
Goodyera oblongifolia (Rattlesnake Plantain)
Hackelia floribunda (Many-flowered Stickseed)
Heracleum lanatum (Cow-parsnip)
Hypericum perforatum (Klamath Weed)
Hypochaeris radicata (Cats Ear)
Iris pseudacris (Yellow Iris)
Lysichitum americanum (Skunk Cabbage)
Linnaea borealis (Twin Flower)
Lobelia dortmanna (Water Lobelia)
Lactuca muralis (Wall Lettuce)
Ludwigia palustris (Water Purslane)
Lythrum salicaria (Purple Loosestrife)
Lupinus spp. (Lupine)
Mentha arvensis (Mint)
Maianthemum dilatatum (Wild Lily of the Valley)
Mimulus guttatus (Monkey Flower)
Marah oreganus (Manroot)
Montropa uniflora (Indian Pipe)
Menyanthes trifoliata (Bog Bean)
Myriophyllum spp. (Water Milfoil)
Nymphaea odorata (White Pond Lily)
Nuphar polysepalum (Yellow Pond Lily)
Oenanthe sarmentosa (Water Parsley)
Pyrola elliptica (White Wintergreen)
Polygonum hydropiper (Marsh Pepper)
Plantago lanceolata (Plantain)
Potamogeton natans (Pond weed)
Potentilla pacifica (Pacific Silverweed)
Potentilla palustris (Potentilla)
Prunella vulgaris (Self-heal)
Parentucellia viscosa (Yellow Schrophularia)
Ranunculus aquatilis (Water Crowfoot)
Rumex spp. (Dock)
Ranunculus repens (Creeping Buttercup)

Herbs (Continued)

Solidago canadensis (Goldenrod)
Solanum dulcamara (Bittersweet Nightshade)
Spiranthes romanzoffiana (Ladies-tresses)
Salicornia virginica (Pickleweed)
Sagittaria latifolia (Wapato)
Sium suave (Water Parsnip)
Streptopus spp. (Twisted Stalk)
Stachys cooleyae (Hedge Nettle)
Trientalis arctica (Bog Starflower)
Thermopsis montana (Buck-bean)
Typha latifolia (Cattail)
Tolmiea menziesii (Youth-on-Age)
Tanacetum officinale (Tanzy)
Triglochin maritimum (Arrow Grass)
Tiarella trifoliata (Foamflower)
Urtica dioic (Stinging Nettle)
Utricularia minor (Bladderwort)
Veronica americana (American Brooklime)
Veratrum californicum (False Hellebore)
Veronica scutellata (Marsh Speedwell)
Viola palustris (Marsh Violet)
Vallisneria americana (Wild Celery)
Zostera marina (Eel Grass)
Zannichellia palustris (Horned Pondweed)

APPENDIX J

WASHINGTON NATURAL HERITAGE PROGRAM LETTERS REPORTING PLANT POPULATIONS IN NORTH CASCADES NATIONAL PARK AND WHATCOM AND SKAGIT COUNTIES

June 9, 1988

Nancy Sprague, Assistant Data Manager
Washington Natural Heritage Program
Division of Land and Water Conservation
Mail Stop EX-13
Olympia, Washington 98504

Dear Nancy,

The National Park Service (NPS) has requested Seattle City Light to provide NPS with information on threatened, endangered and sensitive plant species that may be present on City Light's transmission line rights-of-way within the Skagit Recreation Area. The specific areas of interest are the following:

T36N R11E Sections 1,2,10,11,15,21,22
T37N R11E Section 36
T37N R12E Sections 11,12,13,14,15,20,21,22,29,30,31
T37N R13E Sections 2,3,4,5,6,7
T38N R13E Section 35

We are very interested in knowing if any threatened, endangered or sensitive speices have been previously reported in these areas or are likely to be found in these areas.

If possible, I would also like to request copies of the most current Washington State and Federal threatened, endangered and sensitive plant species lists.

If you are in need of any additional information, please contact me at 684-4909. Please bill us if there are any charges for the database search or materials. Thank you for your time and effort.

Sincerely,

Original Signed By

Judith Baumert, Plant Ecologist
Rights-of-Way Planning & Maintenance

JB.jb

bcc: Hett
Rutz
Baumert
File

WASHINGTON STATE DEPARTMENT OF
Natural Resources

BRIAN BOYLE
Commissioner of Public Lands

OLYMPIA, WA 98504

June 21, 1988

Judith Baumert
City Light Department
City of Seattle
1015 Third Avenue
Seattle, WA 98104

Subject: **City Light's Transmission Line Rights-of-Way Within Ross Lake National Recreation Area**

I've searched the Natural Heritage Data System for information on endangered, threatened and sensitive plants in your study area. We currently have no rare plant records for the transmission line rights-of-way.

You also requested information on rare plants which could potentially occur in your study area. I've enclosed lists of the endangered, threatened and sensitive plants which have been reported to occur in Whatcom and Skagit counties. I've highlighted several of the plants on the Whatcom County list which were identified north of your project area.

I've also enclosed a copy of the most current list of Endangered, Threatened and Sensitive Vascular Plants of Washington. This publication includes information on Federal candidate species. There are currently no federally listed plant species in Washington.

The Natural Heritage Data System is not a complete inventory of Washington's natural features. Many areas of the state have never been thoroughly surveyed. There may be significant natural features in your study area that we don't yet know about. This response should not be regarded as a final statement on the natural features of the areas being considered and doesn't eliminate the need or responsibility for detailed on-site surveys.

If you're planning to conduct any rare plant surveys, we'd be very interested in receiving a copy of your survey report.

I hope you'll find this information helpful.

Sincerely,

Nancy Sprague

Nancy Sprague, Assistant Data Manager
Washington Natural Heritage Program
Division of Land and Water Conservation
Mail Stop: EX-13
Olympia, WA 98504
(206) 753-2449

fg

Enclosures

ENDANGERED, THREATENED AND SENSITIVE
VASCULAR PLANTS OF WASHINGTON
JUNE 1988

WHATCOM COUNTY

SCIENTIFIC NAME	COMMON NAME	PROPOSED STATE STATUS	FEDERAL STATUS*	HISTORIC RECORD*
AGOSERIS ELATA	TALL AGOSERIS	SENSITIVE		H
ASTER SIBIRICUS VAR MERITUS	ARCTIC ASTER	SENSITIVE		
BOTRYCHIUM LANCEOLATUM	LANCE-LEAVED GRAPE-FERN	SENSITIVE		H
BOTRYCHIUM LUNARIA	MOONWORT	SENSITIVE		
BOTRYCHIUM MINGANENSE	VICTORIN'S GRAPE-FERN	SENSITIVE		H
BOTRYCHIUM PINNATUM	ST. JOHN'S MOONWORT	SENSITIVE		
CALAMAGROSTIS CRASSIGLUMIS	THICKGLUME REEDGRASS	THREATENED	C	H
CAREX ATRATA VAR ERECTA	ERECT BLACKENED SEDGE	SENSITIVE		
CAREX COMOSA	BRISTLY SEDGE	SENSITIVE		
CAREX MACROCHAETA	LARGE-AWN SEDGE	SENSITIVE		
CAREX PAUCIFLORA	FEW-FLOWERED SEDGE	SENSITIVE		H
* CAREX PAUPERCULA	POOR SEDGE	SENSITIVE		
CAREX SAXATILIS VAR MAJOR	RUSSET SEDGE	SENSITIVE		H
CAREX SCIRPOIDEA VAR SCIRPOIDEA	CANADIAN SINGLE-SPIKE SEDGE	SENSITIVE		H
CICUTA BULBIFERA	BULB-BEARING WATER-HEMLOCK	SENSITIVE		H
DRABA AUREA	GOLDEN DRABA	SENSITIVE		H
FRITILLARIA CAMSCHATCENSIS	BLACK LILY	SENSITIVE		
GENTIANA GLAUCA	GLAUCOUS GENTIAN	SENSITIVE		H
LIMOSELLA ACAULIS	SOUTHERN MUDWORT	SENSITIVE		H
LOBELIA DORTHANNA	WATER LOBELIA	SENSITIVE		H
* LYCOPODIUM DENDROIDEUM	TREELIKE CLUBMOSS	SENSITIVE		
* LYCOPODIUM INUNDATUM	BOG CLUBMOSS	SENSITIVE		
NYMPHAEA TETRAGONA	PYGMY WATER-LILY	POSSIBLY EXTINCT		H
ORTHOCARPUS BRACTEOSUS	ROSY OWL-CLOVER	SENSITIVE		H
POA GRAYANA	GRAY'S BLUEGRASS	SENSITIVE		
PUCCINELLIA NUTKAENSIS	ALASKA ALKALIGRASS	SENSITIVE		H
SAXIFRAGA DEBILIS	PYGMY SAXIFRAGE	SENSITIVE		
SAXIFRAGA INTEGRIFOLIA VAR APETALA	SWAMP SAXIFRAGE	SENSITIVE		H

* C = CANDIDATE FOR LISTING ON THE 1985 FEDERAL REGISTER, NOTICE OF REVIEW
* H = KNOWN ONLY FROM HISTORIC RECORDS

* Found North of Skagit Roc Area

ENDANGERED, THREATENED AND SENSITIVE
VASCULAR PLANTS OF WASHINGTON
JUNE 1988

SKAGIT COUNTY

SCIENTIFIC NAME	COMMON NAME	PROPOSED STATE STATUS	FEDERAL STATUS*	HISTORIC RECORD*
CAREX COMOSA	BRISTLY SEDGE	SENSITIVE		
CASTILLEJA LEVISECTA	GOLDEN INDIAN-PAINTBRUSH	ENDANGERED	C	
ERYTHRONIUM REVOLUTUM	PINK FAWN-LILY	SENSITIVE		H
LOBELIA DORTHANNA	WATER LOBELIA	SENSITIVE		
LOISELEURIA PROCUMBENS	ALPINE AZALEA	SENSITIVE		
POTAMOGETON OBTUSIFOLIUS	BLUNT-LEAVED PONDWEED	SENSITIVE		H
PUCCINELLIA NUTKAENSIS	ALASKA ALKALIGRASS	SENSITIVE		
SAXIFRAGA DEBILIS	PYGMY SAXIFRAGE	SENSITIVE		H

damp cliffs, rock crevices and talus / alpine / Cas.

* C = CANDIDATE FOR LISTING ON THE 1985 FEDERAL REGISTER, NOTICE OF REVIEW
* H = KNOWN ONLY FROM HISTORIC RECORDS

COASTAL

river banks and light to fairly thick woods, scattered in Wa, known from Skagit Co. and occ. on west side of Dry Pass.
more frequent near the coast in Oregon

WASHINGTON STATE DEPARTMENT OF
Natural Resources

BRIAN BOYLE
Commissioner of Public Lands

OLYMPIA, WA 98504

May 9, 1989

Ron Vanbianchi
Parametrix, Inc.
13020 Northup Way, Suite 9
Bellevue, WA 98005

SUBJECT: Skagit Basin Rare Plant Survey

I've checked our files for information on rare plants and high quality native plant communities in the vicinity of Ross, Diablo, and Gorge Lakes. I've enclosed a printout of the rare plant records currently in the Natural Heritage Data System for Ross Lake National Recreation Area and North Cascades National Park. Lists of the endangered, threatened and sensitive plants which have been reported to occur in Whatcom and Skagit counties are also enclosed. I've also included information on the locations of high quality native plant communities in your study area.

Please keep in mind that the Natural Heritage Data System is not a complete inventory of Washington's natural features. Many areas of the state have never been thoroughly surveyed. There may be significant natural features in your study area that we don't yet know about.

I hope you'll find this information helpful in planning your field surveys. We'd appreciate receiving any new rare plant information that you collect and a copy of your survey report, if possible.

Sincerely,

Nancy Sprague

Nancy Sprague, Assistant Data Manager
Washington Natural Heritage Program
Division of Land & Water Conservation
Mail Stop: EX-13
Olympia, WA 98504
(206) 753-2449

NS:fg
Enclosures

WASHINGTON NATURAL HERITAGE DATA SYSTEM
SPECIAL PLANT RECORDS FOR ROSS LAKE NATIONAL RECREATION AREA
AND NORTH CASCADES NATIONAL PARK
DATA CURRENT AS OF MAY 9, 1989

PLANT NAME AND NUMBER: CALAMAGROSTIS CRASSIGLUMIS 007
COMMON NAME: THICKGLUME REEDGRASS
SOURCE OF LEAD: ZOBEL D & R HASEM 1982
DATE OF SIGHTING: 1978
PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1/4 MILE RADIUS & CONFIRMED BY WNHP
FEDERAL STATUS: CANDIDATE
STATE STATUS: THREATENED
GENERAL DESCRIPTION: NW CORNER OF PYRAMID LAKE W SPIRAEA DOUGLASII, RHODODENDRON ALBIFLORUM, ALNUS SINUATA, ACER CIRCINATUM, ACER GLABRUM, SALIX, CAREX SPP, GALIUM, SPHAGNUM, FONTINALIS ANTIPYRETICA
TOWNSHIP, RANGE AND SECTION: T37N R13E S17
COUNTY: WHATCOM
USGS QUAD NAME: ROSS DAM 7.5
LATITUDE/LONGITUDE: 484145N1210720W
ASPECT:
ELEVATION:
VERIFIED: NO

PLANT NAME AND NUMBER: CAREX PAUPERCULA 007
COMMON NAME: POOR SEDGE
SOURCE OF LEAD: VANBIANCHI R AND WAGSTAFF S 1986
DATE OF SIGHTING: 19860804
PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1/4 MILE RADIUS & UNCONFIRMED BY WNHP
FEDERAL STATUS:
STATE STATUS: SENSITIVE
GENERAL DESCRIPTION: BIG BEAVER VALLEY. APPROX 20 PLANTS IN A COBBLE/GRAVEL FIELD AT THE BASE OF A PERMANENT SNOWFIELD ON A N-FACING SLOPE. NEARLY INACCESSIBLE SITE-NO THREATS. ASSOC SPP: CAREX SPECTABILIS, ATHYRIUM DISTENTIFOLIUM, ACHILLEA MILLEFOLIUM,
TOWNSHIP, RANGE AND SECTION: T38N R12E S01
COUNTY: WHATCOM
USGS QUAD NAME: MT PROPHET 7.5
LATITUDE/LONGITUDE: 484827N1211050W
ASPECT: N
ELEVATION: 2000FT
VERIFIED: YES

PLANT NAME AND NUMBER: LYCOPODIUM INUNDATUM 015
COMMON NAME: BOG CLUBMOSS
SOURCE OF LEAD: VANBIANCHI R AND WAGSTAFF S 1986
DATE OF SIGHTING: 19860804
PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1/4 MILE RADIUS & UNCONFIRMED BY WNHP
FEDERAL STATUS:
STATE STATUS: SENSITIVE
GENERAL DESCRIPTION: BIG BEAVER VALLEY. 1 LARGE COLONY CA 6 METERS IN DIAMETER & SMALL PATCHES SCATTERED ELSEWHERE IN A BOG ON THE S SIDE OF THE VALLEY NEAR THE CONFLUENCE OF MACMILLAN & BIG BEAVER CR. REMOTE SITE-NO LIKELY THREATS. ASSOC SPP: SPHAGNUM SP,
TOWNSHIP, RANGE AND SECTION: T38N R12E S01
COUNTY: WHATCOM
USGS QUAD NAME: MT PROPHET 7.5
LATITUDE/LONGITUDE: 484833N1211040W
ASPECT:
ELEVATION: 1880FT
VERIFIED: YES

PLANT NAME AND NUMBER: CAREX MACROCHAETA 001
COMMON NAME: LARGE-AWN SEDGE
SOURCE OF LEAD: WAGSTAFF SJ MSJW001 002 (1 OTHER COL,1979)
DATE OF SIGHTING: 197907
PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1/4 MILE RADIUS & CONFIRMED BY WNHP
FEDERAL STATUS:
STATE STATUS: SENSITIVE
GENERAL DESCRIPTION: NORTH-FACING BOULDER-STREWN SLOPE NEAR SEEPAGE BY ALSI THICKET ASSOCIATED SP PHAL,TOGL,EPLA,ERPE.FOLLOW STETATTLE CR TOWARDS AZURE LAKE,AVALANCHE TRACK S SIDE OF CR.(ALSO STETATTLE CR DRAINAGE BASIN ABOVE DIABLO,ELEV 3200',N-ASP SL)
TOWNSHIP, RANGE AND SECTION: T38N R12E S26
COUNTY: WHATCOM
USGS QUAD NAME: MT PROPHET 7.5
LATITUDE/LONGITUDE: 484555N1211320W
ASPECT:
ELEVATION:
VERIFIED: YES

PLANT NAME AND NUMBER: LYCOPODIUM INUNDATUM 014
COMMON NAME: BOG CLUBMOSS
TOWNSHIP, RANGE AND SECTION: T38N R13E S05
COUNTY: WHATCOM

WASHINGTON NATURAL HERITAGE DATA SYSTEM
SPECIAL PLANT RECORDS FOR ROSS LAKE NATIONAL RECREATION AREA
AND NORTH CASCADES NATIONAL PARK
DATA CURRENT AS OF MAY 9, 1989

SOURCE OF LEAD: VANBIACHI R AND MAGSTAFF S 1986
DATE OF SIGHTING: 19860804
PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1/4 MILE RADIUS & UNCONFIRMED BY WNHP
FEDERAL STATUS:
STATE STATUS: SENSITIVE
GENERAL DESCRIPTION: BIG BEAVER VALLEY. A COLONY APPROX 2.5 METERS IN DIAMETER WAS SEEN IN A BOG JUST EAST OF 39 MILE CREEK. ASSOC SPP: SPHAGNUM SP, RHYNCHOSPOSA ALBA, TOFIELDIA GLUTINOSA, DROSERA ROTUNDIFOLIA, CAREX SPP. THREATS: INUNDATION IF ROSS DAM IS
USGS QUAD NAME: MT PROPHET 7.5
LATITUDE/LONGITUDE: 484818N1210801W
ASPECT:
ELEVATION: 1680FT
VERIFIED: YES

PLANT NAME AND NUMBER: LYCOPODIUM DENDROIDEUM 006
COMMON NAME: TREELIKE CLUBMOSS
SOURCE OF LEAD: VANBIANCHI R AND MAGSTAFF S 1986
DATE OF SIGHTING: 19860704
PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1/4 MILE RADIUS & UNCONFIRMED BY WNHP
FEDERAL STATUS:
STATE STATUS: SENSITIVE
GENERAL DESCRIPTION: BIG BEAVER VALLEY. CA 20 SHOOTS UNDERNEATH A LARGE OVERHANGING ROCK IN A MATURE DOUGLAS-FIR DOMINATED FOREST. THREATS: TRAMPLING-COLONY IS ALONG BIG BEAVER VALLEY TRAIL. GROWING SYMPATRICALLY WITH L. COMPLANATUM. ASSOC SPP: LINNAEA
TOWNSHIP, RANGE AND SECTION: T38N R13E S06
COUNTY: WHATCOM
USGS QUAD NAME: MT PROPHET 7.5
LATITUDE/LONGITUDE: 484836N1210955W
ASPECT:
ELEVATION: 1880FT
VERIFIED: YES

PLANT NAME AND NUMBER: CAREX PAUPERCULA 006
COMMON NAME: POOR SEDGE
SOURCE OF LEAD: VANBIANCHI R AND MAGSTAFF S
DATE OF SIGHTING: 19860804
PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1/4 MILE RADIUS & UNCONFIRMED BY WNHP
FEDERAL STATUS:
STATE STATUS: SENSITIVE
GENERAL DESCRIPTION: BIG BEAVER VALLEY. A SINGLE PLANT ON A GRAVEL BAR AT THE CONFLUENCE OF BIG BEAVER CREEK & AN UNNAMED TRIBUTARY ENTERING ON THE N SIDE AT RIVER MILE 5.5.
TOWNSHIP, RANGE AND SECTION: T38N R13E S09
COUNTY: WHATCOM
USGS QUAD NAME: PUMPKIN MTN 7.5
LATITUDE/LONGITUDE: 484758N1210645W
ASPECT:
ELEVATION: 1640FT
VERIFIED: YES

PLANT NAME AND NUMBER: LYCOPODIUM DENDROIDEUM 005
COMMON NAME: TREELIKE CLUBMOSS
SOURCE OF LEAD: VANBIANCHI R AND MAGSTAFF S 1986
DATE OF SIGHTING: 19860704
PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1/4 MILE RADIUS & CONFIRMED BY WNHP
FEDERAL STATUS:
STATE STATUS: SENSITIVE
GENERAL DESCRIPTION: BIG BEAVER VALLEY. APPROXIMATELY 10 SHOOTS UNDERNEATH A LOW SHRUB CANOPY (VACCINIUM SP) IN A FOREST/WETLAND ECOTONE NEAR THE MOUTH OF THE VALLEY, ON THE SOUTH SIDE. THREATS: NONE AT PRESENT; INUNDATION IF ROSS DAM WERE EVER RAISED.
TOWNSHIP, RANGE AND SECTION: T38N R13E S14
COUNTY: WHATCOM
USGS QUAD NAME: PUMPKIN MTN 7.5
LATITUDE/LONGITUDE: 484653N1210455W
ASPECT:
ELEVATION: 1640FT
VERIFIED: YES

PLANT NAME AND NUMBER: POA GRAYANA 004
COMMON NAME: GRAY'S BLUEGRASS
SOURCE OF LEAD: LESHER R 1981
DATE OF SIGHTING: 198008
TOWNSHIP, RANGE AND SECTION: T40N R12E S03
COUNTY: WHATCOM
USGS QUAD NAME: MT SPICKARD 7.5
LATITUDE/LONGITUDE: 485943N1211335W

WASHINGTON NATURAL HERITAGE DATA SYSTEM
SPECIAL PLANT RECORDS FOR ROSS LAKE NATIONAL RECREATION AREA
AND NORTH CASCADES NATIONAL PARK
DATA CURRENT AS OF MAY 9, 1989

PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1 MILE RADIUS & UNCONFIRMED BY WNHP — ASPECT:
FEDERAL STATUS: — ELEVATION:
STATE STATUS: SENSITIVE — VERIFIED: YES
GENERAL DESCRIPTION: OCCASIONAL IN VEGETATION MATS ON MODERATELY-$TEEP TALUS SLOPES, S ASP, 7100FT EL & FELLFIELD HABITAT ON EAST RIM OF SILVER LAKE.

PLANT NAME AND NUMBER: SAXIFRAGA DEBILIS 015 — TOWNSHIP, RANGE AND SECTION: T40N R12E S04
COMMON NAME: PYGMY SAXIFRAGE — COUNTY: WHATCOM
SOURCE OF LEAD: LESHER, R 1981 — USGS QUAD NAME: MT SPICKARD 7.5
DATE OF SIGHTING: 198008 — LATITUDE/LONGITUDE: 485900N1211435W
PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1/4 MILE RADIUS & CONFIRMED BY WNHP — ASPECT:
FEDERAL STATUS: — ELEVATION:
STATE STATUS: SENSITIVE — VERIFIED: YES
GENERAL DESCRIPTION: INFREQUENT PLT RESTRICTED TO OUTWASH AREA OF INLET STREAM,SILVER LAKE. FOUND IN MOIST MOSSY SITES OF GRAVELLY-SILTY SOIL. ASSOC SP: CAREX SPECTABILIS,C PHAEOCEPHALA,JUNCUS DRUMMONDII,J MERTENSIANUS,POA ALPINA,FESTUCA OVINA BREVIFOLIA,TRISET

PLANT NAME AND NUMBER: CAREX BUXBAUMII 011 — TOWNSHIP, RANGE AND SECTION: T40N R14E S18 SE
COMMON NAME: BUXBAUM'S SEDGE — COUNTY: WHATCOM
SOURCE OF LEAD: NAAS R & D 1986 (5194) — USGS QUAD NAME: HOZOMEEN MTN 7.5
DATE OF SIGHTING: 19860816 — LATITUDE/LONGITUDE: 485702N1210151W
PRECISION: LATITUDE/LONGITUDE ACCURATE TO 1/4 MILE RADIUS & UNCONFIRMED BY WNHP — ASPECT:
FEDERAL STATUS: — ELEVATION: 3140FT
STATE STATUS: SENSITIVE — VERIFIED: YES
GENERAL DESCRIPTION: RIDLEY LAKE. ABUNDANT ON BOGGY LAKESHORE. LAKE IN CONIFEROUS FOREST. ASSOCIATED SPECIES: LONICERA INVOLUCRATA, SPIRAEA DOUGLASII, MENTHA ARVENSIS, EQUISETUM SP.

ENDANGERED, THREATENED AND SENSITIVE
VASCULAR PLANTS OF WASHINGTON
FEBRUARY 1989

WHATCOM COUNTY

SCIENTIFIC NAME	COMMON NAME	PROPOSED STATE STATUS	FEDERAL STATUS*	HISTORIC RECORD*
AGOSERIS ELATA	TALL AGOSERIS	SENSITIVE		H
ASTER SIBIRICUS VAR MERITUS	ARCTIC ASTER	SENSITIVE		
BOTRYCHIUM LANCEOLATUM	LANCE-LEAVED GRAPE-FERN	SENSITIVE		H
BOTRYCHIUM LUNARIA	MOONWORT	SENSITIVE		
BOTRYCHIUM MINGANENSE	VICTORIN'S GRAPE-FERN	SENSITIVE		H
BOTRYCHIUM PINNATUM	ST. JOHN'S MOONWORT	SENSITIVE		
CALAMAGROSTIS CRASSIGLUMIS	THICKGLUME REEDGRASS	THREATENED	C	H
CAREX ATRATA VAR ERECTA	ERECT BLACKENED SEDGE	SENSITIVE		
CAREX BUXBAUMII	BUXBAUM'S SEDGE	SENSITIVE		
CAREX COMOSA	BRISTLY SEDGE	SENSITIVE		
CAREX MACROCHAETA	LARGE-AWN SEDGE	SENSITIVE		
CAREX PAUCIFLORA	FEW-FLOWERED SEDGE	SENSITIVE		H
CAREX PAUPERCULA	POOR SEDGE	SENSITIVE		
CAREX SAXATILIS VAR MAJOR	RUSSET SEDGE	SENSITIVE		H
CAREX SCIRPOIDEA VAR SCIRPOIDEA	CANADIAN SINGLE-SPIKE SEDGE	SENSITIVE		H
CICUTA BULBIFERA	BULB-BEARING WATER-HEMLOCK	SENSITIVE		H
DRABA AUREA	GOLDEN DRABA	SENSITIVE		H
FRITILLARIA CAMSCHATCENSIS	BLACK LILY	SENSITIVE		
GENTIANA GLAUCA	GLAUCOUS GENTIAN	SENSITIVE		H
LIMOSELLA ACAULIS	SOUTHERN MUDWORT	SENSITIVE		H
LOBELIA DORTMANNA	WATER LOBELIA	SENSITIVE		H
LYCOPODIUM DENDROIDEUM	TREELIKE CLUBMOSS	SENSITIVE		
LYCOPODIUM INUNDATUM	BOG CLUBMOSS	SENSITIVE		
NYMPHAEA TETRAGONA	PYGMY WATER-LILY	POSSIBLY EXTINCT		H
ORTHOCARPUS BRACTEOSUS	ROSY OWL-CLOVER	SENSITIVE		H
POA GRAYANA	GRAY'S BLUEGRASS	SENSITIVE		
PUCCINELLIA NUTKAENSIS	ALASKA ALKALIGRASS	SENSITIVE		H
SAXIFRAGA DEBILIS	PYGMY SAXIFRAGE	SENSITIVE		
SAXIFRAGA INTEGRIFOLIA VAR APETALA	SWAMP SAXIFRAGE	SENSITIVE		H

* C = CANDIDATE FOR LISTING ON THE 1985 FEDERAL REGISTER, NOTICE OF REVIEW
* H = KNOWN ONLY FROM HISTORIC RECORDS

ENDANGERED, THREATENED AND SENSITIVE
VASCULAR PLANTS OF WASHINGTON
FEBRUARY 1989

SKAGIT COUNTY

SCIENTIFIC NAME	COMMON NAME	PROPOSED STATE STATUS	FEDERAL STATUS*	HISTORIC RECORD*
CAREX COMOSA	BRISTLY SEDGE	SENSITIVE		
CASTILLEJA LEVISECTA	GOLDEN INDIAN-PAINTBRUSH	ENDANGERED	C	
ERYTHRONIUM REVOLUTUM	PINK FAWN-LILY	SENSITIVE		H
LOBELIA DORTMANNA	WATER LOBELIA	SENSITIVE		
LOISELEURIA PROCUMBENS	ALPINE AZALEA	SENSITIVE		H
POTAMOGETON OBTUSIFOLIUS	BLUNT-LEAVED PONDWEED	SENSITIVE		H
PUCCINELLIA NUTKAENSIS	ALASKA ALKALIGRASS	SENSITIVE		H
SAXIFRAGA DEBILIS	PYGMY SAXIFRAGE	SENSITIVE		H

* C = CANDIDATE FOR LISTING ON THE 1985 FEDERAL REGISTER, NOTICE OF REVIEW
* H = KNOWN ONLY FROM HISTORIC RECORDS

WASHINGTON NATURAL HERITAGE DATA SYSTEM
HIGH QUALITY NATIVE PLANT COMMUNITIES
REPORTED TO OCCUR IN NATIONAL PARK AREAS
DATA CURRENT AS OF JUNE 30, 1988

---------- NAMEAREA=ROSS LAKE NRA ----------

USGS QUAD NAME	TOWNSHIP, RANGE AND SECTION	PLANT COMMUNITY NAME
PUMPKIN MTN 7.5	T33N R13E S09	VINE MAPLE FOREST
PUMPKIN MTN 7.5	T33N R13E S14	RED ALDER/SALMONBERRY COMMUNITY
DIABLO DAM 7.5	T37N R13E S06	LODGEPOLE PINE-DOUGLAS FIR FOREST
DIABLO DAM 7.5	T37N R13E S06	LODGEPOLE PINE-DOUGLAS FIR FOREST
PUMPKIN MTN 7.5	T36N R13E S14	LODGEPOLE PINE/BEARBERRY COMMUNITY
HOZOMEEN MTN 7.5	T40N R13E S35	DOUGLAS FIR-LODGEPOLE PINE FOREST
PUMPKIN MTN 7.5	T38N R13E S10	DOUGLAS FIR-WESTERN HEMLOCK/OREGON BOXWOOD COMMUNITY
HOZOMEEN MTN 7.5	T40N R13E S33	DOUGLAS FIR/VINE MAPLE COMMUNITY
HOZOMEEN MTN 7.5	T40N R13E S35	DOUGLAS FIR/OCEANSPRAY COMMUNITY
MARBLEMOUNT 1S	T37N R12E S31	WILLOW COMMUNITY
MT PROPHET 7.5	T38N R13E S06	WESTERN REDCEDAR/VINE MAPLE COMMUNITY
PUMPKIN MTN 7.5	T38N R13E S09	WESTERN REDCEDAR/VINE MAPLE COMMUNITY
PUMPKIN MTN 7.5	T38N R13E S10	WESTERN HEMLOCK/OREGONGRAPE COMMUNITY

WASHINGTON NATURAL HERITAGE DATA SYSTEM
HIGH QUALITY NATIVE PLANT COMMUNITIES
REPORTED TO OCCUR IN NATIONAL PARK AREAS
DATA CURRENT AS OF JUNE 30, 1988

NAMEAREA=NORTH CASCADES NPK

USGS QUAD NAME	TOWNSHIP, RANGE AND SECTION	PLANT COMMUNITY NAME
MT CHALLENGER 15	T39N R12E S09	PACIFIC SILVER FIR FOREST
DIABLO DAM 7.5	T36N R13E S04	PACIFIC SILVER FIR FOREST
DIABLO DAM 7.5	T36N R13E S04	PACIFIC SILVER FIR FOREST
MT SHUKSAN 15	T38N R10E S15	PACIFIC SILVER FIR-WESTERN HEMLOCK FOREST
DIABLO DAM 7.5	T38N R12E S36	PACIFIC SILVER FIR-WESTERN HEMLOCK FOREST
DIABLO DAM 7.5	T36N R13E S04	PACIFIC SILVER FIR-WESTERN HEMLOCK/SALAL COMMUNITY
DIABLO DAM 7.5	T36N R13E S04	PACIFIC SILVER FIR-MOUNTAIN HEMLOCK FOREST
MT CHALLENGER 15	T39N R12E S16	PACIFIC SILVER FIR-MOUNTAIN HEMLOCK FOREST
CASCADE PASS 7.5	T35N R13E S36	PACIFIC SILVER FIR-MOUNTAIN HEMLOCK FOREST
MT CHALLENGER 15	T40N R10E S25	PACIFIC SILVER FIR-MOUNTAIN HEMLOCK FOREST
DIABLO DAM 7.5	T37N R12E S02	PACIFIC SILVER FIR-MOUNTAIN HEMLOCK FOREST
DIABLO DAM 7.5	T36N R13E S04	PACIFIC SILVER FIR/DEVILSCLUB COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	PACIFIC SILVER FIR/DEVILSCLUB COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	PACIFIC SILVER FIR/WESTERN COOLWORT COMMUNITY
DIABLO DAM 7.5	T36N R13E S04	PACIFIC SILVER FIR/ALASKA HUCKLEBERRY COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	PACIFIC SILVER FIR/ALASKA HUCKLEBERRY COMMUNITY
DIABLO DAM 7.5	T37N R13E S20	PACIFIC SILVER FIR/BIG HUCKLEBERRY COMMUNITY
MT CHALLENGER 15	T39N R11E S10	SUBALPINE FIR FOREST
MT CHALLENGER 15	T40N R11E S17	VINE MAPLE FOREST
MT SPICKARD 7.5	T40N R12E S35	VINE MAPLE FOREST
MT CHALLENGER 15	T38N R10E S01	VINE MAPLE FOREST
MT SHUKSAN 15	T38N R10E S15	BIGLEAF MAPLE-BLACK COTTONWOOD FOREST
DIABLO DAM 7.5	T36N R13E S04	BIGLEAF MAPLE-BLACK COTTONWOOD FOREST
MT SHUKSAN 15	T38N R10E S15	BIGLEAF MAPLE/SALMONBERRY COMMUNITY
DIABLO DAM 7.5	T36N R11E S04	RED ALDER FOREST
MT SPICKARD 7.5	T40N R12E S35	RED ALDER FOREST
MT CHALLENGER 15	T38N R10E S01	RED ALDER-BLACK COTTONWOOD FOREST
MT PROPHET 7.5	T36N R12E S02	RED ALDER/SALMONBERRY COMMUNITY
MT CHALLENGER 15	T38N R10E S01	RED ALDER/SALMONBERRY COMMUNITY
MT CHALLENGER 15	T39N R12E S20	SITKA ALDER FOREST
MT CHALLENGER 15	T40N R11E S17	SITKA ALDER FOREST
MT PROPHET 7.5	T38N R12E S02	SITKA ALDER FOREST
MT CHALLENGER 15	T38N R10E S01	SITKA ALDER FOREST
MT PROPHET 7.5	T38N R12E S26	SITKA ALDER FOREST
MT SHUKSAN 15	T39N R10E S30	SITKA ALDER FOREST
MT SHUKSAN 15	T39N R10E S30	SITKA ALDER FOREST
DIABLO DAM 7.5	T36N R13E S04	SITKA ALDER FOREST
FORBIDDEN PEAK 7.5	T35N R14E S08	SITKA ALDER FOREST
ROSS DAM 7.5	T37N R13E S16	SITKA ALDER-VINE MAPLE COMMUNITY
FORBIDDEN PEAK 7.5	T35N R14E S17	SITKA ALDER-VINE MAPLE COMMUNITY
DIABLO DAM 7.5	T36N R13E S04	BEARBERRY COMMUNITY
DIABLO DAM 7.5	T37N R12E S02	BEARBERRY COMMUNITY
MT PROPHET 7.5	T38N R12E S19	BEARBERRY COMMUNITY
MT SPICKARD 7.5	T41N R12E S34	BEARBERRY COMMUNITY
MT LOGAN 7.5	T35N R14E S21	BEARBERRY COMMUNITY
CASCADE PASS 7.5	T35N R13E S36	WESTERN CASSIOPE-RED MOUNTAINHEATHER COMMUNITY
MT CHALLENGER 15	T39N R11E S10	WESTERN CASSIOPE-RED MOUNTAINHEATHER COMMUNITY
MT CHALLENGER 15	T40N R10E S25	WESTERN CASSIOPE-RED MOUNTAINHEATHER COMMUNITY
DIABLO DAM 7.5	T37N R12E S02	WESTERN CASSIOPE-RED MOUNTAINHEATHER COMMUNITY
MT SPICKARD 7.5	T40N R12E S34	WESTERN CASSIOPE-RED MOUNTAINHEATHER COMMUNITY

WASHINGTON NATURAL HERITAGE DATA SYSTEM
[redacted]SH G[redacted]Y N[redacted] PL[redacted]S
REPORTED TO OCCUR IN NATIONAL PARK AREAS
DATA CURRENT AS OF JUNE 30, 1988

---------- NAMEAREA=NORTH CASCADES NPK ----------

USGS QUAD NAME	TOWNSHIP, RANGE AND SECTION	PLANT COMMUNITY NAME
FORBIDDEN PEAK 7.5	T35N R14E S19	WESTERN CASSIOPE-RED MOUNTAINHEATHER COMMUNITY
MT CHALLENGER 15	T40N R10E S23	WESTERN CASSIOPE/LUETKEA COMMUNITY
MT CHALLENGER 15	T40N R10E S23	BLACK ALPINE SEDGE COMMUNITY
DIABLO DAM 7.5	T37N R12E S02	BLACK ALPINE SEDGE COMMUNITY
MT SPICKARD 7.5	T40N R12E S04	BLACK ALPINE SEDGE COMMUNITY
DIABLO DAM 7.5	T36N R13E S04	ALASKA CEDAR FOREST
DIABLO DAM 7.5	T36N R13E S04	ALASKA CEDAR FOREST
CASCADE PASS 7.5	T35N R13E S36	CROWBERRY COMMUNITY
MT PROPHET 7.5	T38N R12E S19	CROWBERRY COMMUNITY
MT CHALLENGER 15	T39N R12E S20	SUBALPINE LARCH COMMUNITY
FORBIDDEN PEAK 7.5	T35N R14E S16	SUBALPINE LARCH COMMUNITY
MT CHALLENGER 15	T39N R11E S10	RED MOUNTAINHEATHER-BLUELEAF HUCKLEBERRY COMMUNITY
MT CHALLENGER 15	T40N R10E S25	RED MOUNTAINHEATHER-BLUELEAF HUCKLEBERRY COMMUNITY
DIABLO DAM 7.5	T37N R12E S02	RED MOUNTAINHEATHER-BLUELEAF HUCKLEBERRY COMMUNITY
FORBIDDEN PEAK 7.5	T35N R14E S16	RED MOUNTAINHEATHER-BLUELEAF HUCKLEBERRY COMMUNITY
MT CHALLENGER 15	T39N R11E S10	CREAM MOUNTAINHEATHER SHRUBLAND
MT PROPHET 7.5	T38N R12E S19	CREAM MOUNTAINHEATHER SHRUBLAND
MT SPICKARD 7.5	T40N R12E S04	CREAM MOUNTAINHEATHER SHRUBLAND
MT SPICKARD 7.5	T41N R12E S34	WHITEBARK PINE-SUBALPINE FIR FOREST
DIABLO DAM 7.5	T38N R12E S26	DOUGLAS FIR-LODGEPOLE PINE FOREST
MT CHALLENGER 15	T40N R11E S09	DOUGLAS FIR-WESTERN HEMLOCK FOREST
MT SPICKARD 7.5	T40N R12E S35	DOUGLAS FIR-WESTERN HEMLOCK/OREGON BOXWOOD COMMUNITY
MT SPICKARD 7.5	T40N R13E S29	DOUGLAS FIR-WESTERN HEMLOCK/OREGON BOXWOOD COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	DOUGLAS FIR-WESTERN HEMLOCK/OREGON BOXWOOD COMMUNITY
ROSS DAM 7.5	T37N R13E S16	DOUGLAS FIR-WESTERN HEMLOCK/OREGON BOXWOOD COMMUNITY
MT PROPHET 7.5	T38N R12E S01	DOUGLAS FIR/VINE MAPLE COMMUNITY
MT PROPHET 7.5	T38N R12E S26	DOUGLAS FIR/SALAL COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	THIMBLEBERRY/FIREWEED COMMUNITY
MT SPICKARD 7.5	T40N R12E S04	CASCADE WILLOW/ALPINE FESCUE COMMUNITY
MT SPICKARD 7.5	T41N R12E S34	SNOW WILLOW/ALPINE FESCUE COMMUNITY
MT CHALLENGER 15	T39N R11E S10	ALPINE SAXIFRAGE-PIPER'S WOODRUSH COMMUNITY
MT CHALLENGER 15	T40N R10E S25	ALPINE SAXIFRAGE-PIPER'S WOODRUSH COMMUNITY
DIABLO DAM 7.5	T37N R12E S02	ALPINE SAXIFRAGE-PIPER'S WOODRUSH COMMUNITY
MT SPICKARD 7.5	T41N R12E S34	ALPINE SAXIFRAGE-PIPER'S WOODRUSH COMMUNITY
DIABLO DAM 7.5	T36N R13E S04	WESTERN REDCEDAR-WESTERN HEMLOCK FOREST
DIABLO DAM 7.5	T36N R13E S04	WESTERN REDCEDAR-WESTERN HEMLOCK FOREST
MT SHUKSAN 15	T39N R10E S19	WESTERN REDCEDAR-WESTERN HEMLOCK FOREST
MT SPICKARD 7.5	T40N R12E S35	WESTERN REDCEDAR-WESTERN HEMLOCK FOREST
MT PROPHET 7.5	T39N R12E S02	WESTERN REDCEDAR-WESTERN HEMLOCK/VINE MAPLE COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	WESTERN REDCEDAR-WESTERN HEMLOCK/DEVILSCLUB/LADYFERN COMMUNITY
DIABLO DAM 7.5	T37N R13E S20	WESTERN REDCEDAR-WESTERN HEMLOCK/DEVILSCLUB/LADYFERN COMMUNITY
MT CHALLENGER 15	T40N R11E S05	WESTERN REDCEDAR/VINE MAPLE COMMUNITY
MT SPICKARD 7.5	T40N R12E S35	WESTERN REDCEDAR/VINE MAPLE COMMUNITY
MT SPICKARD 7.5	T40N R12E S35	WESTERN REDCEDAR/VINE MAPLE COMMUNITY
MT CHALLENGER 15	T38N R10E S01	WESTERN REDCEDAR/VINE MAPLE COMMUNITY
MT SPICKARD 7.5	T40N R12E S35	WESTERN REDCEDAR/SKUNKCABBAGE COMMUNITY
DIABLO DAM 7.5	T36N R13E S04	WESTERN REDCEDAR/SKUNKCABBAGE COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	WESTERN REDCEDAR/SKUNKCABBAGE COMMUNITY
MT CHALLENGER 15	T40N R11E S05	WESTERN REDCEDAR/DEVILSCLUB COMMUNITY
MT SPICKARD 7.5	T40N R12E S34	WESTERN REDCEDAR/DEVILSCLUB COMMUNITY

NAMEAREA=NORTH CASCADES NPK

USGS QUAD NAME	TOWNSHIP, RANGE AND SECTION	PLANT COMMUNITY NAME
MT CHALLENGER 15	T40N R11E S31	WESTERN HEMLOCK FOREST
DIABLO DAM 7.5	T36N R13E S04	WESTERN HEMLOCK FOREST
DIABLO DAM 7.5	T39N R12E S26	WESTERN HEMLOCK/OREGONGRAPE COMMUNITY
DIABLO DAM 7.5	T38N R13E S31	WESTERN HEMLOCK/OREGONGRAPE COMMUNITY
DIABLO DAM 7.5	T36N R13E S04	WESTERN HEMLOCK/SALAL COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	WESTERN HEMLOCK/SALAL COMMUNITY
DIABLO DAM 7.5	T36N R13E S04	WESTERN HEMLOCK/SALAL COMMUNITY
DIABLO DAM 7.5	T36N R13E S04	WESTERN HEMLOCK/SALAL COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	WESTERN HEMLOCK/SALAL COMMUNITY
MT PROPHET 7.5	T38N R12E S13	WESTERN HEMLOCK/WESTERN COOLWORT COMMUNITY
DIABLO DAM 7.5	T36N R13E S04	WESTERN HEMLOCK/ALASKA HUCKLEBERRY COMMUNITY
DIABLO DAM 7.5	T37N R13E S20	WESTERN HEMLOCK/BIG HUCKLEBERRY COMMUNITY
MT PROPHET 7.5	T38N R12E S04	WESTERN HEMLOCK/OVALLEAF HUCKLEBERRY COMMUNITY
MT SPICKARD 7.5	T39N R12E S04	WESTERN HEMLOCK/OVALLEAF HUCKLEBERRY COMMUNITY
MT SHUKSAN 15	T39N R10E S19	MOUNTAIN HEMLOCK FOREST
CASCADE PASS 7.5	T35N R13E S36	MOUNTAIN HEMLOCK-SUBALPINE FIR COMMUNITY
MT CHALLENGER 15	T40N R10E S23	MOUNTAIN HEMLOCK-SUBALPINE FIR COMMUNITY
MT PROPHET 7.5	T38N R12E S11	MOUNTAIN HEMLOCK/RED MOUNTAINHEATHER-BLUELEAF HUCKLEBERRY COMMUNITY
MT CHALLENGER 15	T40N R10E S25	MOUNTAIN HEMLOCK/RED MOUNTAINHEATHER-BLUELEAF HUCKLEBERRY COMMUNITY
DIABLO DAM 7.5	T37N R12E S02	MOUNTAIN HEMLOCK/RED MOUNTAINHEATHER-BLUELEAF HUCKLEBERRY COMMUNITY
MT CHALLENGER 15	T39N R11E S10	MOUNTAIN HEMLOCK/RED MOUNTAINHEATHER-BLUELEAF HUCKLEBERRY COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	MOUNTAIN HEMLOCK/CASCADES AZALEA
FORBIDDEN PEAK 7.5	T35N R14E S20	MOUNTAIN HEMLOCK/CASCADES AZALEA
DIABLO DAM 7.5	T36N R13E S04	BIG HUCKLEBERRY SHRUBLAND
CASCADE PASS 7.5	T35N R13E S36	BIG HUCKLEBERRY-BLUELEAF HUCKLEBERRY COMMUNITY
MT CHALLENGER 15	T39N R11E S10	BIG HUCKLEBERRY-BLUELEAF HUCKLEBERRY COMMUNITY
MT CHALLENGER 15	T40N R10E S25	BIG HUCKLEBERRY-BLUELEAF HUCKLEBERRY COMMUNITY
DIABLO DAM 7.5	T37N R12E S02	BIG HUCKLEBERRY-BLUELEAF HUCKLEBERRY COMMUNITY
CASCADE PASS 7.5	T35N R13E S36	SITKA VALERIAN-AMERICAN FALSE HELLEBORE COMMUNITY
DIABLO DAM 7.5	T37N R12E S02	SITKA VALERIAN-AMERICAN FALSE HELLEBORE COMMUNITY
DIABLO DAM 7.5	T38N R12E S26	SITKA VALERIAN-AMERICAN FALSE HELLEBORE COMMUNITY