APPENDIX J

HERBICIDES

Appendix J: Herbicides

Contents

Tables

APPENDIX J: HERBICIDES

This appendix provides a summary of available scientific information about the characteristics and effects of herbicides that would potentially be used for treatment of exotic plants under this management plan. More detailed information can be found in the literature cited in the draft environmental impact statement as well as national and regional websites managed by various agencies and organizations including the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), and the Nature Conservancy. This information was referred to for writing of the environmental analysis. Information in this appendix was also taken from the U.S. Forest Service (USFS) *Draft Environmental Impact Statement for the Invasive Plant Control Project* with permission from that agency (USFS 2004b).

HERBICIDE CHARACTERISTICS AND ENVIRONMENTAL EFFECTS

GLYPHOSATE

Glyphosate is among the most widely used pesticides in the United States, having been used to treat between 13 and 20 million acres annually in recent years (EPA 1993). It is estimated that up to 100 million pounds of glyphosate were applied in 2000 (Beyond Pesticides 2001). It is a broad spectrum, non-selective herbicide used in the treatment of grasses, herbaceous plants, some broadleaf trees and shrubs, and some conifers. It works by inhibiting the synthesis of key amino acids necessary for protein synthesis and plant growth.

Trade name herbicides that contain Glyphosate include Roundup, Rodeo, Gallop, Ranger, Accord, Vision, Pondmaster, Landmaster and Touchdown. Glyphosate may also be an ingredient in the formulations of other types of herbicides.

Health and Safety

There is a chance that glyphosate may inhibit two enzymes involved in the synthesis of amino acids. Humans also use one of these enzymes in synthesizing amino acids. In one study, it was shown that Roundup can affect enzymes found in mammals; specifically, that it decreased the activity of two detoxification enzymes in the liver and an intestinal enzyme of rats (Hietanen, E., K. Linnainmaa, and H. Vainio 1983 cited in Cox 1998). One study, published in 1980, showed that the presence of glyphosate on the surface of chicken eggs does not significantly alter the rate of hatchability for the eggs (Batt 1980 cited in Cox 1998). The study did not, however, investigate other species-specific reactions or the possibility of parental consumption affecting young.

Glyphosate is of relatively low oral and dermal acute toxicity, and several chronic toxicity/carcinogenicity studies have shown glyphosate to be non-carcinogenic (EPA 1993) The dietary risk assessment concluded a minimal level of chronic dietary risk (based on an assumption of 100% of all commodities/acreages being treated) (EPA 1993). Despite this rating, it has been shown to persist in food for over two years (Pesticide Action Network 1997). In California, glyphosate ranks among the most common pesticides cited as causing injury or illness to workers, mainly eye and skin irritation due to splashes while mixing and loading, resulting in swollen eyes, face, and joints, facial numbness, burning skin, blisters, rapid heart rate, chest pains, coughing, headache, and nausea (CPISP 1998). A study of the acute toxicity of glyphosate to humans found red blood cell destruction, among other symptoms, after ingestion.

The EPA has found glyphosate to potentially cause congestion of the lungs and increased breathing rate in the short term, when people are exposed to it at levels above the maximum contaminant levels within *Clean Water Act* parameters for relatively short periods of time. In the long term, glyphosate has the potential to cause kidney damage and reproductive effects from a lifetime exposure at levels above the maximum contaminant level. A Swedish study found that people with occupational exposure to the herbicide had a threefold higher risk of the cancer non-Hodgkin's lymphoma, but also found elevated risk of the disease for all other variables tested, including paint and presence of farm animals, raising doubts about causative relationships (Nordstrom et al. 1998 cited in Cox 1998).

Some suggest that when the active ingredient in glyphosate is tested alone for adverse effect (without its inert ingredients contained in the commercial versions of the product) that it is impossible to accurately assess its hazards (Cox 1998). For example, the final product Roundup is more acutely toxic than either glyphosate or POEA (its surfactant) alone (Martinez and Brown 1991 cited in Cox 1998).

Threatened and Endangered Species

Glyphosate may be a hazard to endangered plant species if applied to areas where they live (IVI 2004a), and it may injure or kill endangered or threatened plant species if the spray comes into contact with their leaves. Glyphosate itself is nontoxic to birds, mammals, and bees, but no tests of chronic effects on terrestrial animals have been undertaken to date (IVI 2004a). The EPA expects that most endangered terrestrial or aquatic organisms will not be affected by the registered uses of glyphosate; however, many endangered plants may be at risk (EPA 1993).

Water Quality

Glyphosate accumulates on the surface of soils, but does not move vertically through the first 6 inches of soil. It is not active in soil; rather, it has a strong tendency to adsorb to soil particles. This property also prevents glyphosate from leaching. Because of this, impacts on groundwater would be unlikely. Contamination of surface water could occur if glyphosate is oversprayed directly near water or in the case of erosion (due to the tendency to adsorb to soil particles suspended in runoff). Glyphosate dissolves easily in water (solubility is 900,000 ppm) (Tu et al. 2001). Although originally thought to be unaffected by sunlight, recent research has indicated that glyphosate is susceptible to photodegradation. A half-life of four days was reported for glyphosate in deionized water under ultraviolet light (Tu et al. 2001). It rapidly dissipates through adsorption, degradation, and dilution (Tu et al. 2001). In one 1976 study, however, more than 50% of the glyphosate added directly to the waters of an irrigation canal were present over 14 kilometers downstream. At least one formulation of glyphosate, Rodeo is registered for aquatic use. Glyphosate, itself, has been deemed safe in water by the EPA, but some surfactants, when added, can cause detrimental effects in an aquatic environment, preventing registration (Tu et al. 2001).

Native Plants

Glyphosate is effective on grasses and other herbaceous plants, as well as brush and some broadleaf trees and conifers. Glyphosate is absorbed through the leaves and inhibits growth. Care should be taken, especially in natural areas, to prevent it from being applied to desirable, native plants because it will likely kill them (IVI 2004a). In terrestrial systems, glyphosate can be applied to foliage, green stems, and cut stems (cut stumps), but cannot penetrate woody bark. Additional study is necessary to evaluate fully the effects of glyphosate on nontarget terrestrial plants (EPA 1993). Only certain formulations of glyphosate (e.g., Rodeo) are registered for aquatic use, as glyphosate by itself is essentially nontoxic to submersed plants, but the adjuvents often sold for use with glyphosate may be toxic to aquatic plants and animals.

Wildlife

MacKinnon and Freedman acknowledge that glyphosate has not been shown to have direct toxicity to birds and other animals, but vegetation changes following application do affect populations (IVI 2004a). A study conducted in northern Maine demonstrated that areas treated with glyphosate experienced a general reduction of small mammal populations (masked shrews, pygmy shrews, short-tailed shrews, and red-backed voles), but the decline was attributed to vegetation change and resulting loss of habitat rather than direct effects of the chemical treatment on animals (Santillo et al. 1989 cited in Cox 1998).

Glyphosate has been shown to have effects on some terrestrial invertebrates. A study conducted by the International Organization for Biological Control found that exposure to Roundup killed over 50% of three beneficial species of insect: a parasitoid wasp, a lacewing and a ladybug, and over 80% of a fourth species, a predatory beetle (Hassan 1988 cited in Cox 1998).

The EPA has required some glyphosate products to be labeled "Toxic to fish" when applied directly to aquatic environments due to one of the end-product's toxic inert ingredients, namely, the surfactant (EPA 1993). The technical grade of glyphosate is no more than slightly toxic to fish and is practically nontoxic to aquatic invertebrates. The 96-hour LC_{50} of glyphosate is 120 mg/L for bluegill and is 86 mg/L for rainbow trout (EXTOXNET 1996c). The 48-hour LC_{50} of glyphosate for Daphnia is 780 mg/L (EXTOXNET 1996c). Some formulations are more toxic to fish and aquatic species because of the toxicity of the surfactants. The LC_{50} for Roundup is 5–26 ppm for fish and 4–37 ppm for invertebrates (IVI 2004a). The Rodeo and Accord formulations have an LC_{50} of greater than 1,000 mg/L for fish and 930 mg/L for Daphnia (Infoventures 2004 gly).

In a recent mesocosm study, application of Roundup (glyphosate) at the manufacturer's recommended maximum application rate of 3.8 mg AI/L resulted in community level effects to freshwater systems. In this particular study, it was found that total species richness was 22% lower in treated than controls. Roundup had reduced tadpole richness by 70 percent by eliminating leopard and gray tree frogs although no effect was detected on the larval stages of toads, spring peepers, or spotted salamanders (Relyea 2005). Other studies have also shown high mortality rates of tadpoles associated with Roundup. These other studies estimated an LC_{50}16-d values for six different species of tadpoles were lower than previously observed for amphibian species, ranging from 0.5 to 2.5 mg AI/L which suggests, according to the author, that a direct overspray at a rate of 3.6 mg AI/L would be highly lethal to amphibians (Relyea 2005). Roundup has not been shown to have any effect on insect predators or snails (Giesy et al. 2000; Relyea 2005). In studies involving the use of glyphosate herbicides that lack the POEA surfactant, such as Rodeo, these effects were not indicated and an excessively high application rate of the herbicide, greater than 450 mg AI/L (Mann and Bidwell 1999) and 9,729 mg AI/L (Perkins et al. 2000) would be required to cause mortality of 50% of the test subjects in 48 to 96 hours. The rapid dissipation from aquatic environments of glyphosate formulations also prevents build-up of herbicide concentrations that would be lethal to most aquatic species (Tu et al. 2001). The surfactants which cause detrimental effects to aquatic environments are the reason certain glyphosate products such as Roundup are not registered for use in aquatic environments. As such only those glyphosate herbicides that are approved for use in aquatic setting, such as Rodeo, would be used in the parks according to label instructions.

Soils

Glyphosate is strongly adsorbed to soil particles, which prevents it from excessive leaching or from being taken up from the soil by nontarget plants. It is degraded primarily by microbial metabolism, but strong adsorption to soil can inhibit microbial metabolism and slow degradation. Chemical degradation is not significant in the dissipation of glyphosate from soils. Although originally thought to be unaffected by sunlight, recent research has indicated that glyphosate is susceptible to photodegradation (Tu et al. 2001).

Glyphosate remains chemically intact for 3 to 130 days, depending upon soil content and texture. However, glyphosate binds differently to different types of soil: one study found desorption (detaching from the soil particles) of 80% of the applied glyphosate to occur within a 2-hour period (Piccolo 1994). Plants do not absorb it from the soil, and it has no known effect on soil microorganisms (IVI 2004a). The main break down products are aminomethylphosphonic acid, which is broken down further by microorganisms, and carbon dioxide (EPA 1993).

METSULFURON METHYL

This nonspecific, broad-spectrum herbicide is used for the treatment of woody plants, annual and perennial broadleaf weeds, and annual grassy weeds. Metsulfuron methyl is absorbed through roots and foliage and moves rapidly through the plant, inhibiting cell division in roots and shoots. It dissolves easily in water and is of relatively low toxicity for most animals tested, with little to no bioaccumulation (IVI 2004c).

Commercial formulations of metsulfuron methyl (Escort, Ally) contain 60% metsulfuron methyl and 40% inert ingredients.

Water Quality

Metsulfuron methyl is classified as highly mobile and can leach through silt loam and sand soils, and endanger groundwater sources at very low concentrations. The potential also exists for surface water contamination if metsulfuron methyl is applied directly to water bodies or wetlands. Tests show that its half-life in water ranges from one to eight days when exposed to artificial sunlight (IVI 2004c).

Native Plants

It must be applied carefully because even a small amount of overspray onto nontarget native plants may cause injury or death of those plants (IVI 2004c). It is also active in soil, so plants adjacent to a treated area may be lost if the herbicide is absorbed through their roots. This nonspecific, broad-spectrum herbicide will impact all plant species (IVI 2004c). It is biologically active at low concentrations and small amounts of drift can cause damage to plants and trees.

Wildlife

Metsulfuron methyl contact with nontarget plants may injure or kill plants that wildlife species rely on for food or shelter. Metsulfuron methyl is practically nontoxic to fish and aquatic invertebrates and does not build up (bioaccumulate) in fish. It is practically nontoxic to birds, mammals, and bees (IVI 2004c). Acute oral LD_{50} was greater than 5,000 mg/kg in rats; acute dermal LD_{50} was greater than 2,000 mg/kg in rabbits (IVI 2004c). Based upon the results of animal studies, metsulfuron methyl is not classified as a carcinogen, mutagen, teratogen, or reproductive inhibitor (IVI 2004c). The primary adverse effect from exposure to metsulfuron methyl appears to be weight loss.

Metsulfuron methyl has very low toxicity to aquatic organisms. LC_{50} for fish and daphnia was less than 150 ppm (IVI 2004c). It appears that compound related mortality after acute exposure is not likely to be observed in fish exposed to concentrations less than or equal to 1,000 mg/L (SERA 2000). A study conducted regarding the toxicity of Metsulfuron methyl to fish, eggs and fry, observed no effects on rainbow trout hatchling, larval survival or larval growth over a 90-day exposure period at a concentration of up to 4.7 mg/L. Concentrations greater that 8 mg/L resulted in small but significant decreases in hatching and survival of fry (Kreamer 1996 cited in SERA 2004).

Soils

Metsulfuron methyl is generally active in the soil, and is usually absorbed from the soil by plants. The adsorption (accumulation on soil surfaces) of metsulfuron methyl to soil varies with the amount of organic matter present in the soil and with soil texture and pH, the measure of acidity or alkalinity (Ismail and Azlizan 2002). The chemical remains unchanged in the soil for varying lengths of time, depending on soil texture, pH, and organic matter content. The half-life of metsulfuron methyl ranges between 120 and 180 days in silt loam. In tropical soils, typically moister, warmer, and more acidic, the half-life of mesulfuron methyl is much less. Ismail and Tet-Vun observed a maximum half-life of 13.4 days in Malaysian soil (2003). Soil microorganisms and chemical hydrolysis (reaction with water) break down metsulfuron methyl to nontoxic, nonherbicidal, lower molecular weight compounds under anaerobic (no oxygen) conditions (IVI 2004c). It degrades faster in acidic conditions and in soils with high moisture content and high temperature.

TRICLOPYR

Triclopyr is a selective herbicide used to control broadleaf and woody plants. It has little or no impact on grasses. It imitates a plant hormone classified as auxins and causes the growing tips of the plant to elongate wither, and die It is believed to acidify cell walls, allowing them to expand.

Triclopyr herbicides come in one of two formulations, a triethylmine salt (triclopyr amine or salt) or a butoxyethyl ester (triclopyr ester). Trade names for triclopyr herbicides are Access, Crossbow, ET, Garlon, PathFinder, Redeem, Rely, Remedy and Turflon.

Native Plants

Triclopyr was developed for woody plant control and is applied to cut surfaces using backpack sprayers. Small amounts of it will impact nontarget native woody plants, which can absorb it through roots and leaves. It is not especially effective on grasses and other plants with a single embryonic leaf on the seed, such as lilies (IVI 2004d). The effects to nontarget plant species include genetic damage, inhibition of mycorrhizal fungi (which increase nutrient uptake by plants), reduction of nitrogen cycling, damage to mosses and lichens, and stimulation of algae blooms (Cox 2000). Triclopyr has also been shown to have a negative effect on bryophytes and lichens, although the effect varies with species (Cox 2000).

Water Quality and Hydrology

Surface water runoff in the Coastal Plain watershed near Gainesville, Florida, was tested for residues during storm events after triclopyr use. Trace levels (1 to 2 parts per billion) were detected in the first event after application. No traces were detected in subsequent events over the next six months (Bush et al. 1991).

Triclopyr is considered mobile, based on its ability to desorb (become released) from soil particles and organic matter as well as its ability to dissolve in water. While degradation is rapid in water exposed to sunlight, with a reported half-life of 10 hours in 95°F water, triclopyr is stable for up to nine months (the length of the study) in the absence of light (such as in ground or well water). Contamination of surface water is also a concern; studies in Oregon found residues of 6 parts per billion in runoff water five months after treatment at 3 pounds per acre (SSPM 2001).

Wildlife

Triclopyr shows low to moderate acute toxicity in mammals. The oral dose of technical triclopyr that causes 50% mortality in rats is 630 to 720 milligrams per kilogram (mg/kg); it is higher (2,000 to 3,000 mg/kg) for formulated products. The LD_{50} for bobwhite quail is 1,698 mg/kg, 2,935 mg/kg for mallard ducks (Tu et al. 2001). For triclopyr acid LD_{50} values for aquatic species are somewhat lower. For bluegill sunfish it is 148 mg/L and rainbow trout have an LD_{50} of 117 mg/L (Tu et al. 2001).

Testing to detect mutation in bacterial systems has yielded negative results, and the screenings to detect bacterial mutation are thought to be invalid for predicting if chlorinated hydrocarbons cause cancer. A dominant lethal test in rats indicated a weakly positive mutation-causing effect, but no similar effect was seen in mice (SSPM 2001).

Birth defect studies on rats and rabbits showed no birth defects in pups, but the rat study reported defects in fetuses, including delayed skull bone formation; this effect may be secondary to maternal toxicity effects. The fetal “no observable effect level” in this study was 50 mg/kg, and the maternal “no observable effect level” was less than 50 mg/kg (SSPM 2001). In laboratory tests, feeding mice and rats triclopyr increased the incidence of breast cancer and a type of genetic damage called dominant lethal mutations (EPA 1996 cited in Cox 1998).

Triclopyr acid and the salt formation herbicide are only slightly toxic to fish. The LC_{50} for the acid is 117 mg/L for rainbow trout and 148 mg/L for bluegill sunfish (Tu et al. 2001). The LC_{50} for the salt formation is 552 mg/L and 891 mg/L for rainbow trout and bluegill sunfish, respectively (Tu et al. 2001). The ester formulation however is highly toxic to fish, with an LC_{50} of 0.74 mg/L for rainbow trout and 0.87 mg/L in bluegill sunfish (Vencill 2002). The ester formulation was also found to be toxic to some species of frog tadpoles (LC_{50} = 1.2 mg/L). Tadpoles exposed to one-half or one-quarter the lethal dose levels exhibited loss of avoidance behavior when prodded, which may affect survival (Cox 2000). The high toxicity of the ester formulation is compounded by the fact that this form is hydrophobic and, therefore, is readily absorbed into fish tissue where it is degraded to triclopyr acid. This provides a means by which fish can acquire high levels of triclopyr acid that may reach or exceed the LC_{50}. Although the ester formulation degrades rapidly to triclopyr acid, it has been shown that there is a significant chance that fish may acquire acute lethal doses when exposed to high concentrations of the ester formulation for more than 6 hours. Application procedures of the ester formulation (e.g., overspray) and factors affecting the rate of breakdown of ester formulations (soil type, moisture, temperature, pH and light) determine the risk of lethal exposure for fish (Cox 2000). Nevertheless, most authors have concluded that if applied properly, triclopyr would not be found in

concentrations adequate to kill aquatic organisms (Tu et al. 2001). Triclopyr does not accumulate in fish and is slightly toxic to practically non-toxic to aquatic invertebrates. Triclopyr is practically nontoxic to aquatic invertebrates. The triclopyr LC_{50} for Daphnia Magna is 1,140 ppm (IVI 2004d). After treating a stream with Grazon, Maloney (1995) found aquatic invertebrate species composition did not significantly change in treated and control sites.

Triclopyr and its formulations have not been tested for chronic effects in aquatic animals. Application via ground methods and use of BMPs and SOPs during aerial application further reduce the potential for triclopyr to have adverse effects on aquatic organisms or amphibians found near or in the aquatic environment.

Studies on mallard ducks indicate triclopyr is of low acute oral toxicity, and subchronic studies on quail and ducks also report low toxicity. No bird field studies are known to exist (SSPM 2001). However, in tests of the hatchlings of mother ducks that were fed triclopyr, the hatchlings had a survival rate of 15% to 20% lower than those of unexposed mothers (EPA 1981 cited in Cox 1998).

The breakdown products, trichloropyridinol and trichloromethoxypyridine, are generally more persistent than the parent compound, with half-lives ranging from 8 to 279 days and 50 to 300 days, respectively (SSPM 2001). Considering that laboratory tests have shown that chronic (long term) and subchronic feeding studies in dogs and rodents found kidney and liver effects, this could prove toxic to burrowing animals or to species that feed on them (SSPM 2001).

Triclopyr has little if any potential to bioaccumulate. The bioconcentration factor in whole bluegill sunfish is 1.08 (EXTOXNET 1996b).

Soils

The breakdown of triclopyr in the environment is due primarily to exposure to sunlight and microbial decomposition. Somewhat persistent, its half-life in soil is strongly dependent on specific soil type and climatic conditions. Garlon® labels suggest that conifer seedlings not be planted in soil sprayed within six months, suggesting that the soil will remain toxic to conifers for that length of time. A Swedish study found residues persisting for one to two years, and in some cases beyond two years. Under favorable degradation conditions (95°F and high moisture), Dow reports a half-life of 46 days (SSPM 2001). The breakdown products, trichloropyridinol and trichloromethoxypyridine, are generally more persistent than the parent compound, with half-lives ranging from 8 to 279 days and 50 to 300 days, respectively (SSPM 2001).

IMAZAPYR

Imazapyr is a broad spectrum herbicide used to control annual and perennial grass and broadleaved weeds, brush and vines, and many deciduous trees. Because imazapyr is generally slow-acting and does not break down quickly in plants, it is particularly effective against woody species (Tu et al. 2001). It is absorbed through roots and foliage and moves rapidly through the plant, inhibiting synthesis of DNA and cell division in roots and shoots. According to three federal agencies (USDA, USFS, and BLM) imazapyr's acute oral toxicity to birds, fish and water is low (USFS 1992). It is suspected that over six weedy plant species have developed resistance to imazapyr (Cox 1996). This has not been tested, it has been observed that use of other herbicides with the same mode of action (primarily the sulfonylurea herbicides) has developed cross-resistance (Cox 1996). The trade name for imazapyr is Arsenal®.

Native Plants

Very small amounts of the spray will impact nontarget native plants if absorbed into the roots through the soil or allowed to contact leaves (IVI 2004b). Imazapyr can be transferred between intertwined root systems as many plants, such as mesquite, exude the herbicide from their roots (Tu et al. 2001). Because imazapyr can be highly mobile, persistent, and can affect a wide range of plants, care must be taken in the application of this herbicide to prevent accidental contact with nontarget species. Additionally, recent studies report that imazapyr can "leak" out of the roots of treated plants and adversely affect the surrounding native vegetation.

Water Quality and Hydrology

Imazapyr is mobile in soil and thus likely to move in water. However, in studies of application in forested areas, imazapyr remained in the top 12 to 18 inches of soil, showed no tendency for lateral movement, did not run off into nearby streams, and has little potential to contaminate groundwater. If imazapyr does enter surface water, it has an average half-life of two to three days and is degraded primarily by light and microbes (Vencill 2002).

Wildlife

Imazapyr is practically nontoxic to mammals and birds (IVI 2004b; SERA 1999). In birds, the LD_{50} was reported to less than 2,150 mg/kg and in mammals between 4,800 and 5,000 mg/kg (IVI 2004b). Imazapyr has not been found to be mutagenic and there has been no evidence to support developmental effects. Imazapyr can cause irritant effects in the skin and eyes (SERA 1999). The EPA has classified imazapyr as a Class E compound, one having evidence of noncarcinogenicity. Under typical and conservative worst-case exposure assumptions, the evidence suggests that no adverse effects would be expected from the application of imazapyr (SERA 1999).

Imazapyr and its formulations are low in toxicity to invertebrates and practically nontoxic to fish. Acute oral toxicity in rates tested LD_{50} greater than 5,000 mg/kg, dermal toxicity was greater than 2,000 mg/kg in rabbits. Chronic toxicity is not apparent and shows no evidence of developmental effects and there is not enough information available at this time to determine whether it causes cancer or adverse reproductive or fertility effects (IVI 2004b).

Threatened and Endangered Species

No specific studies have been conducted on the effects of imazapyr on threatened or endangered species. The U.S. Fish & Wildlife Service has identified 100 counties in 24 states east of the Mississippi River where endangered species may be jeopardized by the use of imazapyr (Cox 1996). Rare and endangered plants are at risk from herbicide exposure as discussed above under Native Vegetation.

Soils

Imazapyr moves readily in soil and can persist in it for several months, depending on environmental conditions. Imazapyr has been implicated in the disruption of nutrient cycling in soil, by inhibiting decomposition of cellulose (Cox 1996). The adsorption capacity of imazapyr changes according to the pH of the soil. As soil pH decreases below 5 (becomes more acidic) the adsorption capacity of imazapyr increases. The more basic the soil above pH 5, the less likely imazapyr is to adsorb to soil particles, and the more available it is for plant absorption (Tu et al. 2001). Generally, it does not bind strongly to soil particles.

Degradation of imazapyr in soils results mostly from microbial metabolism. Photolysis and other chemical reactions have not been shown to have great effects on this chemical's degradation (Tu et al. 2001). The half-life of imazapyr in soil averages from 1 to 5 months (Tu et al. 2001).

HUMAN HEALTH RISK ASSESSMENT

There is much controversy over the potential health effects of human exposure to herbicides (both directly and indirectly). The EPA is responsible for reviewing and assessing the scientific data submitted by the producer for risks to human health. A four-step approach is used for the assessment of a candidate pesticide:

Step One — Hazard identification (toxicology)

Step Two — Dose-response assessment

Step Three — Exposure assessment

Step Four — Risk characterization

In this assessment, public literature and other sources are investigated, in concert with the documentation provided by the producer of the pesticide, to determine the likelihood and intensity of any effects. A ten-fold safety requirement and "uncertainty factors" are built in to the analysis to ensure safety for children, infants, and people and animals of differing thresholds for reactions to the pesticide (EPA 1999b).

Considerable data from tests on laboratory animals are available for herbicides. These tests have been conducted as a requirement for EPA registration of these herbicides for use in the United States. Acute reactions tested include oral, dermal, and inhalation toxicity; acute delayed neurotoxicity; eye and dermal irritation; and dermal allergic sensitization. All herbicides used by the national parks are EPA approved and have been assigned a EPA registration number.

Sublethal poisoning may include irritation of the skin or eyes, nervous system disorders, reproductive system disorders, damage to other organ systems (liver, kidney, lungs, etc.), birth defects, mutations, or cancer. Table J-1 shows acute toxicity categories, with category IV compounds having lowest toxicity and category I compounds having highest toxicity. The table includes the label alert, dose required for toxicity through various means, and degree of irritation associated with each category.

TABLE J-1: TOXICITY CATEGORIES FOR VARIOUS TYPES OF HARMFUL, ACUTE REACTIONS

Toxicity Category	Signal Words	Oral Dose (mg/kg)[a]	Inhalation Dose (mg/L)[a]	Dermal Dose (mg/kg)[b]	Eye Effects	Dermal Effects
I	DANGER	0 to 50	0 to 0.2	0 to 200	Corrosive: corneal opacity not reversible within 7 days	Corrosive
II	WARNING	>50 to 500	>0.2 to 2.0	>200 to 2,000	Corneal opacity reversible within seven days; irritation persisting for 7 days	Severe irritation at 72 hours
III	CAUTION	>500 to 5,000	>2.0 to 20	>2,000 to 20,000	No corneal opacity; irritation reversible within 7 days	Moderate irritation at 72 hours
IV	CAUTION	>5,000	>20	>20,000	No irritation	Mild or slight irritation at 72 hours

Source: EPA Toxicity Categories and Pesticide Label Statements Website http://www.epa.gov/pesticides/health/tox_categories.htm

a. Dosage that will kill 50% of animal test subjects in a single administration.

b. Concentration in the air that will kill 50% of animal test subjects in a single administration.

The EPA also considers chronic toxicity to animals during the herbicide registration process. Criteria evaluated include potential to cause cancer (carcinogenicity), potential to cause birth defects (teratology), potential disruptions of reproduction, and potential to cause mutations (mutagenicity). The study data are used to make inferences relative to human health.

Risks to workers and the public are primarily functions of the toxicity of the herbicide used, the method of application, the length of exposure, and the route of exposure. The possibility of illness from exposure varies from person to person, but is considered to be low for nonrestricted herbicides. The public would have an even smaller risk from exposure than do the workers who apply herbicides. People with known sensitivities or allergies to herbicides would not be allowed to work on application teams.

Acute toxicity (short-term toxicity) is a function of the amount of toxicant received and the route of administration. It is often associated with a single, large dose that produces a near-immediate effect. Proper use of these herbicides in routine operations would result in exposure levels below those shown to cause harmful effects in laboratory studies. Spills of concentrated herbicide present workers with the highest risk for dangerous exposure levels, so following label instructions and wearing appropriate protective clothing are particularly important at such times (DiTomaso 1999).

Most incidents reported in humans have involved skin or eye irritation in workers after exposure during mixing, loading, or application of glyphosate formulations. Nausea and dizziness have also been reported after exposure. Swallowing approximately one half cup of concentrated glyphosate has caused mouth and throat irritation, abdominal pain, vomiting, low blood pressure, reduced urine output, and, in some cases, death.

Table J-2 shows the EPA acute toxicity categories for the four herbicides used by the participating parks.

Chronic toxicity (long-term toxicity) results from prolonged, repeated, or continuous exposure to a chemical, typically at levels lower than necessary to cause acute toxicity. It often demonstrates a delayed response. Table J-3 shows the chronic effects for humans, as evaluated by the EPA, of the herbicides used by the parks. Potential effects generally range from none to slight. Most studies find no adverse toxicological effects of the four types of herbicides used in the nine parks (USFS 2003b).

Carcinogenicity. Monnig calculated increases in cancer probabilities for workers applying 2,4-D and picloram, two herbicides that appear to have carcinogenic effects similar to or greater than the herbicides used by the parks. Please note that these particular herbicides would not be used by the parks under this management plan. He found that cancer probabilities would increase by about one in one million after spraying 2,4-D for 193 days or picloram for 17,000 days (Monnig 1988). These estimates were based on a worst-case scenario of a high dose of herbicide with a low amount of worker protection. For comparison, other events that cause an increase of approximately one in one million for cancer risk include one round-trip transcontinental air trip, living in Denver, Colorado, for 1.5 months rather than at sea level, smoking two cigarettes, or consuming 200 gallons of drinking water from Miami or New Orleans (Crouch and Wilson 1982).

TABLE J-2: HUMAN HAZARDS BASED ON ACUTE TOXICITY CATEGORIES FOR WEED CONTROL HERBICIDES

Herbicide	Acute Oral Toxicity Category [a]	Acute Dermal Toxicity Category	Acute Inhalation Toxicity Category	Primary Eye Irritation Toxicity Category [b]
Metsulfuron methyl	IV	III	III	II
Triclopyr	III	III	III	III[a]
Imazapyr	IV	III	III	III
Glyphosate	IV	IV	III	II

Sources: Information Ventures, Inc. Pesticide Fact Sheet; EXTOXNET Pesticide Information Profiles

a. Refer to table J-1 above for definition of each toxicity category.

b. Garlon 3A® is a Category I eye irritant.

TABLE J-3: CHRONIC EFFECTS ON HUMANS OF HERBICIDES USED TO CONTROL EXOTIC PLANTS IN THE NINE PARKS

Herbicide Active Ingredient	Potential Chronic Effects			
	Carcinogenic	Teratogenic	Reproductive	Mutagenic
Metsulfuron Methyl	No Effects[a]	No Effects	No Effects	No Effects
Triclopyr	No Effects	No Effects	No Effects	Unlikely[b]
Imazapyr	Unknown[c]	No Effects	Unknown	No Effects
Glyphosate	No Effects	No Effects	Unlikely	No Effects

Sources: Information Ventures, Inc. Pesticide Fact Sheet; EXTOXNET Pesticide Information Profiles

a. No Effects – No effects have been shown in laboratory tests; the herbicide is not considered a hazard to humans.

b. Unlikely – Inconsistent or isolated effects have been shown in laboratory tests; the herbicide is not considered a hazard to humans at expected exposure levels.

c. Unknown – Laboratory tests are inconclusive or further testing is required.

While the EPA believes that the herbicides used in the nine parks present little long-term danger to the public, the past decade has seen increasing concern among some ecologists, epidemiologists, endocrinologists, toxicologists, and members of the public about the effects of endocrine-disrupting chemicals on human and wildlife endocrine systems.

The World Health Organization (WHO) recently stated that it is plausible that exposure to endocrine-disrupting chemicals could damage reproductive and developing systems in humans and wildlife (WHO 2002). Most existing studies of endocrine-disrupting chemicals involve their effects on the reproductive system; possible human health effects include breast cancer and endometriosis in women, testicular and prostate cancers in men, abnormal sexual development, and reduced male fertility. However, potential disruptors could also interfere with growth regulators such as pituitary and thyroid glands, production of the "stress hormone" cortisol by the adrenal glands, insulin production, immune suppression, and neurobehavioral effects. Endocrine systems also control metabolism and regulate body processes like kidney function, body temperature, and calcium regulation (USFS 2003b).

Because some pesticides mimic the effects of some hormonal or reproductive responses in their target species, they are sometimes blamed for decreases in fertility, altered sexual characteristics in wildlife, or increases in certain cancers (USFS 2003b). Because 2,4-D mimics the growth hormone auxin, which in turn causes uncontrolled growth and eventual death in target plant species (Tu et al. 2001), it has been implicated as an endocrine disrupter. However, no other synthetic chemicals have been implicated for hormonal disruption (Tu et al. 2001), and little connection has been made between endocrine disruption in wildlife or human health and herbicide use, primarily because information is not available (Safe et al. 2000).

Although concern over endocrine-disrupting chemicals focuses primarily on synthetic chemical compounds, naturally occurring endocrine-disrupting chemicals, such as soy proteins, can also affect hormonal processes (Safe et al. 2000). While some studies suggest that naturally occurring chemicals in foods may produce more significant effects than do synthetics (Mullison 1985; Monnig 1988; USFS 1992; and EPA 1994), other studies indicate that synthetics could be more likely to bioaccumulate, increasing their effect (Tu et al. 2001).

Synergism occurs when the combined impact of two or more chemicals exceeds the summed impacts of their individual effects. The U.S. Forest Service has summarized existing reports on the possible synergistic effects of herbicides, and concluded that such cumulative interactions among herbicides would be rare. They also noted that the low and short-lived doses that would result from spraying these herbicides would be very small compared to many other chemicals in the environment (USFS 2001b).

Some members of the public have expressed concern about the potential for adverse health effects from contacting or consuming vegetation, water, or animals exposed to herbicides. These individual fears are sometimes conveyed through environmental associations. The Center for Biological Diversity has filed several recent lawsuits to compel the EPA to consult with the U.S. Fish & Wildlife Service in considering the impacts of pesticides on endangered species, as the EPA has been accused of failing to consult with wildlife regulatory agencies during the product

licensing process. The lawsuits concern the registration of 45 pesticides impacting over 300 listed species nationwide (Center for Biological Diversity n.d.). It should be noted that in 2004, an alternative agreement for consultation that satisfies the requirements of 50 CFR section 402.45 was reached between the EPA and the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service to streamline the consultation process. Under this agreement, the EPA is able to make the determination that an action under the *Federal Insecticide, Fungicide, and Rodenticide Act* is not likely to adversely affect listed species or designated critical habitat, as these terms are used within the context of the *Endangered Species Act*, without additional informal consultation with the Services or written concurrence from the Services (Volume 69, Number 150, *Federal Register*, August 5, 2004).

The National Coalition against the Misuse of Pesticides in its Website's discussion of invasive weed treatment asserts that about 110,000 non-fatal human pesticide poisonings occur each year in the United States, and that pesticides are also linked to increases in certain cancers, respiratory diseases, asthma, and sterility (Pimentel n.d.). The Pesticide Action Network recently opposed a U.S. Forest Service plan for aerial herbicide application at a former burn site near Yosemite National Park (PAN 2004).

Spray drift (the physical movement of chemicals through the air following application) can occur during herbicide administration activities, increasing the chemical's chances of affecting unintended targets and resulting in additional human, plant, and animal exposure. It has been asserted that less than 0.1% of the herbicide applied reaches its target pest (Pimentel n.d.). In addition, herbicides have been implicated in the increase of plant pathogens (up to five-fold), on non-target plants exposed to herbicides (Pimentel n.d.). This weakens the immune systems of the non-target species and leads to increased susceptibility to illness and mortality. The inert ingredients in many commercial herbicide products are often as dangerous as—if not more than—the active ingredient; these inerts are often toxic to humans, plants, and animals (Cox 1998).

Many environmental organizations also recognize that herbicides, if used carefully, can be a viable element in exotic plant control efforts. Like the National Park Service, the Nature Conservancy uses herbicides, such as glyphosate, that degrade rapidly. Also like the National Park Service, it minimizes the amounts applied and requires that all applicators be licensed (Nature Conservancy 2004). A Sierra Club report of a volunteer trip removing invasive plants in tributary canyons of the Grand Canyon explains the importance of using nonrestricted herbicides such as triclopyr (also used by the nine parks in south Florida and the Virgin Islands) for the control of exotic plants, citing their low toxicity for wildlife (Millar 2004).

Among the most extensive studies to date of herbicide presence in the environment is the U.S. Geological Survey's National Water-Quality Assessment Program (NAWQA), which analyzed data on 76 pesticides and seven selected pesticide degradation products collected from 1992 to 1996 in about 8,500 samples of groundwater and surface water in 20 of the nation's major watersheds. These 76 herbicides, insecticides, and fungicides account for approximately 75% of agricultural pesticide use in the United States (USGS 1999a). Similar to other large-scale studies, fewer than 2% of groundwater samples exceeded one microgram of target chemical per liter, with fewer than 0.1% exceeding standards established to protect human health (all exceedences were for atrazine, a herbicide not proposed for use in this management plan). The report authors do caution that safety standards have not yet been established for many pesticides, and that existing standards do not account for the possibility of additive or synergistic effects of mixtures or the effects of temporary byproducts as pesticides break down (USGS 1999b).

WILDLIFE RISK ASSESSMENT

Some studies on effects of herbicides to terrestrial and aquatic organisms were discussed in the previous section with respect to specific herbicides. Results from other risk assessment studies add to those effects described. Risk assessment studies indicate the potential for certain herbicides to cause a number of impacts including impaired kidney function, reproductive problems, eye irritation, and nontarget plant impacts. Establishing effects thresholds is usually performed on rabbits and rats, and then potential impacts on various other species are inferred. The problem with this type of analysis is that specific thresholds for a particular species are never truly quantified. Therefore, any data compiled that states exact toxicities of a given herbicide on a group of animals must be weighed in relation to the physiological similarities of the species in question and the species used in the testing.

In addition, the concentrations used in testing are typically at least 50% chemical. When actually implementing an herbicide application plan, concentrations come nowhere near these levels. Formulations of the proposed herbicides would likely be anywhere from tens to thousands of times below those resulting in impacts on animals and, often, concentrations would be similar to those experienced as background levels.

To determine the degree of impact on wildlife from herbicides, several factors need to be considered. There are twelve herbicides being considered for use. Each may have a different impact on different species or groups of species dependent upon:

- The proposed application rate of herbicide applied to an area,
- The persistence of the herbicide in the environment, and
- The geographic extent of the proposed application.

Although there has been some concern regarding the synergistic effects associated with interactions between various chemicals (including herbicides), no evidence of synergistic effects with other chemicals has been demonstrated for any of these herbicides.

Various herbicide formulations have the potential to cause eye and skin irritation in the context of splash or spill scenario. The potential for eye and skin irritation to wildlife from normal application, while still possible, is expected to be less than that described because of the reduced concentration of herbicide in a spray scenario when compared to a spill or splash scenario. Mitigation measures aimed at controlling spills are found in chapter 2 "Alternatives."

A risk analysis of various herbicides to terrestrial wildlife species prepared for the Forest Service (USFS 1992) considered toxicity, potential dosage through various routes (ingestion, inhalation, dermal), and length of exposure to a number of vertebrate wildlife species and concluded that potential risks for most wildlife species are low for most herbicides and surfactants using recommended application rates. Risk was moderate to high for only a few species and a few herbicides under extreme situations that would not occur under typical application scenarios. Most of the proposed herbicides are either nontoxic or of low toxicity to birds, mammals, and insects. None of those tested have been shown to cause cancer, birth defects, genetic defects, or problems with fertility or reproduction. There is no evidence of synergistic effects or hormone disruption from any of these chemicals (EXTOXNET 1996a-c; SERA 2002).

Considering that the dosages after dilution with water are far below (often thousands of times below) concentrations of these chemicals that have demonstrated any level of acute or chronic toxicity in tests performed, it is very unlikely that any birds, mammals, fish, or insects would be affected by herbicide use following recommended application rate procedures (IVI 2004 a-d). Triclopyr, while considered a moderately toxic compound does not pose a carcinogenic, mutagenic, reproductive, developmental risk to animals or humans at doses anticipated for this project (IVI 2004d). It should be noted that little research has been conducted to date to determine the effects of imazapyr and metsulfuron methyl on amphibians. However application of herbicides according to the label, application predominantly by ground crews, implementation of BMPs, and SOPs to prevent spills near aquatic environments where amphibians are most likely to be encountered and to prevent overspray during aerial applications it is unlikely that amphibian populations would be adversely affected.

NOTE: References are included in the reference section of the main document.

APPENDIX K

PLANNING CRITERIA

Appendix K: Planning Criteria

Contents

APPENDIX K: PLANNING CRITERIA

GENERAL PLANNING CRITERIA

The following general planning criteria were considered in developing this draft exotic plant management plan / environmental impact statement.

GENERAL PLANNING CRITERIA
• Compatibility of proposed management with the purposes for which the parks were established • Existing laws, regulations, and agency policies • Plans, programs, and policies of other federal, state, local governments, and North American Indian tribes • Public input • Past and present use of the park units • Public welfare and safety • Environmental impacts • Appropriate scientific findings

SPECIFIC PLANNING CRITERIA

In addition to the General Planning Criteria, the following program-specific criteria were applied to individual resources. Planning criteria are listed on the left; the laws, regulations, and policies that guide or mandate the criteria are referenced on the right.

Native Plants / Vegetation Categories	
Planning Criteria	*Laws, Regulations, Policies*
The "fundamental purpose" of the national park system begins with a mandate to conserve park resources and values and provide for the public enjoyment of the park's resources and values to the extent that the resources will be left unimpaired for future generations. Native vegetation is identified as a park resource. The plan will control or eliminate exotic plants to restore native communities using technologies that are effective and least damaging to the environment. Vegetation will be managed to achieve desired plant communities or desired future condition. Ecological site potential would be considered, providing for biodiversity; protection and restoration of native species; and nonconsumption uses, including plant protection, visual quality, and watershed protection. The desired plant communities will provide both wildlife habitat and forage for livestock and native wildlife. The plan will identify and describe desired plant communities and those actions necessary to achieve that desired future condition. The plan will allow for identification of baseline conditions through inventorying of native plants and exotic species and regularly monitor the distribution and condition of native plant species recovery and exotic plant species control.	*National Environmental Policy Act*; *NPS Organic Act*; NPS *Management Policies 2001*; *Executive Order* 13112
Soils	
Planning Criteria	*Laws, Regulations, Policies*
Current laws and policies require that soils in national park units function as naturally as possible. The plan will identify any Best Management Practices or mitigations necessary, or desirable, to maintain or enhance soil conditions in order to maintain long-term productivity of soils.	*National Environmental Policy Act;* NPS *Management Policies 2001*
Water Quality and Hydrology	
Planning Criteria	*Laws, Regulations, Policies*
States and territories define the uses for waters occurring within their borders, and each water body must be managed in accordance with its designated uses. Water quality standards are established for each designated use. Standards must be at least as stringent as those established by the U.S. Environmental Protection Agency, and in most cases, states have adopted the same EPA standards. Water quality will be maintained or improved in accordance with state and federal standards. The plan will identify any best management practices necessary, or desirable, to protect watersheds.	*Clean Water Act;* NPS *Management Policies 2001;* Florida Administrative Code 62-40.110, 1996; *Everglades Forever Act*

Special Status Species	
Planning Criteria	*Laws, Regulations, Policies*
Management actions authorized, funded, or implemented by NPS will be conducted in a manner that will not jeopardize the continued existence of federally listed, threatened, or endangered plant or animal species. The agencies will consult with the U.S. Fish and Wildlife Service in preparing the plan. Species proposed, or candidates for, federal listing will be given the same consideration as listed species. Planning criteria will protect federally listed threatened or endangered plant or animal species, including protection of critical habitat through control of exotic plants and restoration of native habitat. The plan will monitor for effects of management actions on sensitive species. The parks will take action to prevent or minimize adverse impacts on sensitive species through best management practices and adaptive management.	*Endangered Species Act of 1973; Bald and Golden Eagle Protection Act of 1940; South Florida Multi-Species Recovery Plan; Everglades Forever Act;* NPS *Management Policies 2001*
Wildlife and Wildlife Habitats	
Planning Criteria	*Laws, Regulations, Policies*
Parks are to conserve wildlife unimpaired for future generations. This is interpreted by the agency to mean that native animal life should be protected and perpetuated as part of a park's natural ecosystem. Natural processes are relied on to control populations of native species to the greatest extent possible; otherwise they are protected from harvest, harassment, or harm by human activities. The plan will enhance protection of wildlife and wildlife habitat through control of exotic plants and restoration of native habitat. The plan will monitor the effects of management actions to control exotic plants on native wildlife and wildlife habitat and use best management practices and adaptive management to minimize effects.	*Organic Act of 1916*; *Fish and Wildlife Coordination Act of 1934; Migratory Bird Treaty Act of 1918; Florida Multi-Species Recovery Plan; South Florida Multi-species Recovery Plan*
Air Quality	
Planning Criteria	*Laws, Regulations, Policies*
The prevention of significant deterioration program was designed to protect clean air resources. The program was developed out of a May 30, 1972, decision by the U.S. District Court for the District of Columbia, in a lawsuit brought by the Sierra Club, interpreting the *Clean Air Act* as requiring the prevention of significant deterioration of air quality in all clean air areas of the country. Current laws and policies require that air quality in the Monument meets National Ambient Air Quality Standards (NAAQS) for specified pollutants and that park activities do not contribute to the deterioration of air quality. Parks will conduct management activities in compliance with federal and state air quality regulations.	*Clean Air Act, Regional Haze Rule; Florida Prescribed Burning Act; Florida's Revised Prescribed Fire Law; Organic Act*

Cultural Resources	
Planning Criteria	*Laws, Regulations, Policies*
The fundamental purpose of the national park system is to conserve park resources and values while providing for the public enjoyment of the parks, leaving resources unimpaired for future generations. "If they [resources] are degraded or lost, so is the parks' reason for being." The plan will provide for protection of cultural resources by prioritizing treatment sites within the parks that have cultural resources at risk from effects of exotic plants. Effects to cultural resources from management actions would be reduced through implementation of mitigation and best management practices. Exotic plants important to interpretation of the parks history will be maintained in cultural landscapes.	National Register of Historic Places criteria, *National Historic Preservation Act; Director's Order 28: Cultural Resource Management; NPS-28: Cultural Resource Management Guideline, Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes; Executive Order* 13007; NPS *Management Policies 2001; Comprehensive Everglades Restoration Plan; Miccosukee Reserved Area Act (Public Law 105-313 of October 30, 1998)*
Visitor Use and Experience	
Planning Criteria	*Laws, Regulations, Policies*
Enjoyment of park resources and values by the people of the United States is "part of the fundamental purpose of all park units and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks "this of course includes parks in both south Florida and the Caribbean. The plan will enhance visitor understanding and appreciation for native park resources through restoration of native species and enhanced educational programs to increase public awareness of impacts of exotic plants.	NPS *Management Policies 2001;* NPS *Strategic Plan* for 2000 through 2005
Soundscapes	
Planning Criteria	*Laws, Regulations, Policies*
As described in section 1.4.6 of NPS *Management Policies 2001*, natural soundscapes are recognized and valued as a park resource in keeping with the NPS mission. The parks will monitor management activities that generate noise that adversely affects park's soundscapes. The parks will take action to prevent, or minimize, all noise that, through frequency, magnitude or duration, adversely affects the natural soundscape or other park resources or values, or that exceeds levels that have been identified as being acceptable to or appropriate for visitor uses at the sites being monitored.	*Director's Order 47: Soundscape Preservation and Noise Management;* NPS *Management Policies 2001*

Wilderness	
Planning Criteria	*Laws, Regulations, Policies*
The *Wilderness Act*, passed on September 3, 1964, established a national wilderness preservation system, "administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness" (16 USC 1131). The plan will allow for parks to comply with NPS wilderness policies by restoring native vegetation and enhancing their wilderness character. Through best management practices and mitigations, the plan will minimize impacts to wilderness within Everglades National Park from management activities.	*Wilderness Act, Director's Order 41*; NPS *Management Policy* 6.2.1, *Assessment of Wilderness Suitability or Nonsuitability*
Public Health and Safety	
Planning Criteria	*Laws, Regulations, Policies*
NPS *Management Policies 2001* requires that parks provide a safe and healthful environment for visitors and employees. Management actions strive to protect human life and provide injury-free visits, to the extent that they will not impair park resources and values. Best management practices will be adhered to for the protection of the public and workers during management activities including transport, storage, and application of herbicides.	*Organic Act of 1916*; NPS *Management Policies 2001*

Planning Criteria	Laws, Regulations, Agencies, Policies, Plans, and Programs
Law and NPS management policies require the analysis of potential effects to determine whether or not actions would impair resources. The goal is to always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on resources and values. Although management discretion may allow certain impacts within NPS units, impairment of resources and values is not permitted unless specifically authorized by federal law. A determination on impairment is made in the "Environmental Consequences" section for each impact topic.	NPS *Organic Act*; NPS *Management Policies 2001*; *National Environmental Policy Act*; *Omnibus Management Act*; *Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision-making*
The *Plant Protection Act* became law in June 2000 as part of the *Agricultural Risk Protection Act*. The *Plant Protection Act* consolidates all or part of 10 existing U.S. Department of Agriculture plant health laws into one comprehensive law, including the authority to regulate plants, plant products, certain biological control organisms, noxious weeds, and plant pests. The *Plant Quarantine Act*, the *Federal Pest Act*, and the *Federal Noxious Weed Act* are among the 10 statutes that the new act replaces. The *Plant Protection Act* is necessary because of the major impact plant pests could have or currently have on the agriculture, environment, economy, and commerce of the United States. The *Plant Protection Act* gives the Secretary of Agriculture (and through delegated authority, the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture) the ability to prohibit or restrict the importation, exportation, and interstate movement of plants, plant products, certain biological control organisms, noxious weeds, and plant pests. The act also authorizes the Animal and Plant Health Inspection Service to regulate "any enemy, antagonist, or competitor used to control a plant pest or noxious weed."	*Plant Protection Act of 2000*
Section 2 of Executive Order 13112 on Invasive Species, signed February 1999, directs federal agencies to identify actions that may affect the status of invasive species and take action to • prevent the introduction of invasive species • detect and respond rapidly to control populations of such species in a cost-effective and environmentally sound manner • monitor invasive species populations accurately and reliably • provide for restoration of native species and habitat conditions in ecosystems that have been invaded • conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species • promote public education on invasive species and the means to address them	Executive Order 13112
FIFRA and the regulations established by the U.S. Environmental Protection Agency (40 CFR 116-117, 165, 170-172) serve as primary guidance governing pesticide registration, pesticide use, the training and certification of pesticide applicators, and the criminal and civil penalties associated with misuse of pesticides.	*Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA)

Planning Criteria	Laws, Regulations, Agencies, Policies, Plans, and Programs
FIFRA defines the term "pesticide" as (1) any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pests; (2) any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant; and (3) any nitrogen stabilizer, except that the term "pesticide" shall not include any article that is a "new animal drug" within the definition of the *Federal Food, Drug, and Cosmetic Act*. NPS policy also uses this definition of pesticide. All pesticides used in the United States must be registered (licensed) by the U.S. Environmental Protection Agency. Registration ensures that pesticides will be properly labeled, and if used in accordance with specifications, will not cause unreasonable harm to the environmental. Pesticide labels include directions for the protection of workers who apply the pesticide and directions for reducing exposure to non-applicators. Violation of these directions constitutes a violation of FIFRA. The storage and disposal of most pesticides are also regulated under the act, with specific direction provided on pesticide labels. Enforcement of the act is delegated to individual states. FIFRA also gives the U.S. Environmental Protection Agency review authority for biological control agents when they are used to control invasive pests. Herbicides are a class of pesticides used to chemically treat plants. Selective herbicides kill certain target plants while leaving the desired nontarget plants relatively unharmed.	*Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA) (continued)
Although the *Plant Protection Act of 2000* superseded and repealed most of the *Federal Noxious Weed Act of 1974*, section 15 (Management of Undesirable Plants on Federal Lands [7 USC 2814]) was retained. Section 15 requires federal land management agencies to develop and establish management programs to control undesirable plants on federal lands under the agencies' jurisdiction. Undesirable plants are those classified under state and federal law as undesirable, noxious, harmful, injurious, or poisonous. The act also requires that federal land management agencies enter into cooperative agreements to coordinate the management of undesirable plant species on federal lands where similar programs are being implemented on state and private lands in the same area. The Secretaries of Agriculture and the Interior must coordinate their respective control, research, and educational efforts relating to noxious weeds.	*Federal Noxious Weed Act*
The *Wilderness Act* established a national wilderness preservation system, "administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness" (16 USC § 1131).	*Wilderness Act*

Planning Criteria	Laws, Regulations, Agencies, Policies, Plans, and Programs
The act defines wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." An area of wilderness is further defined to mean "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable, (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation, (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value" (16 USC § 1131). Everglades National Park is the only park involved in this EPMP/EIS that contains wilderness. Approximately 86% of Everglades National Park was designated as the "Everglades Wilderness" by Congress in 1978. This large wilderness area was renamed in 1997 (PL 105-82) to honor the famous Everglades activist, Marjory Stoneman Douglas. The wilderness area contains 1,296,500 acres of the park's 1,509,000 acres—the largest wilderness in the southeastern United States. These lands, now shielded from encroachment by development, are managed to protect the plants and animals of the Everglades ecosystem and to provide vital habitat for its many species (NPS 2000a). The park's lands that are designated wilderness are more restricted in the kinds of uses that can take place because of the *Wilderness Act* requirements. These restrictions include the management tools the park can use to control exotic plants. Management activities implemented as a result of this EPMP/EIS will be conducted in accordance with the requirements of the *Wilderness Act.*	*Wilderness Act* (continued)
Congress passed the *National Historic Preservation Act of 1966* because "the historical and cultural foundations of the Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the American people" (16 USC 470b[2]). Through the act, Congress recognized that cultural resources are valuable for knowing and understanding our history, providing a sense of roots and identity, recognizing and commemorating the past, and inspiring future generations.	*National Historic Preservation Act*

Planning Criteria	Laws, Regulations, Agencies, Policies, Plans, and Programs
Section 106 of the *National Historic Preservation Act* requires that federal agencies consider the effects of their undertakings on historic properties (those cultural resources eligible for the National Register of Historic Places). Treatment methods proposed to control exotic plants, and the presence of exotic plants among historic structures and archeological sites, may have effects on historic properties in the parks. Some exotic plant species can be considered ethnographic resources because they have cultural significance to traditionally associated peoples; consequently, control of these species may affect ethnographic resources in parks. To ensure compliance with section 106 of the act, this EPMP/EIS addresses the impacts that current management and the proposed alternatives for exotic plant management have or could have on cultural landscapes and archeological, historic, and ethnographic resources in the nine national parks.	*National Historic Preservation Act* (continued)
Section 7 of the *Endangered Species Act* requires all federal agencies to ensure that any action authorized, funded, or carried out by the agency will not jeopardize the continued existence of any endangered or threatened species or adversely modify any critical habitat of these species (16 USC 1536[a][2]). Each federal agency must consult with the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service for any action that may affect a listed species. Numerous endangered or threatened species, as well as critical habitat for these species, exist in the nine parks participating in this EPMP/EIS. Pursuant to the act, plans to control exotic plants in the parks are expected to be consistent with recovery planning goals for listed species. The *South Florida Multi-Species Recovery Plan* is one of the first and most far-reaching ecosystem plans that the USFWS has developed. This plan serves as a blueprint to recover 68 threatened and endangered species and to restore and maintain biodiversity of native plants and animals in the 23 natural communities throughout about 26,000 square miles of the 19 southernmost counties in Florida (USFWS 1999b). Recovery plans for threatened or endangered species occurring in the U.S. Virgin Islands have been developed for the green sea turtle and the endangered *Calyptranthes thomasiana* plant, which occurs on St. John. The USFWS and NPS work cooperatively with numerous other federal, state, and local agencies as members of the Noxious Exotic Weed Task Team, which was formed at the direction of the South Florida Ecosystem Restoration Task Force to control the spread of exotic plants in south Florida. The team's plan to manage and control the spread of exotic plants in the five south Florida national parks will support continued efforts by the USFWS. In addition, the USFWS and NPS have collaborated to establish mutual priorities for areas and species to treat and shared staff to treat these refuges and parks. These collaborations and coordinated efforts would continue to occur or be enhanced under this EPMP/EIS.	*Endangered Species Act*

Planning Criteria	Laws, Regulations, Agencies, Policies, Plans, and Programs
In response to a national interest in the restoration and preservation of the Everglades, several plans were developed to target the removal of exotic plants. The *Final Fish and Wildlife Coordination Act Report* for *The Comprehensive Everglades Restoration Plan* considers the control and management of exotic plants to be a critical aspect of ecosystem restoration in south Florida. This plan recommends accelerating the existing control measures, developing more effective techniques, and revising and enforcing existing regulations to prevent further introductions of exotic plants. In 2002 the U.S. Army Corps of Engineers authorized a conceptual plan for a four-part, multi-million dollar invasive species management and control project to be implemented as part of *The Comprehensive Everglades Restoration Plan*. The plan consists of the following four components: a cost-sharing project with the University of Florida to construct an invasive species quarantine and research facility a cost-sharing project with the University of Florida to construct an invasive species quarantine and research facility a cost-sharing project with multiple partners for the release of biological control agents preparation of a report to detail federal interest and potential federal involvement in exotic plant projects in south Florida A comprehensive and effective program to control exotic plants in the nine national parks would be consistent with these various initiatives presented in this section.	*Comprehensive Everglades Restoration Plan*
Florida does not have a state environmental policy act or a statewide appointed regulatory board. All major projects are reviewed at the local and regional levels, and any appeals are made to the governor and the governor's cabinet (Weblocator 2004).	*State Environmental Policy Act*
The mission of the Florida Fish and Wildlife Conservation Commission is to manage fish and wildlife resources for their long-term well-being and the benefit of people. In fulfilling its mission to manage Florida's fish and wildlife resources, the commission participates in the management of exotic plants through its involvement with the Noxious Exotic Weed Task Team. A description of the Noxious Exotic Weed Task is included later in this section.	Florida Fish and Wildlife Conservation Commission
The Florida Department of Environmental Protection's (DEP) Bureau of Invasive Plant Management is the lead agency in Florida responsible for coordinating and funding two statewide programs controlling exotic aquatic and upland plants on public conservation lands and waterways throughout the state. Florida's aquatic plant management program is one of the oldest exotic plant removal programs, with its beginnings dating back to the late 1800s. With the addition of the upland plant program, the Bureau of Invasive Plant Management oversees the largest exotic plant management program of its kind in the United States. The bureau also ensures that beneficial native aquatic plants are protected through its permitting programs.	Florida Bureau of Invasive Plant Management

Planning Criteria	Laws, Regulations, Agencies, Policies, Plans, and Programs
The Bureau of Invasive Plant Management serves to protect Florida's native biodiversity by leading the management of exotic plants on Florida's public lands maintaining recreational, economic, and ecological values of Florida's public lands providing education and information to the public developing and maintaining inventories of plant communities on public lands collecting information to support science-based decision making	Florida Bureau of Invasive Plant Management (continued)
The Florida Division of Forestry is responsible for three main programs in the state. management of the state forest system protection of resources from wildfire landowner assistance through the Cooperative Forestry Assistance Program The Division of Forestry is dedicated to "manage public lands to retain their unique character, and to provide multitude public benefits." All state forest five-year plans include a commitment to manage invasive, nonindigenous plants and animals. The division uses the more comprehensive Florida Exotic Pest Plant Council list to identify infestations in state forests, using staff or private contractors to address the problem. A major problem facing the Division of Forestry is the adjacent landowners' lack of knowledge regarding exotic plants and the problems they cause. Some of the landowners may not be aware that the exotic plants on their property are providing a seed source for re-infestations on public land.	Florida Department of Agriculture and Consumer Services, Division of Forestry
The Florida Department of Agriculture and Consumer Services, Division of Plant Industry has the responsibility for detecting, intercepting, identifying, and controlling plants that threaten Florida's agricultural, horticultural, and native plant resources. This regulatory agency enforces the state statutes and rules that regulate plant pests, arthropods, noxious weeds, genetically engineered plants, and biological controls. The agency maintains a list of nuisance plants in chapter 5B-57.007 of the Florida Statutes. The list, voted upon by the state legislature, is much less comprehensive than the list maintained by the Florida Exotic Pest Plant Council (discussed below). The council's focus in the past has been on agriculture, but it has joined forces with the Noxious Exotic Weed Task Team (also discussed below) to support nuisance plant eradication.	Florida Department of Agriculture and Consumer Services, Division of Plant Industry

Planning Criteria	Laws, Regulations, Agencies, Policies, Plans, and Programs
The Florida Department of Transportation has recently started addressing exotic plant problems during roadway design, construction, and maintenance. The biggest problem is controlling exotic plants on rights-of-way when the adjacent private property provides the sources for re-infestation. Another problem is the inadvertent spread of exotic plants through the movement of soil, hay, and sod on the rights-of-way. The activities that occur during highway construction can spread noxious weeds throughout the state.	Florida Department of Transportation
The Florida Exotic Pest Plant Council was formed in 1984 by a diverse group of professionals to focus attention on the impacts of exotic pest plants on biodiversity, native plant community and function, habitat loss, and endangered species. The council informs and educates resource managers and the public about the species that should be monitored and helps establish priorities for management. The goals of the council are to build public awareness about the serious threat of exotic plants, secure funds and support for control and management of exotic plants, and develop integrated management and control methods to prevent the continued spread of exotic pest plants throughout the United States. The Florida Exotic Pest Plant Council provides the following: a continually updated list of problem and potential problem plants a database of exotic plants that includes photos, distribution maps, life history, and botanical description of all high-priority exotic plants a newsletter published quarterly with information on programs in the state exotic plant management plans for high-priority species such as Old World climbing fern, Brazilian pepper, and melaleuca	Florida Exotic Pest Plant Council
The state is divided into five water management districts that manage invasive plants and animals on approximately 2 million acres of conservation lands and in 240,000 public lakes and rivers; Florida Water Management District waters; and flood-control canals. Each district operates separately according to its particular needs. The districts spent more than $18 million in 2000 managing noxious weeds on public lands. The districts fund and conduct research projects on chemical, mechanical, and biological controls and resource assessment and mapping projects, along with education and outreach programs.	Florida Water Management Districts
The Invasive Plant Working Group comprises 11 regional divisions in the Florida DEP Bureau of Invasive Plant Management. The regional divisions develop local strategies to map exotic plant population densities, prioritize funding needs, develop long-term management goals, and educate the public about the benefits of removing exotic plants.	Invasive Plant Working Group

Planning Criteria	Laws, Regulations, Agencies, Policies, Plans, and Programs
Collier County has strict land development codes prohibiting the planting or retention of about 70 types of exotic plants in certain areas and completely prohibiting other exotic plant species. The burden of removal is apparently left to the landowner, but the county provides instructions and offers disposal sites. The county also provides educational programs to promote planting and preserving native species in landscapes and open areas.	Collier County Environmental Services Department
Miami-Dade County Department of Environmental Resource Management has entered into a cooperative agreement with Everglades National Park for managing exotic plants in the eastern portion of the park, which lies in Miami-Dade County. The Department of Environmental Resource Management provides funding and resources for treatment efforts in and adjacent to park boundaries.	Miami-Dade County Department of Environmental Resource Management
The Noxious Exotic Weed Task Team was formed at the direction of the South Florida Ecosystem Restoration Task Force by the South Florida Ecosystem Restoration Working Group to develop an assessment of the current status of exotic plants and identify the highest priority species provide a system-wide comprehensive plan for managing exotic plants and maximizing and augmenting the effectiveness of existing programs develop close cooperation among state, local, and federal governments in order to be eligible for federal funding under Executive Order 13112 The Noxious Exotic Weed Task Team includes U.S. Army Corps of Engineers U.S. Department of Agriculture (Agricultural Research Service and Animal and Plant Health Inspection Service) U.S. Department of Interior (U.S. Geological Survey, National Park Service, and U.S. Fish and Wildlife Service) Florida Department of Agriculture and Consumer Services (Division of Forestry and Division of Plant Industry) Florida Department of Environmental Protection Florida Department of Transportation Florida Fish and Wildlife Conservation Commission Florida water management districts Seminole and Miccosukee Tribes of Florida Miami-Dade County City of Sanibel	Noxious Exotic Weed Task Team

Planning Criteria	Laws, Regulations, Agencies, Policies, Plans, and Programs
The University of Florida Institute for Food and Agricultural Science is a federal, state, and local government partnership dedicated to education, research, and extension. This organization responds to the threat of exotic plants through its cooperative extension program, which trains and certifies herbicide applicators for exotic plant management, makes recommendations for preventative actions to horticultural operations, and increases public awareness.	University of Florida Institute for Food and Agricultural Science
The Center for Aquatic and Invasive Plants is a multidisciplinary research, teaching, and extension unit devoted to the study and management of freshwater aquatic plants and aquatic and terrestrial exotic plants. Personnel from about a dozen university departments contribute to its programs and projects. The center maintains the Aquatic, Wetland, and Invasive Plant Information Retrieval System database—the largest free database of its kind in the world, with over 60,000 citations. The database is supported by the Florida DEP Bureau of Invasive Plant Management, the U.S. Army Corps of Engineers, and the St. John's Water Management District. The searchable database is a resource for over 2,200 research citations on aquatic and terrestrial exotic plants.	University of Florida Institute for Food and Agricultural Science, Center for Aquatic and Invasive Plants

APPENDIX L

SUMMARY OF PROJECTS OR PLANS

WITH CUMULATIVE EFFECTS BY PARK AND RESOURCES

Appendix L: Summary of Projects or Plans with Cumulative Effects by Park and Resources

Contents

SUMMARY OF PROJECTS OR PLANS WITH CUMULATIVE EFFECTS BY PARK AND RESOURCES

Project/Plan	Impact Topic/Resource											
	Air Quality	**Cultural Resources**	**Essential Fish Habitat**	**Native Plants Vegetation Categories**	**Public Health and Safety**	**Soils**	**Soundscapes**	**Special Status Species**	**Visitor Use and Experience**	**Water Quality and Hydrology**	**Wilderness**	**Wildlife and Wildlife Habitats**
Projects Occurring Outside and/or Within the Parks												
Florida Power & Light Company - Turkey Point [Nuclear] Plant – The freshwater cooling canals also provide habitat utilized by crocodiles. FPL controls the Turkey Point transmission line corridors through a combination of ownership and easements. The corridors are maintained by a combination of trimming, mowing, and herbicide application. Herbicides are used primarily to the control exotic species melaleuca (Melaleuca quinquenervia) and Australian pine (Casuarina equisetifolia). Noise from the Turkey Point units is detectable at some times by visitors in Biscayne National Park. Noise transmission is facilitated by the location of the Turkey Point units on Biscayne Bay (NPS scoping comments). The noise is most noticeable under calm wind conditions or when the wind is blowing lightly in a direction from the Turkey Point site to the park. Noise from Turkey Point Units 3 and 4 is generally not an issue at locations to the west of the plant because of the setback from non-FPL property and because of intervening vegetation and trees.							BISC EVER				BISC EVER
South Florida Ecosystem Team's Ecosystem Plan (USFWS) – Contains the goal of protecting, restoring, and managing water quality, quantity, and deliveries to mimic natural hydrologic conditions on national interest lands. Action items include: identify threshold limits for nutrients and evaluate extent/effect of water quality problems and contaminants on national interest lands; modify water delivery systems and regulation schedules that affect national interest lands as needed; and collaborate with other agencies for monitoring. Contains the goal of reducing and/or eliminating exotic species from national interest lands. Action items include: increase management efforts to eradicate exotics and invasive natives from national interest lands, improve habitat for native flora and fauna, and monitor success of eradication efforts.			EVER	BICY BISC DRTO EVER				BICY BISC DRTO EVER		BICY BISC DRTO EVER	EVER	BICY BISC DRTO EVER
South Florida Water Management District (SFWMD) – Ecosystem restoration efforts ongoing at Everglades and Biscayne National Park; in-lake restoration and exotic vegetation eradication projects ongoing at Lake Okeechobee. This district controls a 1,800-mile network of canals and levees and hundreds of water control structures, to help protect regional water supplies and alleviate flooding. Minimum Flows and Levels have been established for Everglades National Park, the Water Conservation Areas, Lake Okeechobee and the Northern Biscayne aquifer (except that portion of the aquifer located in southern Miami-Dade County). Minimum Flows and Levels also have been established for the Caloosahatchee River, St. Lucie River and Estuary and the Northwest Fork of the Loxahatchee River. This effort was required by, Florida Statute, Chapter 373. The SFWMD Modified Water Deliveries to Everglades National Park Project is designed to restore the hydrologic balance between western Shark River Slough and northeastern Shark River Slough, to benefit Everglades National Park flora and fauna. Basin-specific Feasibility Studies are being conducted in 13 basins that discharge into the Everglades. These studies will evaluate alternative combinations of source controls and regional treatment to reduce phosphorus loading to the Everglades. The District will continue to work closely with private and public organizations and to integrate these efforts with those of the Comprehensive Everglades Restoration Plan. Over 21,254 acres of land was acquired (by April 30, 2002) by the District to serve as reservoirs and stormwater treatment areas and to improve the south Florida region's flood control system, drainage, and water supply. The district also does exotic plant removal on district owned agricultural lands along the eastern boundary of the Everglades and within 8.5 square miles.			EVER	BISC EVER				BISC EVER		BISC EVER		BISC EVER
The Comprehensive Everglades Restoration Plan (CERP) – Involves multiple agencies and over 50 complex and long-term projects to restore the quantity, quality, storage, timing and distribution of water in South Florida. Implementation of CERP is progressing through acquiring lands, conducting pilot projects and feasibility studies, and developing essential project planning documents. Eight CERP projects are intended to improve flows in and around Everglades National Park.			EVER	EVER		EVER		EVER		EVER	EVER	EVER
Florida regional exotic plant management programs:												
Lygodium Task Force. Biological control, herbicide application, and physical removal to eliminate Lygodium from Florida's ecosystems.				BICY				BICY				BICY
Brazilian Pepper Task Force. Biological control, herbicide application, physical and mechanical removal, prescribed fire, and flooding to eliminate Brazilian Pepper from Florida's ecosystems.				BISC				BISC				BISC

SUMMARY OF PROJECTS OR PLANS WITH CUMULATIVE EFFECTS BY PARK AND RESOURCES (CONTINUED)

Project/Plan	Impact Topic/Resource											
	Air Quality	Cultural Resources	Essential Fish Habitat	Native Plants Vegetation Categories	Public Health and Safety	Soils	Soundscapes	Special Status Species	Visitor Use and Experience	Water Quality and Hydrology	Wilderness	Wildlife and Wildlife Habitats
Melaleuca Task Force. Biological control, herbicide application, and physical and mechanical removal to eliminate Melaleuca from Florida's ecosystems.				EVER				EVER				EVER
The 1994 Big Cypress National Preserve Fire Management Plan (FMP) – It is a management objective of the plan that prescribed natural fire will be used for the management of exotic species (particularly *melaleuca* in its seedling stage), and fire will be used so as not to encourage the opportunistic growth of fire-benefiting exotic vegetation. Typically, this means cutting and removing any trees burned during the fire and chemically treating the stumps. Extraordinary efforts are expended to keep wildfire out of dense melaleuca stands as the fire induced stress forces seed release.	BICY			BICY	BICY							BICY
Everglades National Park Fire Management Plan (draft 2005) – Fire management objectives include hazard fuel reduction, maintenance of native fire-adapted communities, and control of mature stands of melaleuca, Australian pine, Brazilian pepper and Lygodium.	EVER			EVER	EVER						EVER	EVER
Wildland Fire Management Plan and Environmental Assessment for Canaveral National Seashore – Fire management objectives include hazard fuel reduction, maintenance of fire subclimax communities, and removal of exotic species. Australian pine and Brazilian pepper (Schinus terebinthifolius) have invaded many disturbed sites in CANA, and are noxious exotics which threaten native species.				CANA	CANA							CANA
USFWS – Use of any or all of the following treatments to eradicate invasive exotics at the south Florida National Wildlife Refuges: mechanical, chemical, and biological controls and prescribed burning.				CANA EVER							CANA EVER	CANA EVER
Homestead General Airport (X51) – Homestead General is located adjacent to Everglades national Park and 25 minutes away from Biscayne National Park. Offering Jet-A and 100LL fuel, Homestead General is the most southern public general aviation airport in the continental United States and the last refueling stop before the Florida Keys, the Bahamas and all points south. It serves general aviation, agricultural and sport aviation, with two paved runways, one Ultralight turf runway, Aerobatics box and Skydive drop zone.				EVER			BISC EVER					
Homestead Air Reserve Base (home of the 482nd fighter wing) – Base of activities for F-16 multi-purpose fighter aircrafts, helicopters, and pilots and personnel for the 482nd fighter wing reserve unit.							BISC EVER					
Seminole Tribe of Florida - Seminole Everglades Restoration Initiative – This project will improve the quantity and quality of water coming off the Big Cypress Reservation into the Everglades. This will enhance the hydroperiod in Big Cypress National Preserve, and improve flood control and remove pollutants.				BICY EVER						BICY EVER		
VIALCO (Alumina plant) – Tailings (red mud) from alumina processing have been accumulating since operations began in the late 1960s. The environmental impact of the byproducts is unclear, but they are unsightly. The waters in this area are designated as Class C and have been termed as "stressed" by the USEPA. Several sewage drainage sites infuse the area, causing concern for the well-being of humans and wildlife.			VIIS SARI BUIS							SARI		SARI
HOVENSA Oil Refinery – Oil seepage from the Hess Oil Refinery has been noted for decades and other hydrocarbon storage sites have contaminated the groundwater supply. The waters in this area are designated as Class C and have been termed as "stressed" by the USEPA. Several sewage drainage sites infuse the area, causing concern for the well-being of humans and wildlife. HOVENSA conducts weekly monitoring for sulfur dioxide output.			VIIS SARI BUIS							SARI		SARI
Virgin Islands Rum Industries, Ltd. – Effluent from the rum distillery was determined to be toxic to marine life and may even affect nesting sea turtles at Sandy Point. Heavy metal concentrations are above standard, and Storm water runoff adds to the burden. The waters in this area are designated as Class C and have been termed as "stressed" by the USEPA. Several sewage drainage sites infuse the area, causing concern for the well-being of humans and wildlife.	SARI		SARI							SARI		SARI
Coral Species and Ecosystem Conservation Project - **National Marine Fisheries Service** – This project serves to evaluate the biological status of coral species and coral reef ecosystems that occur in U.S. territorial waters. This two-year project(from 1998) is designed to provide the information needed by NMFS to determine the most effective strategy to conserve threatened coral species and the rich ecosystems for which they form the foundation.			VIIS SARI BUIS					VIIS SARI BUIS				VIIS SARI BUIS

SUMMARY OF PROJECTS OR PLANS WITH CUMULATIVE EFFECTS BY PARK AND RESOURCES (CONTINUED)

Project/Plan	Impact Topic/Resource											
	Air Quality	**Cultural Resources**	**Essential Fish Habitat**	**Native Plants Vegetation Categories**	**Public Health and Safety**	**Soils**	**Soundscapes**	**Special Status Species**	**Visitor Use and Experience**	**Water Quality and Hydrology**	**Wilderness**	**Wildlife and Wildlife Habitats**
Generic Amendment for Addressing Essential Fish Habitat Requirements in the following Fishery Management Plans of the Gulf of Mexico – The Gulf of Mexico Fishery Management Council amended its Gulf of Mexico fishery management plans to effect a permanent closure to fishing of the Tortugas South area and the portion of Tortugas North in the council's jurisdiction. The state of Florida also has implemented regulations to prohibit fishing in those portions of the Tortugas Ecological Reserve that are within state waters. Combined, these actions will result in comprehensive protection for habitats and communities from shallow to deep waters extending from the park into sanctuary waters and the Gulf of Mexico Fishery Management Council waters. It also allows for the rapid modification to definitions of Essential Fish Habitat (EFH), and establishment of new, or modification of existing, Essential Fish Habitat-Habitat Areas of Particular Concern (EFH-HAPCs).			CANA EVER VIIS SARI BUIS					CANA EVER VIIS SARI BUIS				CANA EVER VIIS SARI BUIS
Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region – This document amends the seven fishery management plans (FMP) of the South Atlantic Region Council. The purpose of this action is to analyze within each fishery a range of potential alternatives to: (1) describe and identify Essential Fish Habitat (EFH) for the fishery, (2) identify other actions to encourage the conservation and enhancement of such EFH and (3) identify measures to prevent, mitigate or minimize to the extent practicable the adverse effects of fishing on such EFH. It also allows for the rapid modification to definitions of Essential Fish Habitat (EFH), and establishment of new, or modification of existing, Essential Fish Habitat-Habitat Areas of Particular Concern (EFH-HAPCs).												
Generic Essential Fish Habitat Amendment to the Fishery Management Plans of the U.S. Caribbean – This document amends the four fishery management plans (FMP) of the Caribbean Fishery Management Council. The purpose of this action is to analyze within each fishery a range of potential alternatives to: (1) describe and identify Essential Fish Habitat (EFH) for the fishery, (2) identify other actions to encourage the conservation and enhancement of such EFH and (3) identify measures to prevent, mitigate or minimize to the extent practicable the adverse effects of fishing on such EFH. It also allows for the rapid modification to definitions of Essential Fish Habitat (EFH), and establishment of new, or modification of existing, Essential Fish Habitat-Habitat Areas of Particular Concern (EFH-HAPCs).												
U.S. Virgin Islands Division of Environmental Protection – The Territorial Pollutant Discharge Elimination System (TPDES) Program – monitors discharges and enforces regulations controlling discharges from specific sites (point sources), including industrial, commercial and some residential sites that discharge into the waters of the USVI.	VIIS SARI BUIS									VIIS SARI BUIS		
Projects Occurring Within the Parks												
Development of general management plans in Biscayne National Park, Buck Island Reef National Monument, Canaveral National Seashore, Everglades National Park, and Virgin Islands National Park – These plans would define the long-term direction of park management by defining the desired resource conditions and visitor experiences to be achieved and provide a framework for manager to make decisions regarding protection of park resources, providing quality visitor experience.	BISC BUIS CANA EVER VIIS	BISC BUIS CANA EVER VIIS	BUIS CANA EVER VIIS	BISC BUIS CANA EVER VIIS	BISC BUIS CANA EVER VIIS	BISC BUIS CANA EVER VIIS	BISC BUIS CANA EVER VIIS	BISC BUIS CANA EVER VIIS	BISC BUIS CANA EVER VIIS	BISC BUIS CANA EVER VIIS	EVER	BISC BUIS CANA EVER VIIS
Scenic Corridor Visitor Safety Highway Improvements – Establishment/re-design of 10 wayside areas adjacent to U.S. 41 and Loop Road to reduce accident rates, improve safety, and enrich the visitor experience. Expected completion: 10/04.					BICY				BICY			
Off-road Vehicle Trail Rehabilitation – Designation of up to 400 miles of existing trails for marking and/or stabilization. Work is done each dry season through FY 2012 as funds are available.	BICY			BICY			BICY					BICY
Tamiami Trail Welcome Center – To be located on U.S. 41 just west of Headquarters in Ochopee. Scheduled to start later this year once permits are secured and funds are released.				BICY					BICY			
Seminole Housing – Six three-acre sites to along U.S. 41 to be expanded and developed for traditional Seminole home sites. Awaiting completion of Environmental Assessment and securing of fill permits.						BICY						BICY

SUMMARY OF PROJECTS OR PLANS WITH CUMULATIVE EFFECTS BY PARK AND RESOURCES (CONTINUED)

Project/Plan	Impact Topic/Resource											
	Air Quality	Cultural Resources	Essential Fish Habitat	Native Plants / Vegetation Categories	Public Health and Safety	Soils	Soundscapes	Special Status Species	Visitor Use and Experience	Water Quality and Hydrology	Wilderness	Wildlife and Wildlife Habitats
Oil and Gas Management Plan/EIS – The park is developing this management plan/EIS to manage future exploration, development, and transportation of oil and gas within the preserve. These activities could result in the introduction of new exotic plant species within the preserve, due the removal of native vegetation in the development area which would expose soils and provide an environment for the establishment of exotic plants. In addition, large machinery can transport seeds and spores of exotic plants within the preserve and introduce new species from areas outside the preserve. If an alternative is selected that allows for the continuation of exploration and development, mitigation measures would be identified to reduce the potential for the establishment of exotic species in these areas.				BICY		BICY	BICY	BICY				BICY
Miami-Blue Butterfly Restoration Plan – The proposed project would reintroduce this extirpated butterfly to Everglades and Biscayne National Parks as five-year experimental populations. It is the hope of the project that it will result in establishment of self-sustaining new colonies, and help prevent the extinction of this species from the wild. Furthermore, the reintroduction will restore this biotic component to its ecological role within the parks.								BISC EVER				
Salt Marsh Restoration – The national seashore staff are working with St. John's River Water Management District and Volusia County to restore impacted salt marsh areas. This project entails scraping down old spoil piles to marsh level. This will have the secondary, but not minor, effect of eliminating the Brazilian pepper that covers many of them.				CANA				CANA				
Historic Structures Report Amendment – The National Park Service has contracted for the preparation of a historic structures report amendment to re-examine and re-evaluate treatment strategies. The need for this amendment was based on advances in preservation technologies, discovery of new information about the resource, changes in the physical condition of the resource, changes in NPS philosophy and/or management strategies, and changes in visitor and staff impacts, needs, and uses. In addition, the amendment will update physical condition information to document the current state of the resource, monitor rates of deterioration and/or emerging patterns of failure, and record maintenance activities that have resulted in the successful repair or replacement of historic fabric.		DRTO										
Improvements to the Garden Key main docking facility – The National Park Service is planning the construction of a new finger dock, approximately 5 feet wide and 40 to 50 feet in length, to serve both private and commercial boats. The dock would be located between the south coaling dock and the ferry dock. Construction would take approximately 2 weeks to complete. The project would be performed by a contractor and would involve the use of a mid-size pile driving barge, which may also serve as a staging area.										DRTO		DRTO
Installation of new employee housing within Fort Jefferson – The National Park Service is planning to install 2 new employee housing units within the residential area of Fort Jefferson not accessible to the public. This project will be implemented by the National Park Service staff over the next two years, with work occurring periodically. The casemates would be repointed prior to moving pre-fabricated housing shells into the fort and would take approximately 2 weeks. Other work, spanning a two-year period, would focus on the housing interiors.						DRTO						DRTO
Waterproofing the Fort Jefferson terreplein – The terreplein of Fort Jefferson was designed to be a waterproof system to protect the fort masonry and to serve as a water catchment, channeling rainwater to vertical cast iron drainpipes leading to underground cisterns. Much of the waterproofing was never accomplished when construction of the fort stopped. A waterproofing system is vital to the long-term preservation of the fort. Grieves, Worrall, Wright, & O'Hatnick, Inc. (1999) recommended design alternatives that reflect the original design modified with contemporary materials and techniques. Only testing of the terreplein to gather information for future decision-making is part of the preferred alternative. Future waterproofing actions would require extensive disturbance, archeological monitoring, and consultation with the State Historic Preservation Office.		DRTO				DRTO						
Relocation and expansion of the visitor center and park offices – The park is developing a facilities plan to reassess space allocation. Funding has been requested to move the visitor center and expand its size from one to two casemates. This action would result in 990 square feet of museum exhibition space. Implementation of the facilities plan would also provide 240 square feet for the interpretive offices, 225 square feet for a video viewing area, and 495 square feet for a bookstore and stock storage.						DRTO			DRTO			DRTO
DRTO Visitor Experience and Resource Protection (VERP) Plan – Underway in 2002, stopped in 2003, hopefully to be restarted in 2004. One aspect of this is determining indicators/standards/ monitoring needs for resource conditions including vegetation.				DRTO					DRTO			

SUMMARY OF PROJECTS OR PLANS WITH CUMULATIVE EFFECTS BY PARK AND RESOURCES (CONTINUED)

Project/Plan	Impact Topic/Resource											
	Air Quality	Cultural Resources	Essential Fish Habitat	Native Plants / Vegetation Categories	Public Health and Safety	Soils	Soundscapes	Special Status Species	Visitor Use and Experience	Water Quality and Hydrology	Wilderness	Wildlife and Wildlife Habitats
Airboat Concessions Plan – Everglades National Park is developing a plan to manage airboat use by concessionares within East Everglades. This plan would establish use limits within this area of the park including the establishment of designated trails for airboats.	EVER						EVER	EVER	EVER	EVER	EVER	EVER
Replacement of fort wastewater management system – This project involves: Installing a treated wastewater disposal mound on the parade ground; placing a brine concentrate disposal field on the parade ground; installing a wastewater treatment plant in casemate #62 of Fort Jefferson; installing an underground dosing station in the parade ground along front 3; and installing underground utilities for the water/wastewater treatment systems. This project would be archeologically monitored to ensure that it would not have any adverse effects on cultural resources.				DRTO		DRTO						DRTO
East End Marine Park – This preserve will protect the largest island barrier reef system in the Caribbean. Extending from the high-water mark out three miles (4.8 kilometers), it encompasses 60 square miles (155.4 square kilometers) of offshore coral reef and other marine habitat. The park includes about five square miles (13 square kilometers) of "no-take areas," which are off limits to any fishing and harvesting. A turtle refuge will extend about a mile (1.6 kilometers) into the Caribbean Ocean from the shoreline of the island's primary hawksbill and green turtle nesting beaches on Jack Bay, Isaac Bay and East End Bay.	BUIS		BUIS						BUIS			BUIS
Mangrove Restoration at Sugar Bay – In 1989, hurricane Hugo destroyed the red mangrove community in Sugar Bay. The mangrove community had not significantly regenerated within the decade following the hurricane. Mangroves will be used to reduce the amount of sedimentation reaching the bay. Given the water quality functions of mangrove communities, the St. Croix Environmental Association proposed to restore the mangrove community. Approximately 4,500 red mangroves were to be planted each summer from 1999–2001.			SARI	SARI								
North Shore Road Project – Roadbed stabilization along the north shore. A federal highways project. Bermuda grass (an exotic plant) would be planted along roadsides after construction to stabilize soils. Construction on this project may start in 2005.				VIIS		VIIS						
Rats, Cats, and Mongoose Management Plan – The park has recently implemented a plan to control feral animals within the park. The plan calls for removal of cats, rats, mongoose, hogs, goats, and sheep. These animals can disperse exotic plant seeds through the park, and their reduction would reduce this dispersal.				VIIS								