

**POLLUTION PREVENTION OPPORTUNITY
ASSESSMENT AT THE
U.S. ARMY CORPS OF ENGINEERS
JOHN H. KERR DAM AND RESERVOIR
BOYDTON, VIRGINIA**

by

TRC Environmental Corporation
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Project Officer

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FOREWORD

The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory is the Agency's center for investigation of technological and management approaches for reducing risks from threats to human health and the environment. The focus of the Laboratory's research program is on methods for the prevention and control of pollution to air, land, water and subsurface resources; protection of water quality in public water systems ; remediation of contaminated sites and ground water; and prevention and control of indoor air pollution. The goal of this research effort is to catalyze development and implementation of innovative, cost-effective environmental technologies; develop scientific and engineering information needed by EPA to support regulatory and policy decisions; and provide technical support and information transfer to ensure effective implementation of environmental regulations and strategies.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

E. Timothy Oppelt, Director
National Risk Management Research Laboratory

ABSTRACT

This report summarizes work conducted at the U.S. Army Corps of Engineers (USACE) John H. Kerr Dam and Reservoir project in Boydton, Virginia under the U.S. Environmental Protection Agency's (EPA's) Waste Reduction Evaluations at Federal Sites (WREAFS) Program. This project was funded by EPA and the Strategic Environmental Research and Development Program (SERDP) and was conducted in cooperation with USACE officials. The study followed the procedures described in the EPA Facility Pollution Prevention Guide.

The purposes of the WREAFS Program are to identify new technologies and techniques for reducing wastes from process operations and other activities at federal sites, and to enhance the implementation of pollution prevention through technology transfer. New techniques and technologies for reducing waste generation are identified through pollution prevention opportunity assessments (PPOAs) and may be further evaluated through joint research, development, and demonstration projects.

A PPOA was conducted in July 1994 at the John H. Kerr Dam and Reservoir and several related facilities which identified areas for waste reduction at recreation and maintenance areas operated by the USACE, the State of North Carolina, and private marina concessionaire at the project. Currently, there is a cooperative effort to reduce waste generation at the project between these federal, state and private operators at the various campgrounds, marinas and maintenance facilities. This report identifies potential procedural initiatives as well as technology options to achieve further pollution prevention progress.

All waste-generating processes were initially screened during a PPOA tour. The tour included visits to the North Bend State Park, Longwood State Park, and Island Creek Dam, which are operated by the USACE; Satterwhite Point State Park, which is operated by the State of North Carolina Department of Parks and Recreation; and the Clarksville Marina, which is subleased by the City of Clarksville, Virginia to a private marina operator. Opportunities to reduce wastes in each area were identified and evaluated.

This report was submitted in fulfillment of Contract Number 68-D2-0181 by TRC Environmental Corporation, under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from 7/27/94 to 9/30/94; work was completed as of 9/30/94.

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This report was prepared for EPA's Pollution Prevention Research Branch by Ritchie Buschow, Daniel Bowman, and Jan Smith of TRC Environmental Corporation for the U.S. Environmental Protection Agency under Contract No. 68-D2-0181.

SECTION 1

INTRODUCTION

1.1 PURPOSE

The purpose of this project was to conduct a pollution prevention opportunity assessment (PPOA) of the United States Army Corps of Engineers (USACE) John H. Kerr Dam and Reservoir and related facilities in Boydton, Virginia. The assessment was conducted under the Waste Reduction Evaluations At Federal Sites (WREAFS) Program which is administered by the Pollution Prevention Research Branch, National Risk Management Research Laboratory (NRMRL) of the U.S. Environmental Protection Agency (EPA). The study was conducted in accordance with the EPA manual, Facility Pollution Prevention Guide (EPA/600/R-92/088), which provides a methodology for assessing facility operations to identify, evaluate, and implement pollution prevention opportunities.

Pollution prevention in environmental management requires the development of a comprehensive program which continually seeks opportunities to implement cost-effective strategies to reduce waste generation. PPOAs provide detailed assessments of waste streams, options for reducing waste generation or preventing pollution, and analyses of alternative operating practices which generate less waste. Figure 1 identifies key elements contained in a pollution prevention program and shows how a PPOA interrelates to the program. The elements of the pollution prevention program are discussed in detail in the Facility Pollution Prevention Guide.

This section discusses the approach for conducting the PPOA at the John H. Kerr Dam and Reservoir and several related facilities. Section 2 provides a physical description of the John H. Kerr Dam and Reservoir project. Section 3 discusses operations at the areas of the project reviewed during the site visit and characterizes pollution prevention issues related to these operations. Section 4 provides a summary of the results of the PPOA. Appendix A contains Material Safety Data Sheets (MSDS) for relevant chemicals discussed in this report.

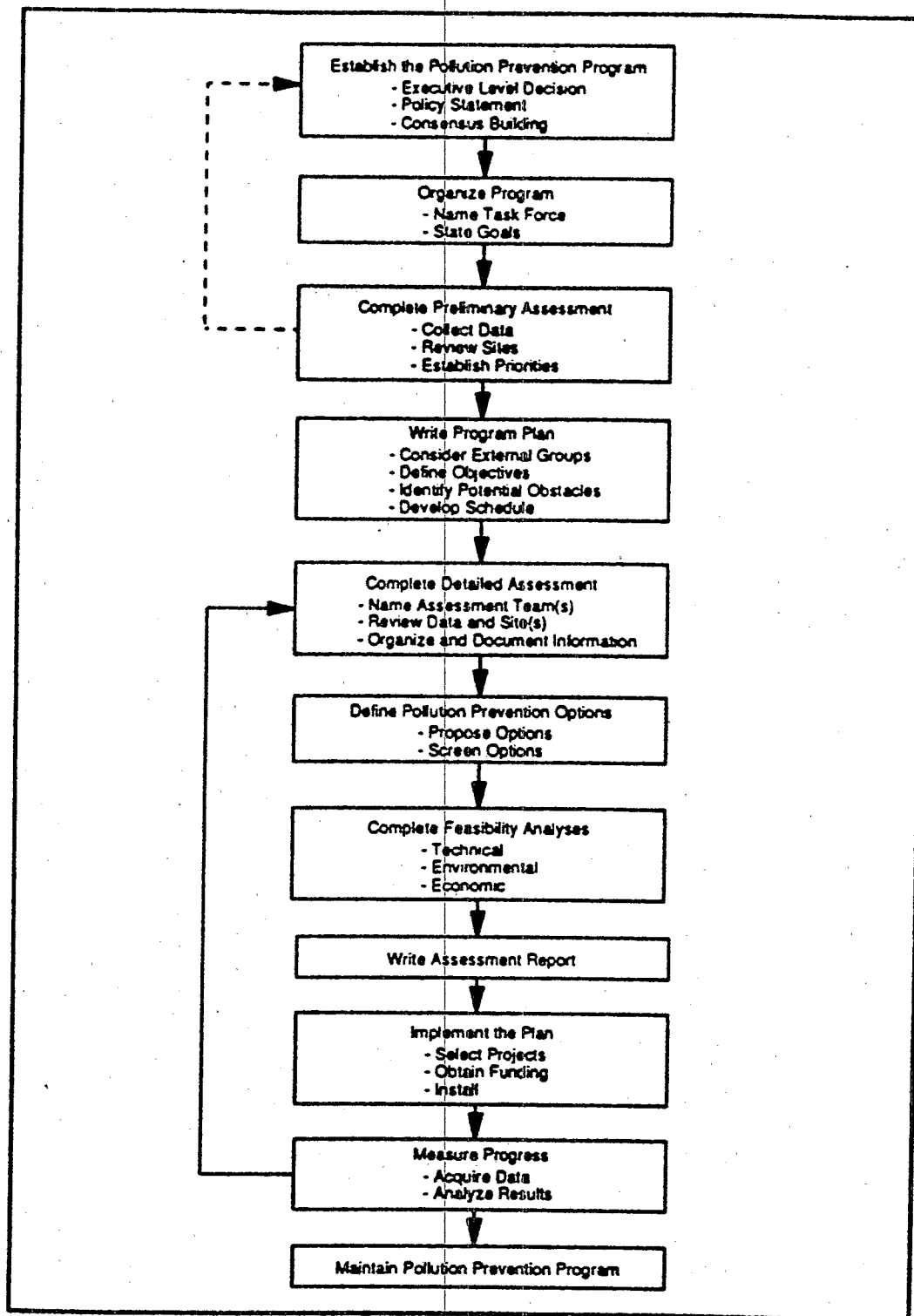


Figure 1. Pollution prevention program overview.

1.2 APPROACH TO THE PPOA AT THE JOHN H. KERR DAM AND RESERVOIR

This PPOA was conducted to identify pollution prevention opportunities at several reservoir facilities. The facilities discussed in this PPOA report are: (1) North Bend Park maintenance facility, spray irrigation water treatment system, marina, and campground, which are all operated by the USACE; (2) Longwood Park, which is operated by the USACE; (3) the pump station at Island Creek Dam, which is operated by the USACE; (4) Satterwhite Point State Park maintenance facility and wastewater treatment system, which is operated by the State of North Carolina Department of Parks and Recreation; and (5) the Clarksville Marina, which is operated by a concessionaire. All of these facilities except number 3, the pump station at Island Creek Dam, were visited during a PPOA tour conducted in July.

Due to the number of sites visited in this assessment, an attempt was made during the development of this report to ensure that a clear description of pollution prevention opportunities for each site was presented. This was accomplished by arranging this report in the following fashion. The entire project is described in Section 2. Section 3, which contains site activity descriptions, includes a discussion of maintenance and pollution prevention issues relevant to all reservoir and dam facilities in Section 3.1, with the remainder of Section 3 describing each of the facilities visited. Any pollution prevention issues specific to individual facilities are discussed in subsections dedicated to each facility in Section 3. Section 4 presents conclusions regarding pollution prevention opportunities and recommendations.

SECTION 2

DESCRIPTION OF JOHN H. KERR DAM AND RESERVOIR

The John H. Kerr Dam and Reservoir is located on the Roanoke River 55 miles north of Raleigh, North Carolina and 100 miles southwest of Richmond, Virginia. The dam and reservoir were authorized by the Flood Control Act of 1944, and was constructed for flood control and aquatic recreation needs. Additional purposes of the project include domestic water supply, water supply for hydroelectric power generation, water quality control, wildlife management, and navigation.

The entire project includes the dam, lake (reservoir), and the Island Creek Pump Station and Dam. The Dam is located on the Roanoke River about 12 miles southwest of South Hill, Virginia. The reservoir extends in a northwesterly direction, upstream from the dam and stretches into both Virginia and North Carolina. The reservoir is contained in Mecklenberg, Charlotte, and Halifax Counties in Virginia and Granville, Vance, and Warren Counties in North Carolina. The reservoir is normally about 48,900 surface acres in area, but it can increase to a maximum of 83,200 surface acres when high water conditions occur. Approximately three quarters of the reservoir's area is in Virginia and one quarter is in North Carolina. The total length of the reservoir is about 39 miles, which includes approximately 1,000 miles of shoreline.

The reservoir contains 29 recreational sites which include 25 campgrounds, three marinas, and one combination campground and marina. Fifteen of these sites are operated by the USACE. The remaining 14 sites are operated by the States of Virginia and North Carolina and by private organizations.

SECTION 3

SITE ACTIVITY DESCRIPTIONS

3.1 GENERAL

This section summarizes the activities at the five facilities investigated during this PPOA and identifies potential pollution prevention opportunities within these areas. These five facilities are operated by the USACE, the State of North Carolina Department of Parks and Recreation, and private entities. Section 3.2 summarizes activities and pollution prevention issues applicable to all facilities in the project, and Sections 3.3 to 3.7 summarize activities and pollution prevention issues applicable to individual facilities at the project.

3.2 USACE ACTIVITIES PERFORMED THROUGHOUT THE ENTIRE RESERVOIR

3.2.1 Description

USACE regulations require that some operations be performed uniformly in all areas of the project. At all five facilities visited, the organization responsible for that facility (e.g., USACE, the State of Virginia) implements these required practices.

USACE regulations require that all dikes at the reservoir be kept clear of woody vegetation in order to minimize possible dike failure and premature deterioration. The USACE uses a licensed contractor for herbicide (i.e., Roundup™) application to localized areas requiring vegetation control, which is usually performed once a year. The contractor uses his/her own supply of herbicide which is stored offsite.

The USACE controls aquatic weeds such as hydrilla through the application of Aquithal K, which contains a surfactant that disrupts aquatic weed growth. Aquithal K has been applied twice in the last two years and has not been shown to be harmful to water quality or other aquatic wildlife.

Painting operations at the reservoir facilities primarily involve reservoir boundary markers. Every five years, boundary markers for up to 200 miles of boundary area are painted. The USACE will also occasionally paint marks on trees to act as trail markers around the park. For these operations, the USACE primarily uses latex-base paints.

Finally, railroad ties throughout the project are generally composed of pressure treated lumber or are treated with creosote. The USACE is currently experimenting with replacing these materials with recycled plastic railroad ties. Preliminary indications are that the material shows good durability.

3.2.2 PPOA Issues

Both herbicide and algicide applications at the project appear to have minimal impact to the environment. These activities are only performed as necessary to control weed growth. The USACE uses latex paints for paint marking rather than oil based paints.

The use of recycled plastic railroad ties appears to be an excellent pollution prevention alternative to the use of pressure treated or creosote treated lumber. The material performs very well, and there do not appear to be any technical barriers to its use. The USACE should consider using this material in such applications wherever possible. In addition, the USACE is currently experimenting with the use of recycled plastic picnic tables and benches in several campground facilities.

3.3 NORTH BEND STATE PARK

3.3.1 Maintenance Facilities

3.3.1.1 Description--

Operations that occur at the North Bend Park maintenance facility include upkeep and repair of equipment associated with the recreational use areas and resource management facilities, including water and wastewater treatment plants. Lubricating oils, solvents, and hydraulic fluids are utilized on a routine basis during equipment operation and maintenance. Additional waste-generating activities include routine cleaning and equipment upkeep and maintenance. Underground storage tanks (USTs) once used at the site have been removed and motor vehicle fuel is not dispensed on site.

The USACE maintains a contract with Safety Kleen Corporation to dispose of used oil, antifreeze, paint solvents which are used for paint removal and cleaning motor vehicle parts, hazardous materials, parts cleaner, and samples taken from the lake. Recycling efforts at the maintenance compound include collection bins for aluminum, office paper, and newspaper. Glass and plastic are not recycled since past recycling efforts failed due to lack of market demand for these materials.

Eight specific areas within the North Bend maintenance operations were reviewed for this assessment. PPOA issues were reviewed at the following North Bend maintenance compound locations: (1) maintenance garage; (2) petroleum/paint storage shed; (3) maintenance warehouse; (4) carpentry shop; (5) sign shop; (6) vehicle wash area; (7) yard storage; and (8) marine shop and buoy shed. Specific descriptions and PPOA issues pertaining to each of these activities are provided in the following sections. Table 1 provides an inventory of hazardous materials stored on site. Table 2 provides typical wastes and waste quantities disposed of by Safety Kleen Corporation.

3.3.1.2 Maintenance Garage--

3.3.1.2.1 Description--

The maintenance garage is used for minor repairs, parts cleaning, routine vehicle maintenance (e.g., oil changes), metal works and welding operations, minor maintenance operations (e.g., sanding), and storing small quantities of parts cleaners and used vehicle tires.

Previous USACE policy required vehicles to have oil changes every 3,000 miles. Recent changes to the policy now allow for 6,000 miles between oil changes, reducing waste oil generation at the maintenance compound. Older model year vehicles may still have more frequent oil changes, however, 6,000 mile oil changes are often allowed for newer vehicles based on vehicle manufacturer specifications. Approximately 50 pounds of oily rags generated during oil changes are disposed of annually. These are contained in 55-gallon drums, and deposited directly into the Mecklenburg County, Virginia landfill near the project. Used vehicle batteries are returned to the manufacturer for new purchases and used tires are sent to the County landfill.

Between three and four 55-gallon drums of waste motor oil are generated at the maintenance garage annually. All waste oil generated at this facility is disposed of by the Safety Kleen Corporation's

**TABLE 1. HAZARDOUS MATERIAL INVENTORY FOR THE SUMMER 1994 AT THE NORTH BEND
MAINTENANCE FACILITY**

Hazardous Material	Quantity
latex paint	143 gallons
oil based paint	496 gallons
paint thinner	22 gallons
paint remover	26 gallons
adhesive/cement	
sealers/auto body fillers	38 containers ranging in size from 4 ounces to 1 gallon
cleaners (includes bleach, powdered car wash, and concrete cleaner)	25 containers ranging in size from 1 pint to 1 gallon
oil (includes motor vehicle oil, diesel oil and air compressor oil/hydraulic fluid)	15 containers ranging in size from 1 pint to 1 gallon
antifreeze (ethylene glycol)	41 containers ranging from 1 quart to 55 gallon drums
grease	300 gallons (1 gallon containers)
cement	10 containers ranging from 1 pound to 5 gallons
fertilizer	60 bags
lime	10 bags
gas cylinders (chlorine)	20 bags
gas cylinders (oxygen)	2 large cylinders (150 pounds per year consumed)
gas cylinders (acetylene)	3 large cylinders & 1 small cylinder
aerosol lacquer	3 large cylinders & 1 small cylinder
aerosol rust inhibitor (WD-40)	size ranges 1 quart container, 6-13 ounce cans; 3-10.5 ounce cans
rust and corrosive preventative	3 cans
rust inhibitor	3-11.75 ounce cans
penetrating fluid	50 gallon drum
automotive transmission fluid	1 can
fulmatic acid	1 gallon
varnish	2 gallons
two-cycle engine oil	1 can
vehicle windshield washer fluid	37 cans
insect repellent	18 gallons
	142 containers ranging in size from 2 ounces to 14 ounces

provides an inventory of hazardous materials stored on site. Table 2 provides typical wastes and waste

TABLE 2. TYPICAL WASTE SHIPMENTS FROM THE NORTH BEND PARK MAINTENANCE FACILITY

Hazardous Material	Use	Quantity (Gallons)	Estimated date of shipment
paint/thinner/varnish mixture	old stock (i.e., outdated)	200	11/91
gear oil/water mixture	contaminated oil	55	11/91
diesel fuel	parts cleaning	40	11/91
oil/water mixture	bad stock	15	11/91
vinyl thinner	old stock	30	11/91
benzene gas/concentrated liquid soap	contaminated soap product	25	11/91
dirt/creosote mixture	contaminated dirt from tank excavation containing creosote laden wooden posts	165	11/91
#2 fuel oil	underground storage tank (UST) removal	400	11/91
used oil	used oil form various processes	210	1/92
used motor vehicle oil	used	200	3/93
water/gasoline mixture	UST removal	200	7/93
fuel oil	used fuel oil	5	7/94
soil/hydraulic oil mixture	contaminated soil from cleanup of spill	55	7/94
lacquer/thinners	old stock	25	7/94

Lexington, South Carolina facility. Safety Kleen normally provides the 55-gallon drums used for disposing of all solvent wastes.

During the winter season, ethylene glycol antifreeze is used in toilet facilities and in piping to prevent toilet bowls from cracking during extremely low temperatures. Between one and three gallons of antifreeze are used at each toilet facility. A total of 125 gallons per year of antifreeze is used for this purpose. Ethylene glycol is considered a toxic compound by the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH).

3.3.1.2.2 PPOA Issues--

The USACE has considered the use of synthetic motor vehicle oils rather than conventional petroleum-based motor oils. Synthetic oils may allow extending change intervals up to approximately 12,000 miles. However, there is conflicting guidance on the recommended interval for changing synthetic-based oils in motor vehicles. To judge the economic impacts of synthetic oil use, the cost of both oils must be compared to the effective life of the products. A 55-gallon drum of synthetic oil costs approximately four times that of the same quantity of petroleum-based oil. Because the effective life of synthetic oils appears to be only about twice that of petroleum oils, the increased cost required to convert to synthetic oils appears to outweigh savings resulting from reduced waste disposal costs.

There are two alternatives to the disposal of oily rags used during changeout of motor vehicle motor oil. One alternative involves using a wringer system to extract most of the waste oil. The rags could then be reused. A wringer system could be attached to the top of a 55-gallon drum, which would collect the waste oil when the oiled rags are passed through the wringer. Not only would such a system reduce the level of solid waste generated at the maintenance compound, it would also reduce the quantity of rags purchased for such uses. In addition, this waste management technique should require minimal additional labor from facility personnel. Figure 2 illustrates a typical wringer system. A second rag management option is to contract with a rag recycling service. This would avoid disposal to a landfill of rags used only once.

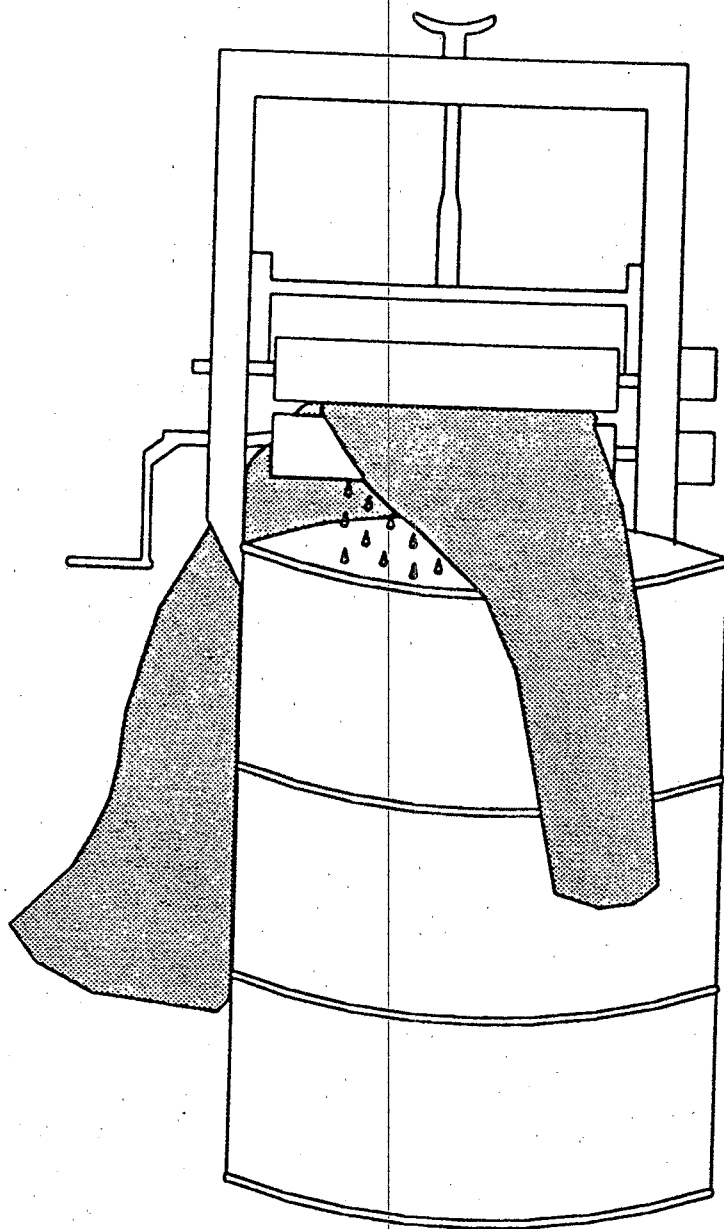


Figure 2. Typical absorbent wringer.

Currently, used vehicle batteries are returned to the manufacturer for new purchases and used tires are sent to the Mecklenburg County, Virginia landfill. To reduce the solid waste generated from tire disposal, the facility should consider repairing damaged tires or explore distributing them to tire recapping manufacturers.

One possible alternative to using ethylene glycol as an antifreeze in toilets and piping systems is propylene glycol. Propylene glycol is a compound which exhibits low toxicity, limited exposure hazards, and is an excellent antifreeze. It has been successfully used as a deicing compound for aircraft for many years. It is also gaining popularity as an environmentally acceptable alternative to ethylene glycol when used as an antifreeze in automobile radiators. There appear to be no recommended occupational breathing limits for propylene glycol as established by the Occupational Safety and Health Administration (OSHA) or the American Conference of Governmental Industrial Hygienists (ACGIH), although acute health effects have been documented. Propylene glycol is not subject to SARA 313 reporting requirements and is not listed as one of the 189 hazardous air pollutants under section 112(b) of the Clean Air Act (CAA). The MSDS for propylene glycol is contained in Appendix A.

3.3.1.3 Petroleum and Paint Storage Building--

3.3.1.3.1 Description--

The petroleum and paint storage building is used to store many flammable and hazardous materials which include bulk 55-gallon drums of paint solvents, motor vehicle oil, hydraulic oil, diesel oil, one-gallon containers of paint and waste motor oil. In addition, three- to five-gallon gasoline containers are also stored in this facility.

A parts washer for cleaning metal surfaces is located in the paint storage area. The parts washer is also used to strip metal surfaces of paint before repainting. Mineral spirits are used to perform parts cleaning. These compounds are significant producers of VOCs. About 25 gallons of waste solvent are disposed of by Safety Kleen Corporation annually. The increased use of latex based paints has reduced the amount of cleaning solvents and thinners required for stripping operations.

3.3.1.3.2 PPOA Issues--

The Dupont Company currently manufactures two solvents used for cleaning metal surfaces. The trade names for these solvents are ARAXEL6000™ AND ARAXEL9000™. Both solvents have no ozone depletion potential, are biodegradable, not toxic to aquatic life, have low vapor pressures and resultant VOC emissions, and are not required to be reported under SARA 313. These products may prove to be effective degreasers for use in USACE operations.

The USACE has experimented with biodegradable hydraulic oils. Unfortunately, they have been unsuccessful in finding effective formulations for use in its operations.

3.3.1.4 Warehouse--

3.3.1.4.1 Description--

The warehouse is used for storing pesticides (3.5 gallon containers of ABATE); sodium hydroxide solution for potable water pH control; and other non-chemical materials. Pesticides (excluding old, out-of-date, pesticides) are not stored in bulk quantities at the maintenance compound and are only stored in sufficient quantities for short term, local applications. Some old paints, paint thinners, and pesticides are stored in the warehouse, but these are likely no longer useable.

3.3.1.4.2 PPOA Issues--

The original inventory system used at the maintenance compound did not always accurately reflect quantities and purchase or expiration dates of hazardous materials (i.e., paints and thinners), in storage. However, the USACE has recently revised their inventory control system in this area. These outdated materials are now accounted for, and are probably scheduled for disposal in the future.

3.3.1.5 Carpentry Shop--

3.3.1.5.1 Description--

The carpentry shop is used for minor fabrication operations, like wood planing and sawing. Scrap wood and sawdust are the majority of waste products on hand. Minor varnishing, paint thinning, and paintbrush cleaning operations also occur in open areas at the shop. Safety Kleen Corporation is contracted to dispose of all used cleaners, varnishes and thinners. All waste is deposited into a single 55-gallon drum.

3.3.1.5.2 PPOA Issues--

Operations in this area appear to be efficient and produce little waste. No improvements in pollution prevention can be suggested for this area.

3.3.1.6 Sign Shop--

3.3.1.6.1 Description--

The sign shop is used to store various paints, including paints used for marking trees and trail signs. The USACE has been using more latex based, water soluble paints. This has reduced the need for additional solvents such as paint thinners and cleaners for painting applications involving oil based paints.

3.3.1.6.2 PPOA Issues--

Operations in this area appear to be efficient and produce little waste. No improvements in pollution prevention can be suggested for this area.

3.3.1.7 Vehicle Wash Area--

3.3.1.7.1 Description--

The vehicle wash area is an open paved area which is slightly sloped and allows runoff to the lake whenever vehicles are washed. Non-phosphate detergents are used for washing vehicles.

3.3.1.7.2 PPOA Issues--

Potential oil and grease discharges to the lake may be reduced by controlling the vehicle wash wastewater. This wastewater should be directed to a sanitary sewer in an approved manner.

3.3.1.8 Yard Storage--

3.3.1.8.1 Description--

The yard storage area is used for storing both surplus and waste lumber campground erosion control equipment, and mechanical equipment. The USACE is currently investigating replacing traditional treated lumber with recycled plastic material for landscape timbers and picnic tables.

3.3.1.8.2 PPOA Issues--

Using recycled plastics in landscape timbers and picnic tables would reduce the use of virgin timber, and would allow for the recycling of post-consumer plastic waste. This would appear to be an excellent pollution prevention option for the USACE to pursue.

3.3.1.9 Marine Maintenance Facility--

3.3.1.9.1 Description--

The marine maintenance facility located at the North Bend maintenance compound is used for repairing small marine engines, swimming equipment, and buoys. In addition, buoys and small motors are stored in this area. The marine maintenance area uses some petroleum based cleaners for cleaning small engine components.

3.3.1.9.2 PPOA Issues--

As discussed in Section 3.2.3.2, the Dupont company currently manufactures two solvents (ARAXEL6000™ and ARAXEL9000™) which appear to be environmentally preferable to traditional solvent use. The use of such chemicals would reduce the amount of VOC emissions generated in parts cleaning.

3.3.2 North Bend Recreation Area Campgrounds

3.3.2.1 Description--

The North Bend recreation area includes both day use and camping facilities. Recycling efforts at the campground area consist of collection bins for aluminum. Glass and plastic materials are not collected at the recreation area due to a lack of market demand for these materials. Refuse from visitors

to the campground and day-use area is collected in individual campsite receptacles. An estimated 675 tons of refuse was collected at the North Bend Park site in the first half of 1994. Much of the waste generated at the campgrounds is deposited on the ground and waste receptacles are frequently inadequate. In addition, recyclable materials in these areas generally are not placed in recycling bins provided.

3.3.2.2 PPOA Issues--

It is possible that civic organizations and/or environmental groups could be approached to sponsor special waste collection days to encourage recycling of cans, glass, and plastic at North Bend and other suitable locations at the project. As an incentive, USACE could provide for adequate collection areas for these materials.

3.3.3 North Bend Wastewater Spray Irrigation Wastewater Treatment Facility

3.3.3.1 Description--

The wastewater spray irrigation system has been in operation since 1976 and processes a maximum flow of 16,000 gallons of wastewater per day from North Bend Park. In the future, the capacity of the system will be modified to treat waste from other areas of the project. The collection system transports wastewater from camping and other public use areas to a treatment plant where aeration and chlorination provide the first stage of treatment. As soil and weather conditions permit, the water is pumped to a five-acre spray irrigation system where it undergoes final treatment.

Approximately 300 pounds per year of chlorine are consumed during the chlorination stage of water treatment. A typical chlorine dose of 2-8 mg/L for effluent from the settler is normally required for adequate treatment and chlorine residual.

3.3.3.2 PPOA Issues--

Other than optimizing chlorine dosage, operations in this area appear to be efficient and produce little waste. No improvements in pollution prevention can be suggested for this area.

3.4 LONGWOOD PARK WASTEWATER TREATMENT FACILITY

3.4.1 Description

The Longwood Park area is located in the southwestern part of the reservoir on the Virginia side. This park operates a wastewater treatment facility that handles wastewater primarily from the campground area. The water is first treated using a sand filtration system. Chlorine tablets are then applied to the water for disinfection using a perforated tube.

3.4.2 PPOA Issues

Other than optimizing chlorine dosage, operations in this area appear to be efficient and produce little waste. No improvements in pollution prevention can be suggested for this area.

3.5 SATTERWHITE POINT STATE PARK

3.5.1 Park Facilities

3.5.1.1 Description--

The Satterwhite Point State Park is operated by the North Carolina Department of Parks and Recreation. The park is located approximately four miles west of Interstate I-85 in Vance County, North Carolina. The facility covers approximately 390 acres and boat mooring and repairs and storage services are made available to the public at the Satterwhite Point marina, which is privately operated through a sublease agreement with the State. The facility also includes about 700 campsites and picnic facilities. The park operates a maintenance facility located nearby. An inventory of materials and chemicals stored at the facility is provided in Table 3.

Solid waste generated at the park is disposed of by a local contractor. Currently, the Jaycees of Henderson, North Carolina provide recycling services for plastics and aluminum. Recycling is voluntary for campers.

The maintenance shop at Satterwhite Point stores used batteries and tires. The used tires are surpluses from the State of North Carolina. Currently, used batteries are recycled by the North State

**TABLE 3. INVENTORY OF MATERIALS/CHEMICALS STORED AT THE SATTERWHITE POINT
MAINTENANCE FACILITY**

Item	Quantity	Disposal Method
petroleum based parts washing solvents	none in storage (used in a mechanic shop cleaning machine for cleaning parts)	contract disposal - Safety Kleen
waste motor vehicle oil	100 gallons (stored in 55 gallon drums)	contract disposal - Safety Kleen
Antifreeze	40 gallons contained in one gallon containers	contract disposal - Safety Kleen
oily rags	30-60 rags/year	dumpsters to local landfill
solid waste/refuse	9,360 yards /year	contract disposal - Waste Industries, Inc.
Vehicle batteries	40	recycled by North State Battery located in Wilson, N.C.
caustic soda (25% sodium hydroxide)	8 x 100 pound drums	used to adjust pH of potable water
chlorine	225 pounds	used in WWT system
latex paints	20 gallons	surplus excess to State
oil based paints	10 gallons	surplus excess to State
epoxy paints	25 gallons	surplus excess to State
aerosol paints	30 conventional size containers	unknown
paint thinners	1 x 55 gallon drum	recycled by Safety Kleen Corporation
gasoline	16,671.2 gallons	motor vehicle fuel
diesel fuel	743 gallons	used in diesel fueled vehicles
kerosene	5 gallons	used for hot water heater for washing park owned motor vehicles
aluminum	320 pounds	Recycled by Henderson, North Carolina Jaycees
glass	exact quantities could not be determined	dumpster - to landfill
plastic	exact quantities could not be determined	dumpster - to landfill
paper	20 pounds	recycled at recycle centers located in Durham and Wake Counties, N.C.

Battery Company located in Wilson, North Carolina. Excess paint in storage is also from the State of North Carolina.

Maintenance activities at the park include painting buildings and structures (e.g., bath house facilities, residence offices, and metal structures such as water tanks). Vehicles are usually painted once a year. The facility is currently expanding its use of latex based paints. A combined inventory of approximately 125 gallons of latex, epoxy and oil based paints is generally kept on hand. Paint thinners used for oil based painting applications are also stored on site.

Parts-washing solvents used in vehicle maintenance activities and waste motor oil are disposed of by Safety Kleen Corporation. At the vehicle service area, waste oil is stored in 55-gallon drums. About 100 gallons are allowed to accumulate before being recycled by the vendor. Vehicle oil changes normally occur at 3,000 mile intervals. However, newer model year vehicles may be allowed 6,000 mile intervals. Oily rags are disposed of in a dumpster for ultimate disposal at the local landfill. It was previously noted that oily rags could be recycled through wringers or via a rag recycling contractor. However, rags are only used at this facility for mechanics to wipe their hands; paper towels are used for cleaning during oil changes. The facility uses 2.5- to 5-gallon safety cans for transporting small quantities of gasoline.

The maintenance facility uses a parts cleaning device called a "mechanic shop" which uses petroleum based solvents. The device holds 10 gallons of cleaning solvent and requires annual cleaning. Spent solvents from the cleaning device are disposed of by Safety Kleen Corporation.

Pesticide is applied frequently around cabins by a local contractor. These applications occur in localized areas only as required. Pesticides are not stored at the facility. Motor vehicles are fueled at the facility which has a UST. The facility will be replacing the UST with an aboveground storage tank (AST) with a secondary containment system in the near future.

Ethylene glycol antifreeze is used in toilet facilities and piping to prevent fixtures and piping from cracking during periods of extremely low temperature. Ethylene glycol is classified as toxic by both OSHA and ACGIH.

Domestic refuse such as glass, plastic materials and paper are generated in significant quantities at the facility. Glass and plastic materials must be deposited in the local landfill. Paper is recycled on a quarterly basis at recycling centers located in Durham and Wake Counties, North Carolina. The park maintains 18 8-cubic yard dumpsters. Much of the waste deposited into these dumpsters is glass and plastic products. Paper recycling efforts have significantly reduced quantities of domestic wastes generated at the State park.

3.5.1.2 PPOA Issues--

Little maintenance is performed at the site, however, the use of reusable rags may reduce solid waste generation. It is possible that synthetic oils could be used in lieu of petroleum based oils during oil changes, and that propylene glycol would be an environmentally preferable alternative to ethylene glycol. This alternative was further discussed in a Section 3.3.1.2.2.

Further recycling of materials could significantly reduce solid waste generation at the facility. This was further discussed in Section 3.3.2.2.

3.5.2 Satterwhite Point State Park Wastewater Treatment Plant

3.5.2.1 Description--

The Satterwhite Point State Park operates a wastewater treatment facility that handles wastewater primarily from the campground area. The water is first treated using a two-sand filtration system. The water is then chlorinated and discharged to surface waters.

3.5.2.2 PPOA Issues--

Operations in this area appear to be efficient and produce little waste. The dosage of chlorine should be controlled to eliminate excess chemical use.

3.5.3 Satterwhite Point State Park Water Treatment

3.5.3.1 Description--

A 25 percent solution of sodium hydroxide (NaOH) is applied to potable well water to adjust pH to meet the current state water quality standards. The NaOH is stored at the Satterwhite Point State Park and is applied at the potable water purification system located at nearby Nutbush Creek State Park. In

general, the NaOH is applied to the potable water by a submersible pump which pumps water into a hypermatic tank. Water from this tank is treated with a 5.25 percent liquid chlorine (bleach) solution from a chemical feed tank system before the water is discharged to the drinking water supply.

3.5.3.2 PPOA Issues--

Operations in this area appear to be efficient and produce little waste. The application rates for the addition of NaOH and chlorine should be controlled to eliminate excess chemical use.

3.6 MARINAS

3.6.1 General

There are three privately operated marinas located at the project: (1) Clarksville Marina located near U.S. Highway 58 in Mecklenburg County, Virginia; (2) Satterwhite Point Marina located at Satterwhite Point State Park; and (3) Steelescreek Marina located in Vance County, North Carolina. These marinas provide mooring slips for private boaters and pump-out facilities for removal of wastes from holding tanks on marine vessels. Due to cost and inconvenient methods of pumping out holding tanks, the USACE believes that most boat operators discharge holding tanks directly into the reservoir. Operations at the Clarksville marina were reviewed during the PPOA visit.

3.6.2 Clarksville Marina

3.6.2.1 Description--

The Clarksville marina occupies approximately six acres of land which is leased to the town of Clarksville, Virginia. The town subleases the marina to a private operator. Activities at the marina include fishing and boat repairs, sales of boating and fishing equipment, and rental of slips.

The marina provides a discharge point to the POTW, which allows boats to empty onboard sewage holding tanks. Currently, boat operators must discharge their holding tanks into a container located at the dock, and then carry the container approximately 100 feet uphill to the discharge point. A fee of \$20 to \$25 is charged by the marina for this service. Due to the cost and inconvenience of this

system, the USACE believes that most boat operators simply discharge their holding tanks directly into the lake.

A recent USACE environmental compliance assessment conducted at the project noted that the marina should establish a formal plan showing recycling, reuse of materials, and substitution of less hazardous materials where possible. Currently, the marina does not store significant quantities of any material considered hazardous and recycles waste marine oil generated at the marine maintenance shop through services provided by the Eastern Oil Company located in Rockville, Virginia. The waste oil is normally emptied into a 500-gallon container and picked up by the oil company every three months. Overall, approximately 100 gallons per year of waste oil are recycled at the marina. Marine vessels are also refueled at marina slips. The USACE has developed a spill prevention, containment, countermeasure and contingency plan in the event of spills involving any hazardous materials.

The marina operates a kerosene parts washer. Spent kerosene from this unit is used as a fuel for a wood stove used at the marina. The actual amount of kerosene used on a yearly basis could not be determined. Kerosene is a light fraction removed from crude oil and may emit significant quantities of regulated air pollutants under various circumstances.

Other than kerosene and waste oil, the only other hazardous material stored onsite is an aluminum boat hull cleaner called ZEP. ZEP is a corrosive. This chemical is also stored at the maintenance shop.

3.6.2.2 PPOA Issues--

Human waste discharged to the reservoir in large volumes raises significant sanitation and health issues, since these waters are used as a domestic water supply. To help persuade boaters to use the sanitary sewer for holding tank disposal, marinas should make discharge points easily accessible by boaters. In addition, the cost structure must be altered to ensure boater cooperation. Perhaps sewer fees could be included in boating licenses, and facilities operating the discharge points could be compensated from these additional fees. Another method of recouping these costs would be to charge boaters a fee each time they disembark from a marina. An alternative to the current fee system must be introduced if sanitary sewer use is to be promoted.

As discussed in Section 3.2.3.2, switching to an alternate, environmentally preferable parts washing chemical would be an acceptable pollution prevention alternative to current practices. The development of a formal plan to track reuse and recycling of materials should be considered, as recommended by the USACE.

SECTION 4

RESULTS OF THE PPOA

There has been substantial cooperation between Federal, state, local and private organizations charged with operating campground and marina facilities throughout the project. Materials used at various maintenance facilities and marinas at the reservoir considered to be hazardous are well inventoried and are stocked in quantities too low to pose any significant health threats to the local environment and communities. However, several specific areas were identified which could benefit from pollution prevention efforts. These areas are summarized in Table 4.

Maintaining adequate collection and disposal of refuse at all campgrounds, day-use areas, and marinas throughout the USACE presents significant logistical difficulties. As discussed in previous sections of the report, Federal, state, local, and private organizations must cooperate to provide adequate waste repositories and maintain a sufficient schedule of waste collection. This waste collection should allow for the recycling of materials wherever possible. Ensuring that adequate recycling facilities exist is becoming increasingly important, as aluminum cans can no longer legally be disposed of in North Carolina landfills. To further recycling efforts, stiffer penalties should be given to those individuals who are found littering in various areas around the reservoir, and improper can disposal should be included among these penalties.

TABLE 4. SUMMARY OF POLLUTION PREVENTION RECOMMENDATIONS

Site for Implementation	Activity Description	Current Practice	Recommended Alternative Practice	Benefits of Alternative
All locations	Railroad tie replacement	Wood, creosote, and recycled plastic tie replacements	Use recycled plastic ties as much as possible	Reduces use of virgin materials
North Bend State Park-Maintenance Facilities	Oily rag generation from car oil changes	Disposal in 55-gallon drums	Wringer system to recover oil and allow reuse of rags	Reduces amount of oil and rags consumed
North Bend State Park-Maintenance Facilities, Satterwhite Point State Park	Antifreeze for toilets and piping	Ethylene glycol used as an antifreeze	Use of propylene glycol instead of ethylene glycol	Much lower toxicity
North Bend State Park-Maintenance Facilities, Clarksville Marina	Parts washing and degreasing	Mineral spirits used in parts washer	Alternative solvent, such as various DuPont® solvents	Reduced VOC emissions
North Bend State Park, Satterwhite Point State Park	Solid waste separation	Many recyclable materials are disposed of as solid waste	Encourage recycling, allow civic groups to collect recyclables, provide bins	Reduced solid waste generation
Island Creek Dam and Pump Station	Inventory control	Materials are not always accounted for and can be allowed to expire	Ensure adequate recordkeeping, allow unneeded chemicals to be distributed	Reduced solid and hazardous waste generation
Clarksville Marina and other marinas	Human waste disposal	Boaters must haul wastes up hill and pay fee	Put sewer hookups near boats, recoup fee in a less direct method	Reduce unsanitary waste disposal

APPENDIX A
MATERIAL SAFETY DATA SHEETS

PRODUCT #: 10246-6 NAME: ETHYLENE GLYCOL, 99+
MATERIAL SAFETY DATA SHEET, Valid 8/94 - 10/94
Printed Monday, August 01, 1994 10:05AM

Sigma Chemical Co.
P.O. Box 14508
St. Louis, MO 63178
Phone: 314-771-5765

Aldrich Chemical Co.
1001 West St. Paul
Milwaukee, WI 53233
Phone: 414-273-3850

Fluka Chemical Corp
980 South Second St
Ronkonkoma, NY 1177
Phone: 516-467-0980
Emergency Phone: 516-467-3535

SECTION 1. - - - - - CHEMICAL IDENTIFICATION - - - - -

PRODUCT #: 10246-6 NAME: ETHYLENE GLYCOL, 99+

SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - -

CAS #: 107-21-1

MF: C2H6O2

SYNONYMS

ATHYLENGLYKOL (GERMAN) * 1,2-DIHYDROXYETHANE * 1,2-ETHANDIOL * 1,2-ETHANEDIOL * ETHANE-1,2-DIOL * ETHYLENE ALCOHOL * ETHYLENE DIHYDRATE * ETHYLENE GLYCOL (ACGIH, OSHA) * GLYCOL * GLYCOL ALCOHOL * LUTROL-9 * MACROGOL 400 BPC * M.E.G. * MONOETHYLENE GLYCOL * NCI-C00920 * NORKOOL * TESCOL * DOWTHERM SR 1 * UCAR 17 *

SECTION 3. - - - - - HAZARDS IDENTIFICATION - - - - -

LABEL PRECAUTIONARY STATEMENTS

TOXIC (USA DEFINITION)

HARMFUL (EUROPEAN DEFINITION)

HARMFUL BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.

IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.

REPRODUCTIVE HAZARD.

TARGET ORGAN(S):

KIDNEYS

LIVER

IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).

IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLenty OF WATER AND SEEK MEDICAL ADVICE.

WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.

SECTION 4. - - - - - FIRST-AID MEASURES - - - - -

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS. CALL A PHYSICIAN.

WASH CONTAMINATED CLOTHING BEFORE REUSE.

PRODUCT #: 10246-6 NAME: ETHYLENE GLYCOL, 99+
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SECTION 5. - - - - - FIRE FIGHTING MEASURES - - - - -

EXTINGUISHING MEDIA

WATER SPRAY.

CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.

SPECIAL FIREFIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO
PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS

EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. - - - - - ACCIDENTAL RELEASE MEASURES - - - - -

WEAR RESPIRATOR, CHEMICAL SAFETY GOGGLES, RUBBER BOOTS AND HEAVY
RUBBER GLOVES.

ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR
DISPOSAL.

VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. - - - - - HANDLING AND STORAGE - - - - -

REFER TO SECTION 8.

SECTION 8. - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION - - - - -

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT
GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.

MECHANICAL EXHAUST REQUIRED.

SAFETY SHOWER AND EYE BATH.

DO NOT BREATHE VAPOR.

AVOID CONTACT WITH EYES, SKIN AND CLOTHING.

WASH THOROUGHLY AFTER HANDLING.

TOXIC.

IRRITANT.

REPRODUCTIVE HAZARD.

KEEP TIGHTLY CLOSED.

HYGROSCOPIC

STORE IN A COOL DRY PLACE.

SECTION 9. - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - -

APPEARANCE AND ODOR

VISCOUS COLORLESS LIQUID

BOILING POINT: 196 C TO 198 C

MELTING POINT: -13 C

FLASHPOINT >230

> 109C

AUTOIGNITION TEMPERATURE: 752 F 399C

UPPER EXPLOSION LEVEL: 15.3%

LOWER EXPLOSION LEVEL: 3.2%

VAPOR PRESSURE: 0.08MM 20 C

VAPOR DENSITY: 2.1

PRODUCT #: 10246-6 NAME: ETHYLENE GLYCOL, 99+
MATERIAL SAFETY DATA SHEET, Valid 8/94 - 10/94
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SPECIFIC GRAVITY: 1.113

SECTION 10. - - - - - STABILITY AND REACTIVITY - - - - -

INCOMPATIBILITIES

STRONG OXIDIZING AGENTS

STRONG BASES

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

CARBON MONOXIDE, CARBON DIOXIDE

SECTION 11. - - - - - TOXICOLOGICAL INFORMATION - - - - -

ACUTE EFFECTS

HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.

VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.

CAUSES SKIN IRRITATION.

MAY CAUSE NERVOUS SYSTEM DISTURBANCES.

PROLONGED EXPOSURE CAN CAUSE:

NAUSEA, HEADACHE AND VOMITING

CHRONIC EFFECTS

MAY CAUSE REPRODUCTIVE DISORDERS.

TARGET ORGAN(S):

LIVER, KIDNEYS

CENTRAL NERVOUS SYSTEM

ADDITIONAL INFORMATION

WHEN INGESTED EARLY SYMPTOMS MIMIC ALCOHOL INEBRIATION AND ARE FOLLOWED BY NAUSEA, VOMITING, ABDOMINAL PAIN, WEAKNESS, MUSCLE TENDERNESS, RESPIRATORY FAILURE, CONVULSIONS, CARDIOVASCULAR COLLAPSE, PULMONARY EDEMA, HYPOCALCEMIC TETANY AND SEVERE METABOLIC ACIDOSIS. WITHOUT TREATMENT, DEATH MAY OCCUR IN 8 TO 24 HOURS. VICTIMS WHO SURVIVE THE INITIAL TOXICITY PERIOD USUALLY DEVELOP RENAL FAILURE ALONG WITH BRAIN AND LIVER DAMAGE.

RTECS NO: KW2975000

ETHYLENE GLYCOL

IRRITATION DATA

EYE-RAT 12 MG/M3/3D	TXAPA9 16,646,70
SKN-RBT 555 MG OPEN MLD	UCDS** 7/21/65
EYE-RBT 500 MG/24H MLD	85JCAE -,205,86
EYE-RBT 100 MG/1H MLD	NTIS** LMF-69
EYE-RBT 12 MG/M3/3D	TXAPA9 16,646,70
EYE-RBT 1440 MG/6H MOD	BUYRAI 31,25,77

TOXICITY DATA

ORL-HMN LDLO:786 MG/KG	BJTKAZ 9,373,76
ORL-HMN LDLO:398 MG/KG	SMEZA5 26(2),48,83
UMB-MAN LDLO:1637 MG/KG	85DCAI 2,73,70
ORL-RAT LD50:4700 MG/KG	GTPZAB 26(6),28,82

PRODUCT #: 10246-6 NAME: ETHYLENE GLYCOL, 99+
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IHL-RAT LC50:10876 MG/KG	GISAAA 39(9),106,74
IPR-RAT LD50:5010 MG/KG	KRRRDT 9,36,81
SCU-RAT LD50:2800 MG/KG	NPIRI* 1,49,74
IVN-RAT LD50:3260 MG/KG	KRRRDT 9,36,81
UNR-RAT LD50:13 GM/KG	GISAAA 33(3),16,68
ORL-MUS LD50:5500 MG/KG	GISAAA 32(3),31,67
IPR-MUS LD50:5614 MG/KG	FEPR7 6,342,47
IVN-MUS LD50:3 GM/KG	JPETAB 65,89,39
UNR-MUS LD50:8050 MG/KG	GISAAA 33(3),16,68
ORL-DOG LD50:5500 MG/KG	RMVEAG 154,137,78
ORL-CAT LD50:1650 MG/KG	RMVEAG 154,137,78
SKN-RBT LD50:9530 MG/KG	34ZIAG -,731,69
UNR-RBT LD50:5017 MG/KG	GISAAA 33(3),16,68
ORL-GPG LD50:6610 MG/KG	JIHTAB 23,259,41
UNR-GPG LD50:11150 MG/KG	GISAAA 33(3),16,68

TARGET ORGAN DATA

PERIPHERAL NERVE AND SENSATION (SENSORY CHANGE INVOLVING PERIPHERAL NERVE
BEHAVIORAL (CONVULSIONS OR EFFECT ON SEIZURE THRESHOLD)
BEHAVIORAL (MUSCLE WEAKNESS)
BEHAVIORAL (COMA)
BEHAVIORAL (HEADACHE)
GASTROINTESTINAL (HYPERMOTILITY, DIARRHEA)
GASTROINTESTINAL (NAUSEA OR VOMITING)
LIVER (OTHER CHANGES)
KIDNEY, URETER, BLADDER (RENAL FUNCTION TESTS DEPRESSIONED)
KIDNEY, URETER, BLADDER (OTHER CHANGES)
ENDOCRINE (HYPOGLYCEMIA)
BLOOD (OTHER CHANGES)
ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES
(RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR
COMPLETE INFORMATION.

SECTION 12. - - - - - ECOLOGICAL INFORMATION - - - - -
DATA NOT YET AVAILABLE.

SECTION 13. - - - - - DISPOSAL CONSIDERATIONS - - - - -
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A
CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - TRANSPORT INFORMATION - - - - -
CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - REGULATORY INFORMATION - - - - -
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-CL 50 PPM, VAPOR
EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION

85INA8 6,612,91

PRODUCT #: 10246-6 NAME: ETHYLENE GLYCOL, 99+
MATERIAL SAFETY DATA SHEET, Valid 8/94 - 10/94
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FERRAC 54,7740,89
MSHA STANDARD-AIR:TWA 10 MG/M3 (PARTICULATE)
DTLWS* 3,19,73
OSHA PEL FINAL:CL 50 PPM (125 MG/M3)
FERRAC 54,2923,89
OEL-AUSTRALIA:TWA 60 MG/M3;STEL 120 MG/M3 JAN93
OEL-BELGIUM:STEL 50 PPM (127 MG/M3) JAN93
OEL-DENMARK:STEL 50 PPM (130 MG/M3) JAN93
OEL-DENMARK:TWA 10 MG/M3 JAN93
OEL-FINLAND:TWA 10 MG/M3;STEL 20 MG/M3 JAN93
OEL-FINLAND:TWA 50 PPM (125 MG/M3);STEL 75 PPM (190 MG/M3) JAN93
OEL-FRANCE:STEL 50 PPM (125 MG/M3) JAN93
OEL-HUNGARY:STEL 50 MG/M3;SKIN JAN93
OEL-THE NETHERLANDS:TWA 10 MG/M3 JAN93
OEL-THE NETHERLANDS:TWA 50 PPM (125 MG/M3) JAN93
OEL-RUSSIA:STEL 5 MG/M3 JAN93
OEL-SWEDEN:TWA 50 PPM (130 MG/M3);STEL 75 PPM (190 MG/M3) JAN93
OEL-SWITZERLAND:TWA 1 MG/M3 JAN93
OEL-SWITZERLAND:TWA 50 PPM (125 MG/M3) JAN93
OEL-UNITED KINGDOM:TWA 10 MG/M3 JAN93
OEL-UNITED KINGDOM:TWA 60 MG/M3;STEL 125 MG/M3 JAN93
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV
NOHS 1974: HZD 32385; NIS 308; TNF 69314; NOS 174; TNE 743782
NOES 1983: HZD 32385; NIS 306; TNF 82823; NOS 204; TNE 1207956; TPE
365158
EPA GENETOX PROGRAM 1988, NEGATIVE: CELL TRANSFORM.-SA7/SHE; N
CRASSA-ANEUPLOIDY
EPA GENETOX PROGRAM 1988, NEGATIVE: HISTIDINE REVERSION-AMBS TEST
EPA GENETOX PROGRAM 1988, INCONCLUSIVE: D MELANOGASTER-WHOLE SEX CHROM.
LOSS
EPA GENETOX PROGRAM 1988, INCONCLUSIVE: D MELANOGASTER-NONDISJUNCTION
EPA TSCA CHEMICAL INVENTORY, JUNE 1993
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0485-0552
ON EPA IRIS DATABASE
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 1994
NIOSH ANALYTICAL METHODS: SEE ETHYLENE GLYCOL, 5500
NTP CARCINOGENESIS STUDY (FRED);NO EVIDENCE:MOUSE
NTPTR* NTP-TR-413,93

THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.
SECTION 16. - - - - - OTHER INFORMATION - - - - -
THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO
BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA, ALDRICH,

FROM:ALDRICH CHEM-MILW WI

TO:9P19199687557

AUG 1, 1994 4:36PM F581 P.28

PRODUCT #: 10246-6 NAME: ETHYLENE GLYCOL, 99+
MATERIAL SAFETY DATA SHEET, Valid 8/94 - 10/94
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FLUKA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING
OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR
PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.
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FLUKA CHEMIE AG
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PRODUCT #: 13436-8 NAME: 1,2-PROPANEDIOL, 99%

MATERIAL SAFETY DATA SHEET, Valid 8/94 - 10/94

Printed Monday, August 01, 1994 10:04AM

Sigma Chemical Co.
P.O. Box 14508
St. Louis, MO 63178
Phone: 314-771-5765

Aldrich Chemical Co.
1001 West St. Paul
Milwaukee, WI 53233
Phone: 414-273-3850

Fluka Chemical Corp
980 South Second St
Ronkonkoma, NY 1177
Phone: 516-467-0980
Emergency Phone: 516-467-3535

SECTION 1. - - - - - CHEMICAL IDENTIFICATION - - - - -

PRODUCT #: 13436-8 NAME: 1,2-PROPANEDIOL, 99%

SECTION 2. - - - - - COMPOSITION/INFORMATION ON INGREDIENTS - - - - -

CAS #:57-55-6

MF: C3H8O2

SYNONYMS

1,2-DIHYDROXYPROPANE * DOWFROST * METHYLETHYLENE GLYCOL * METHYL
GLYCOL * MONOPROPYLENE GLYCOL * PG 12 * PROPANE-1,2-DIOL * PROPYLENE
GLYCOL * PROPYLENE GLYCOL USP * ALPHA-PROPYLENEGLYCOL * 1,2-PROPYLENE
GLYCOL * 1,2-PROPYLENGLYKOL (GERMAN) * SIRLENE * SOLAR WINTER BAN *
TRIMETHYL GLYCOL *

SECTION 3. - - - - - HAZARDS IDENTIFICATION - - - - -

LABEL PRECAUTIONARY STATEMENTS

HARMFUL

HARMFUL BY INHALATION AND IF SWALLOWED.

WEAR SUITABLE PROTECTIVE CLOTHING.

HYGROSCOPIC

SECTION 4. - - - - - FIRST-AID MEASURES - - - - -

FLUSH SKIN WITH WATER.

CONTAMINATION OF THE EYES SHOULD BE TREATED BY IMMEDIATE AND PROLONGED
IRRIGATION WITH COPIOUS AMOUNTS OF WATER.

IF INHALED, REMOVE TO FRESH AIR.

IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.

CALL A PHYSICIAN.

SECTION 5. - - - - - FIRE FIGHTING MEASURES - - - - -

EXTINGUISHING MEDIA

WATER SPRAY.

CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.

SPECIAL FIREFIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO
PREVENT CONTACT WITH SKIN AND EYES.

SECTION 6. - - - - - ACCIDENTAL RELEASE MEASURES - - - - -

WEAR RESPIRATOR, CHEMICAL SAFETY GOGGLES, RUBBER BOOTS AND HEAVY
RUBBER GLOVES.ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR
DISPOSAL.

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MATERIAL SAFETY DATA SHEET, Valid 8/94 - 10/94
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VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
SECTION 7. - - - - - HANDLING AND STORAGE - - - - -
REFER TO SECTION 8.
SECTION 8. - - - - - EXPOSURE CONTROLS/PERSONAL PROTECTION - - - - -
CHEMICAL SAFETY GOGGLES.
USE PROTECTIVE CLOTHING, GLOVES AND MASK.
SAFETY SHOWER AND EYE BATH.
MECHANICAL EXHAUST REQUIRED.
DO NOT BREATHE VAPOR.
AVOID CONTACT WITH EYES, SKIN AND CLOTHING.
WASH THOROUGHLY AFTER HANDLING.
HARMFUL LIQUID.
KEEP TIGHTLY CLOSED.
HYGROSCOPIC
STORE IN A COOL DRY PLACE.
SECTION 9. - - - - - PHYSICAL AND CHEMICAL PROPERTIES - - - - -
APPEARANCE AND ODOR
VISCIOUS COLORLESS LIQUID
BOILING POINT: 187 C
MELTING POINT: -60 C
FLASHPOINT 225 F
107C
AUTOIGNITION TEMPERATURE: 779 F 414C
UPPER EXPLOSION LEVEL: 12.5%
LOWER EXPLOSION LEVEL: 2.6%
VAPOR PRESSURE: 0.08MM 20 C
VAPOR DENSITY: 2.62
SPECIFIC GRAVITY: 1.036
SECTION 10. - - - - - STABILITY AND REACTIVITY - - - - -
INCOMPATIBILITIES
ACID CHLORIDES
ACID ANHYDRIDES
OXIDIZING AGENTS
CHLOROFORMATES
REDUCING AGENTS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE
SECTION 11. - - - - - TOXICOLOGICAL INFORMATION - - - - -
ACUTE EFFECTS
HARMFUL IF INHALED OR SWALLOWED.
MAY CAUSE EYE IRRITATION.
MAY CAUSE SKIN IRRITATION.

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EXPOSURE CAN CAUSE:
GASTROINTESTINAL DISTURBANCES
NAUSEA, HEADACHE AND VOMITING
CNS DEPRESSION

RTECS NO: TY2000000

1,2-PROPANEDIOL

IRRITATION DATA

SKN-HMN 500 MG/7D MLD

JIDEAB 55,190,70

SKN-HMN 104 MG/3D-I MOD

85DKA8 -,127,77

SKN-MAN 104/2D

JIDEAB 19,423,52

EYE-RBT 100 MG MLD

PCTOD7 20,573,82

EYE-RBT 500 MG/24H MLD

85JCAE -,206,86

TOXICITY DATA

ORL-RAT LD50:20 GM/KG

TXAPA9 45,362,78

IPR-RAT LD50:6660 MG/KG

KRKRDT 9,36,81

SCU-RAT LD50:22500 MG/KG

IAEC** 17JUN74

IVN-RAT LD50:6423 MG/KG

ARZNAD 26,1581,76

IMS-RAT LD50:14 GM/KG

IAEC** 17JUN74

ORL-MUS LD50:22 GM/KG

JPETAB 65,89,39

IPR-MUS LD50:9718 MG/KG

PEPRA7 6,342,47

SCU-MUS LD50:17370 MG/KG

KRKRDT 8,46,81

IVN-MUS LD50:6630 MG/KG

ARZNAD 26,1581,76

ORL-DOG LD50:22 GM/KG

JHNTAB 21,173,39

IVN-DOG LD50:26 GM/KG

NTIS** PB280-477

ORL-RBT LD50:18500 MG/KG

FAONAU 53A,491,74

SKN-RBT LD50:20800 MG/KG

NPIRI* 1,101,74

ORL-GPG LD50:18350 MG/KG

JHNTAB 23,259,41

ORL-QAL LD50:>2080 MG/KG

BESADV 6,149,82

TARGET ORGAN DATA

EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)

EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES
(RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR
COMPLETE INFORMATION.

SECTION 12. - - - - - ECOLOGICAL INFORMATION - - - - -
DATA NOT YET AVAILABLE.

SECTION 13. - - - - - DISPOSAL CONSIDERATIONS - - - - -
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A
CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. - - - - - TRANSPORT INFORMATION - - - - -
CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. - - - - - REGULATORY INFORMATION - - - - -

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REVIEWS, STANDARDS, AND REGULATIONS

EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION
FEREAC 54,7740,89

NOHS 1974: HZD 63525; NIS 323; TNF 83144; NOS 224; TNE 1494455

NOES 1983: HZD 63525; NIS 320; TNF 79614; NOS 233; TNE 1840941; TFE
837782

EPA GENETOX PROGRAM 1988, NEGATIVE: SHE-CLONAL ASSAY

EPA TSCA CHEMICAL INVENTORY, JUNE 1993

EPA TSCA SECTION 8(B) STATUS REPORT 8EEQ-0178-0041

ON EPA IRIS DATABASE

EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 1994

SECTION 16. - - - - - OTHER INFORMATION - - - - -

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