GREENING YOUR GOLF COURSE: A POLLUTION PREVENTION GUIDE FOR COLORADO GOLF COURSES

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COLORADO Pollution Prevention PROGRAM

Colorado Department of Public Health & Environment

Tetra Tech EM Inc.

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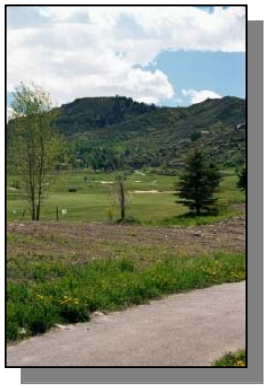
- Audubon International
- CDPHE, Hazardous Materials and Waste Management Division
- Cordillera Valley Course
- Golf Course Superintendents Association of America
- Lakewood Country Club
- National Turfgrass Evaluation Program
- Rain Bird
- Saddle Rock Golf Course
- Snowmass Lodge and Club
- United States Golf Association

SECTION 1 INTRODUCTION

Golf is one of the fastest-growing industries in the U.S. On average, more than one new golf course opens every day in the U.S. (509 courses opened in 1999 and 524 opened in 2000 according to the National Golf Foundation). In 2000, 26.7 million U.S. golfers played on 17,108 courses that occupy at least 1.8 million acres.[1] International golfing is adding to these numbers; therefore, the golf industry, government agencies, and the public are interested in understanding and reducing the impact of golf courses on the environment. In 2000, 243 golf courses operated on about 27,300 acres of land in Colorado.[2] Golf course environmental aspects are, primarily associated with maintenance of grounds, facilities, vehicles, and equipment. For example:



- Nationally, 18-hole golf courses apply about 780 pounds of pesticides (active ingredients) to the course per year.[3]
- In an average year, a Colorado golf course can use about 30 to 65 million gallons of water to maintain all turf areas (greens, tees, fairway, rough, and adjacent areas).[4]
- Use and maintenance of vehicle fleets (for example trucks and carts,) and equipment (for example lawn mowers and weed whips,) generate a variety of hazardous and solid wastes and air emissions.
- Facility operation and maintenance involves water, energy, and janitorial chemicals and generates a variety of solid wastes.

Many golf courses are taking action to reduce their environmental impacts. For example, nationally about 45 percent of golf courses have adopted written integrated pest management plans and have set aside an average of 100 acres of wildlife habitat per golf course.[5] However, a number of strategies can help golf courses reduce their impact on the environment, and even the most proactive can improve; for example, only 5 percent of the golf courses in Colorado, and 1.5 percent nationally[6], have achieved Audubon Cooperative Sanctuary Program certification. Audubon International created this certification to promote environmentally sound management and conservation of natural resources at golf courses.

Audubon International's certification program focuses on natural resource management; it does not specifically address all environmental aspects of golf course operations. Likewise, other program and environmental reference documents are not comprehensive and do not address state-specific compliance issues. This

INFORMATION IN THIS GUIDE

[1] According to a media spokesperson for the National Golf Association.
[2] According to a media spokesperson for the National Golf Association.
[3] Preliminary results of an October 2000 Golf Course Superintendents Association of America (GCSAA) survey of 8,500 golf courses in the U.S.
[4] According to four Colorado golf courses surveyed during the creation of this guide.
[5] Preliminary results of an October 2000 GCSAA survey of 8,500 golf courses in the U.S.
[6] According to the Audubon Cooperative Sanctuary Program

guide will assist Colorado golf courses to better manage their of the environmental “footprint” through prevention and regulatory compliance in areas such as hazardous and solid waste, energy use, and water use. This guide does not cover topics such as wildlife and habitat management, water quality, general resource management, or outreach and education.

SECTION 2 REGULATIONS

Regulations governing golf courses in Colorado fall into four major categories: solid and hazardous waste (including universal waste and used oil), pesticides, water bodies, and endangered species. The U.S. Environmental Protection Agency (EPA), the Colorado Department of Public Health and Environment (CDPHE) Hazardous Materials and Waste Management Division (HMWMD), and the Colorado Department of Agriculture (CDA) promulgate the majority of environmental laws and regulations affecting Colorado golf courses. This section describes some of the primary regulations applicable to golf courses.

Solid And Hazardous Waste Management

Under the state authorization program EPA delegated the primary responsibility of implementing the Resource Conservation and Recovery Act (RCRA) hazardous waste program to Colorado. Colorado's hazardous waste program is equivalent to the federal requirements, but in some cases has adopted more stringent requirements. The following section provides information pertaining to solid waste, hazardous waste, universal waste, and used oil regulations that may be applicable to Colorado golf courses. For additional assistance on any of the following wastes consult CDPHE's *Guide to Generator Requirements of the Colorado Hazardous Waste Regulations* at **www.cdphe.state.co.us/hm//handbk01.pdf** or call the CDPHE Technical Assistance Center at (303) 692-3320 or the RCRA, Superfund, and Emergency Planning and Community Right-to-Know Act (EPCRA) Call Center at (800) 424-9346.

Solid Waste

In Colorado, solid waste is defined by two regulatory agencies, EPA (RCRA) and CDPHE (Colorado Hazardous Waste Regulations [CHWR]). The regulatory definition describes solid waste as any discarded material such as abandoned, recycled, and inherently waste-like material. In practical terms, solid waste generated by golf courses includes grass clipping and leaves, used aerosol cans, used oil, pesticide packaging, spent, or unused pesticides and other chemicals, spent batteries, and trash.

Hazardous Waste

> For more information on solid and hazardous waste regulations or recycling solid and hazardous waste call the CDPHE Technical Assistance Line at (303) 692-3320.

According to CHWR, a waste must be classified as a solid waste before it can be considered a hazardous waste. Any business that generates a solid waste is legally obligated to determine whether that waste is hazardous. Hazardous wastes are identified as a listed or characteristic hazardous waste. Listed hazardous wastes are specific wastes that fall under F-list (process oriented), K-list (industry specific), P-list (acutely toxic), and U-list (toxic). Characteristic hazardous wastes are those that are ignitable, corrosive, reactive, and/or toxic. For more information on listed and characteristic hazardous waste consult CDPHE's *Guide to Generator Requirements of the Colorado Hazardous Waste Regulations* and other documents at **www.cdphe.state.co.us/hm/hmhom.asp**.

EPA and CDPHE, generally classify golf courses as conditionally exempt small quantity generators (CESQG). CESQGs are those that produce less than 220 pounds of hazardous waste or 2.2 pounds of acutely hazardous waste per month and never store more than 2,200 pounds of hazardous waste on their property. CESQGs are still required to determine if they have hazardous waste and properly dispose of it. CESQGs are exempt from administrative requirements such as filing for an EPA identification number, developing contingency plans, and using hazardous waste manifests; although all of these are recommended. For a summary of generator requirements go to the CDPHE HMWMD web page at **www.cdphe.state.co.us/hm/GeneratorTable.PDF**.

Universal Wastes

According to CDPHE's Universal Waste Rule, universal wastes include spent batteries, stocks of certain pesticides, discarded mercury-containing devices, discarded aerosol cans containing hazardous waste, discarded fluorescent lamps, and discarded electronic devices and components. For more information, see CDPHE's Universal Waste Rule Compliance Bulletin at **www.cdphe.state.co.us/hm//UWRgeneral.pdf**.

The Rocky Mountain Chapter of GCSAA is a good resource for local environmental and regulatory information to Colorado golf courses. For more information go to www.rmgcsa.org.

Many universal wastes can be recycled for a fee by private companies. The Colorado Chemsweep Program, implemented by MSE Environmental, Inc. (MSE), was designed to recycle unwanted, unused or banned/outdated waste pesticides. The Chemsweep Program is conducted under the CDPHE universal waste rule, which allows MSE to properly package waste agricultural pesticides from businesses such as golf courses and transport it to a permitted hazardous waste incineration facility. For more information on this program visit the Chemsweep website at **www.larimer.org/publicworks/weeds/chemsweep.htm** or call (888) 242-4362.

For more information about companies that recycle universal wastes call the CDPHE Technical Assistance Line at (303) 692-3320.

Used Oil

Colorado golf courses commonly generate used oil in conjunction with vehicle and grounds keeping equipment maintenance operations. Used oil should be recycled. If it is not recycled, it must be disposed of properly according to state and federal regulations. CDPHE regulations also state that used oil generators are responsible for (1) maintaining the condition and integrity, proper labeling, and storage of all used oil containers, and (2) responding to used oil spills.

Table 1.0 lists the solid and hazardous waste management regulations that may be applicable to Colorado golf courses. For more information visit the CDPHE solid waste and hazardous waste regulations website at **www.cdphe.state.co.us/op/solidwastehazmatregs.asp**.

Table 1.0 CDPHE Solid and Hazardous Waste Regulations

Regulation	Description
6 CCR 1007-3 Sec. 262.2	Defines Solid Waste
6 CCR 1007-3 Sec. 262.4	Solid Waste Exclusions
6 CCR 1007-3 Sec. 262.11	Requires Waste Generators to Determine if Waste is Hazardous
6 CCR 1007-3 Sec. 261	Characteristic and Listed Hazardous Waste
6 CCR 1007-3 Sec. 273	Universal Wastes
6 CCR 1007-3 Sec. 279	Used Oil Management and Storage

Pesticides

The EPA Office of Pesticide Programs (OPP) (**www.epa.gov/pesticides**) and the CDA Division of Plant Industry (DPI) (**www.ag.state.co.us/dpi**) regulate the following:

- Fertilizer storage
- Pesticide use, storage, mixing, loading areas and application
- General and restricted-use pesticides
- Worker protection

Individuals applying restricted use pesticides an a golf course must possess a qualified supervisor's license in the appropriate category and a limited commercial applicators registration with the CDA. Restricted-use pesticides may only be applied by or under the direct supervision of trained and certified qualified supervisors or certified operators.

Restricted-use pesticides are controlled because of their harmful effects on human health and the environment. Although many golf courses do not use restricted-use pesticides, according to the Golf Course Superintendents Association of America (GCSAA) and EPA OPP, the following state and federal restricted use pesticides have been used by golf courses:

State Restricted*	**Federal Restricted***	
Bromacil	Atrazine	Lindane
Diuron	Chlorpyrifos	Pronamide
	Chlorothalonil	Simazine
	Diazinon	

***Note:** Visit **www.ag.state.co.us/dpi/rules/pestact.html** for a complete list of state restricted use pesticides or **www.epa.gov/RestProd** for a complete list of federal restricted use pesticides.

Table 2.0 lists particular federal and state regulations associated with pesticide and fertilizer application, storage, and management in Colorado. For technical assistance call Tom Kosinski, Section Chief of Pesticides, CDA Division of Plant Industry at (303) 239-4145. For more information visit the EPA OPP at **www.epa.gov/pesticides** or the CDA DPI at **www.ag.state.co.us/dpi**.

Table 2.0 Pesticide and Fertilizer Regulations

Regulatory Agency	Regulation	Description
EPA	FIFRA Title 7 Unite States Code (USC) Section 136	Regulates pesticide registration
	FIFRA Title 7 USC Section 136i	Regulates restricted use pesticides
	FIFRA Title 7 USC Section 136j	Regulates unlawful acts
	FIFRA Title 7 USC Section 136q	Storage, Disposal, Transportation, and Recall
CDA	Pesticide Act - Title 35, Article 9, Part 13	Regulates restricted pesticides in Colorado
	Pesticide Act - Title 35, Article 9, Part 13	Regulates pesticide registration in Colorado
	Pesticide Applicator's Act - Title 35, Article 10, Part 2, Subpart B	Regulates limited commercial applicators in Colorado
	Agricultural Chemicals and Groundwater Protection Act- Title 25, Article 8	Regulates commercial fertilizers and pesticides at storage facilities and mixing/loading areas in Colorado

Water Bodies and Wetlands

If a golf course has a wetland, pond, lake, river, or stream on or near its grounds, an EPA Section 404 permit may be required by the golf course. The U.S. Army Corps of Engineers (COE) and the Section 404 of the Clean Water Act (CWA) (**www.wetlands.com/regs/sec404fc.htm**) regulate discharges of dredged and fill material into "waters of the United States", which includes ponds, lakes, streams, rivers, and wetlands. Regulated activities affecting "waters of the U.S." that may be applicable to golf courses include discharging dredged or fill material into a water body for golf course development or the construction of dams, levees or other support structures for golf course enhancement. All permit applications are reviewed on a case-by-case basis. For additional information contact the EPA Wetlands Hotline at 1-800-832-7828 or send e-mail to wetlands.helpline@epa.gov.

Endangered Species Act

It is easy to mistake non-damaging plants and animals for pests, especially if the plant or animal is not one that is encountered often in the wild. The U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service share the responsibility and implementation of the Endangered Species Act (ESA). The ESA set forth guidelines to protect the existence of certain plant and animal species that have been listed by the federal government as threatened, or endangered. The Colorado Division of Wildlife lists threatened or endangered wildlife species in Colorado and the U.S. Geological Survey lists endangered plant species in Colorado. Some species may not be a concern to golf courses based on habitat. For more information on ESA go to **www.epa.gov/region5/defs/html/esa.htm**. For a complete list of the known threatened

and endangered animal species in Colorado go to **http://wildlife.state.co.us/T&E/list.asp** For a complete list of the known threatened and endangered plant species in Colorado go to **www.cpluhna.nau.edu/Biota/endspecieslist.htm**. For additional information e-mail the Colorado Division of Wildlife at AskDOW@state.co.us.

SECTION 3 ENVIRONMENTAL PROGRAMS

Involvement in environmental programs is a good way for a golf course to learn more about proactive environmental management strategies. One program, Audubon Cooperative Sanctuary Program (ACSP), certifies golf courses based on environmental performance. In addition, GCSAA and *Golf Digest* formed the Environmental Leaders in Golf Awards to recognize the stewardship of golf course superintendents and their golf facilities. The importance of interacting with these programs cannot be overstated for golf courses that seek to improve environmental performance and demonstrate environmental leadership. This section discusses the following:

- ACSP for golf
- GCSAA
- U.S. Golf Association (USGA)
- National Turfgrass Evaluation Program (NTEP)
- Colbert-Thein Environmental and Evaluation Management System
- Colorado Environmental Leadership Program (CELP)
- CDPHE Pollution Prevention (P2) Program
- Colorado Materials Exchange (COMEX)
- Water Alliances for Voluntary Efficiency (WAVE)
- WasteWise
- Colorado State University National Integrated Pest Management Network
- Database of IPM Resources
- Radcliffe's IPM World Textbook
- IPM Almanac
- IPM Practitioners Association

Audubon Cooperative Sanctuary Program

Audubon International created education and certification initiatives for different habitats (golf courses, businesses, schools, and backyards) collectively referred to as the Audubon Cooperative Sanctuary Program. The ACSP addresses environmental concerns at golf courses while maximizing opportunities to provide open space benefits. ACSP provides education and certification in six environmental areas:

- Environmental Planning
- Wildlife and Habitat Management
- Water Conservation
- Water Quality Management
- Outreach and Education
- Chemical Use Reduction and Safety

ACSP and its participants are widely regarded as "benchmark" golf courses in terms of environmental stewardship and conservation. As of December 2001, Colorado ACSP-certified golf courses included:

- Applewood Golf Course
- Aspen Glen Club
- Aspen Golf Course
- Breckenridge Golf Club
- Broadmoor East & West Courses
- Castle Pines Golf Club
- Colorado Springs Country Club
- Cordillera Mountain Course
- Cordillera Short Course
- Cordillera Valley Club
- Fox Hollow at Lakewood Golf Course
- Lakewood Country Club
- Roaring Fork Club
- Roselawn Cemetery
- Saddle Rock Golf Course
- Tiara Rado Golf Course
- Vail Golf Club

ACSP provides interested golf courses with a handbook that focuses on (1) assessing property resources, (2) developing a unique environmental plan, and (3) becoming a certified member of the Audubon Cooperative Sanctuary Program. ACSP is available for technical assistance in completing the documentation to achieve certification. The average golf course takes about 6 months to 2 years to complete ACSP documentation. When the documentation is complete, ACSP reviews it and awards or denies certification, usually within 6 weeks of receipt. If ASCP awards certification to a golf course, it also provides individual certificates of recognition to the staff who were primarily responsible for project implementation.

Audubon International also offers the Audubon Signature Cooperative Sanctuary Program (Audubon Signature Program). The Signature Program offers planning and educational services to help new golf courses protect natural resources on and off site during development. Colorado has one Signature golf course, The Haymaker, in Steamboat Springs.

For more information about the ACSP for golf, call Joellen Zeh at (518) 767-9051 extension14, or visit **www.audubonintl.org/programs/acss/golf.htm**.

Golf Course Superintendents Association of America

GCSAA is dedicated to serving its members, advancing their profession, and enhancing the enjoyment and growth of golf. Its 21,000 members are organized by classifications such as superintendent, assistant superintendent, student, educator, affiliate and retired. The association has 102 affiliated chapters, with members from 65 countries. GCSAA's mission includes is educational programming that provides its members the opportunity to stay abreast of practices for golf course maintenance and upkeep. One of its education initiatives is an Environmental Management Program that focuses on six specific study areas (employee safety and right-to-know, golf course development, integrated pest management, storage disposal and recycling, water quality and application, and habitat development and management) and technician training to upgrade field skills.

GCSAA also provides many communication tools and programs, including:

- *Golf Course Management* magazine
- GCSAA Online (**www.gcsaa.org**)
- Annual International Golf Course Conference and Show
- GCSAA NewsWeekly (weekly electronic newsletter)
- Leader Board (quarterly newsletter)
- Greens & Grassroots (publication that provides regular updates of federal and state legislative and regulatory actions that affect golf course management)

In May 2001, GCSAA and *Golf Digest* announced the Environmental Leaders in Golf Awards (ELGA) to recognize the environmental achievements of golf course superintendents and the facilities, in addition to significant work to promote environmental initiatives by communities and individuals. The awards program blends GCSAA's Environmental Steward Awards and Golf Digest's Environmental Leaders in Golf Awards. An independent panel of judges from national environmental groups and the golf industry evaluate applications in six categories:

- Resource Conservation
- Water Quality Management
- Integrated Pest Management
- Wildlife and Habitat Management
- Habitat Development and Management
- Education and Outreach

Criteria for each category include sustainability, criticality (improving the surrounding environment in a fundamental way that another land use would not), originality, and technology

use and implementation. The first winners of ELGA were announced in February 2002. In Colorado, The Raven Golf Club in Silverthorne, Colorado won the Rocky Mountain Chapter ELGA for resort golf courses.

GCSAA also has information regarding Integrated Pest Management (IPM) on its web site. For more information about environmental programs at GCSAA or IPM, call (800) 472-7878 or visit **www.gcsaa.org**.

U.S. Golf Association

In 1995, the USGA Green Section began its Environmental Education Program dedicated to environmental outreach to golf courses. The Green Section works in cooperation with ACSP for golf courses to:

- Fund research, management, and education for the Wildlife Link Program, which focuses on projects related to wildlife management issues for golf courses
- Support the Turfgrass Environmental Research Program
- Maintain a list of environmental publications for the golf industry

For more information about environmental programs at USGA, call (908) 234-2300 or visit **www.usga.org/green/index.html**.

National Turfgrass Evaluation Program

NTEP is a cooperative program between the U.S. Department of Agriculture (USDA), Beltsville Agricultural Research Center, and the National Turfgrass Federation, Inc. NTEP identifies and evaluates grasses for various needs, including reduced inputs (application of pesticides and water) for golf courses. Currently, more than 600 grasses and 17 species are being tested at about 75 sites across the U.S. and Canada. NTEP researches turfgrass and turfgrass systems that will better survive diseases, insects, drought, and traffic, and produces annual progress reports for each of the species tested.

For more information about at NTEP, call (301) 504-5125 or visit **www.ntep.org**.

Colbert-Thien Environmental and Evaluation Management System

The construction of Colbert Hills Golf Course near Manhattan, Kansas.

Beginning in 1999, the Colbert Hills Golf Course was constructed on a 312-acre area of native grassland near Manhattan, Kansas and is perhaps the most extensive environmental research evaluation ever conducted of a golf course. The purpose of the project was to determine the impact of converting native grassland into a golf course and to develop guidelines for the golf industry to minimize negative impacts of golf course construction, operation, and use. The Colbert Hills project was used to develop a system called Colbert-Thien Environmental and Evaluation Management (CTEEM). CTEEM is (1) a system for identifying areas that need remediation, and (2) a source of management strategies to apply toward improving environmental conditions. The CTEEM system involves five steps for implementation, briefly described below.

- Identify natural functions (reactions, processes, and cycles) critical to sustaining ecosystem functions. For example carbon sequestration of soil because it affects many soil properties.
- Select informative, measurable, and economically feasible indicators to evaluate the critical functions. For example, soil organic matter content to measure carbon sequestration.
- Measure indicator status. Measurement may include use of historical data, weather station data, laboratory analysis.
- Establish control chart indices, or acceptable limits of the critical functions. For example, a minimum soil organic matter content of 1% could be selected.
- Transform multiple indices into an environmental quality evaluation graphs, which became a visual representation of environmental quality.

The system is easily customized to individual golf courses. By adopting an environmental evaluation program, superintendents can identify problem areas, be guided toward remediation, and demonstrate progress toward sustainability.

For more information about CTEEM, visit **www.usga.org/green/archive/record/01/mar_apr/multiple.html**.

Colorado Environmental Leadership Program

The CDPHE Executive Directors Office administers CELP, which “raises the bar” for environmental performance by recognizing businesses with environmental management systems and innovative source reduction projects that provide mentoring and leadership in the businesses community and to the general public. To qualify, the compliance record for a golf course must be free of any serious violations for at least 3 years before the golf course can apply. Applicants should also have an established environmental management system, pollution prevention plan, policies and procedures for staying in compliance with environmental laws and regulations, and a set of performance measures and environmental indicators. Once accepted into the program, leaders are asked to implement a number of projects that lead to improvement and enhancement of environmental

quality. Commitments can either be to new projects or programs, or to the enhancement of efforts that are currently underway. Benefits of enrollment include public recognition, financial reward, and regulatory relief. For more information about CELP, call (303) 692-3477 or visit **www.cdphe.state.co.us/el/elphom.asp**.

CDPHE P2 Program P2 Assessments

The CDPHE P2 Program will complete free, on-site P2 assessments. The assessments are confidential, non-enforcement, and result in a report that summarizes P2 opportunities. For more information about CDPHE's P2 Program, call Kirk Mills, at (303) 692-2977, or visit **www.coloradop2.org**.

Colorado Materials Exchange

COMEX is sponsored by the University of Colorado Recycling Services as a statewide clearinghouse of nonhazardous surplus and durable goods. Groups in the private and public sectors as well as citizen and nonprofit organizations can take advantage of COMEX as a means of finding low- or no-cost materials and minimizing waste. For more information about COMEX, call (303) 492-4330 or visit **www.colorado.edu/cure/COMEX/splash.html**.

Water Alliances for Voluntary Efficiency

WAVE is a non-regulatory water-efficiency partnership created and supported by EPA. WAVE's mission is to encourage commercial businesses and institutions to reduce water consumption while increasing efficiency, profitability, and competitiveness. Initiated in 1992, over 115 WAVE participants have reduced water and sewer costs by up to 30 percent. Significant savings in energy, chemical, and maintenance expenses are also possible. The typical payback period is less than 3 years. Benefits include nationwide public service advertising, promotional materials, and press releases. Members also receive free software to analyze water use, technical support, and access to a nationwide help line. For more information about WAVE, call (202) 564-0623 or (202) 564-0624 or visit **www.epa.gov/owm/genwave.htm**.

WasteWise

WasteWise is a free, voluntary, EPA program that helps organizations eliminate municipal solid waste. WasteWise is a flexible program that allows partners to design a solid waste reduction plan tailored to the individual business. WasteWise partners can save thousands of dollars by reducing, reusing, and recycling solid waste. For more information about WasteWise, call 800-EPA-WISE or visit **www.epa.gov/wastewise**.

Colorado State University National Integrated Pest Management Network

Colorado State University maintains the national IPM network at **www.colostate.edu/Depts/IPM/csuipm.html**. The web site contains up-to-date information on pests, weather conditions, and market conditions, IPM information links, and a search engine.

Database of IPM Resources

The Database of IPM Resources (DIR) is an information retrieval/referral system and a compendium of customized directories of worldwide IPM information resources accessible through the Internet. With DIR, one can quickly find the way to thousands of IPM information sites. The DIR covers a wide array of crops, pests, control tactics, regions, organizations, and related topics. It is located at **www.ippc.orst.edu/cicp**.

Radcliffe's IPM World Textbook

Radcliffe's IPM World Textbook is a web site co-sponsored by the University of Minnesota and The Consortium for International Crop Protection. It is an electronic textbook of IPM featuring chapters written by internationally recognized experts. The purpose of the web site is to provide an electronic alternative or complement to printed textbooks for communicating information on IPM. The objectives are to provide: 1) a venue for easily maintaining and up-dating "state of the art" information from the world's leading experts on all aspects of IPM, 2) a resource that can be freely downloaded and used by students, teachers, and IPM practitioners, 3) a forum for the international presentation of practical information and theory on IPM, 4) links to the vast and rapidly growing IPM resources available on the Internet including photographs and decision-support software. Radcliffe's IPM World Textbook is located at **http://ipmworld.umn.edu**.

IPM Almanac

IPM Almanac is a web site intended to provide information and tools for IPM planning and implementation. It contains resources such as IPM basics, IPM plans, a glossary, checklists, and tip sheets, search engines, and links to IPM Solutions Newsletter. It is located at **www.ipmalmanac.com**.

IPM Practitioners Association

The IPM Practitioners Association (IPMPA) is a non-profit association founded in 1989 to facilitate the use and understanding of IPM in primarily non-agricultural resource settings. It maintains a website called IPM ACCESS at **www.efn.org/~ipmpa**. IPM ACCESS is a networking and information service website that provides IPM practitioners and other interested people with the opportunity to find, share, and develop effective, economical, and environmentally sound approaches for the management of vegetation and pests, primarily in non-agricultural resource settings.

SECTION 4 WATER CONSERVATION

Golf courses in Colorado are increasingly faced with water conservation issues because of Colorado's semi-arid climate, rapid population growth, and recent drought. In growing western metropolitan areas, local water use restrictions are increasingly likely to be promulgated. In an average year, golf courses throughout Colorado may use about 30 to 65 million gallons of water each to maintain all turf areas (greens, tees, fairway, rough, and adjacent areas).[1] Golf courses that have adopted water conservation practices realize payback in decreased labor time, and water bills, and also healthier turfgrass. Several factors affect water conservation practices. These factors and some techniques and technologies for water conservation are discussed below. For more information on water management on turfgrasses, visit **http://aggie-horticulture.tamu.edu/plantanswers/turf/publications/water.html**.

> Healthy turf requires less water, fertilizer, and pesticides.

FACTORS THAT AFFECT WATER CONSERVATION

Water use and conservation techniques are unique to each golf course and depend on numerous local climatic, surface, and soil conditions. Golf course superintendents must understand each of these factors as they relate to water use because opportunities for conservation rely on optimizing one or more of these variables. The most important single variable that affects requirements for water is the rate of evapotranspiration (ET), which is the total water loss from soil, including direct evaporation and transpiration, and the loss of moisture through grass and other vegetation. ET is complicated to estimate because it is affected by a number of factors, including:

- Temperature
- Wind
- Turfgrass type
- Solar radiation
- Humidity
- Soil conditions
- Irrigation system operating pressure and nozzle diameter

> Direct evaporation from sprinklers can account for a 50 percent or greater loss of water in a desert climate.
>
> Richard Duble
> Turfgrass Specialist

Soil conditions, surface conditions, and turfgrass selection factors to consider with respect to water conservation include:

Soil Conditions
- Soil porosity in the grass rootzone
- Infiltration
- Percolation
- Water retention

Surface Conditions
- Dense thatch
- Surface crust
- Non-wettable sand

Turfgrass Selection
- Water need
- Transpiration rates
- Adaptability to environment

[1] Based on water use at four Colorado golf courses surveyed during the creation of this guide.

Soil type is also an important consideration with respect to watering practices and conservation because the soil type affects water infiltration and runoff rates, and therefore effective application rates and techniques.

WATER CONSERVATION OPPORTUNITIES

Water can be conserved at golf courses through a number of techniques and technologies. Techniques include deficit irrigation, selection of turfgrass and vegetation, alternative water sources, watering schedules, and hand watering. Technologies include computerized weather stations, and use of global positioning systems (GPS) and geographic information systems (GIS).

Deficit Irrigation

Traditionally, superintendents have operated under the theory that deep, infrequent irrigation (for example, 1 million gallons every third night and nothing the other two nights) is better for root development. Research and the experience of some superintendents in the semi-arid West indicate that the quality of the turf is enhanced by frequent, light watering (for example, 350,000 gallons every night).[2] This practice is known as deficit irrigation. Implementing deficit irrigation is a trial-and-error process to determine how frequently and how lightly to water and these factors vary for different soils, turfgrass, and other vegetation types. According to a golf course superintendent in Colorado, deficit irrigation depends on the turfgrass and soil type. For example, sandy loam soils, soils with high bicarbonate concentrations, and highly compactable soils are well suited to deficit irrigation. Deficit irrigation will not work well in other areas of the country, but Colorado's climate lends itself to the application of this technique, which can save water.

For more information about deficit irrigation, visit **www.gcsaa.org/resource/environ/watercon.html**.

Turfgrass and Vegetation Selection

Significant savings in water use are possible with the correct selection of turfgrass. Rates of water use for grasses differ between species and between cultivated varieties (cultivars) of a single specie. Deficit irrigation used with the appropriate turfgrass can achieve substantial savings in water use. Besides turfgrass, other vegetation on the golf course and around the clubhouse should be selected based on water needs. Xeric landscaping (xeriscape) is both attractive and beneficial because of its low requirements for water. Xeric plants are available for all landscaping needs, including trees, shrubs, ground covers, vines, and many types of accent plants. Information about xeric landscaping is widely available.

> Grasses with poor drought resistance may require three to four times more frequent irrigation compared to excellent drought resistant grasses.

For more information about turfgrass selection, visit **www.ntep.org**. For more information about xeriscape, visit **www.xeriscape.org**, **www.greenbuilder.com/sourcebook/xeriscape.html**, or many other sources on the Internet.

[2] Information obtained from Golf Course Superintendents Association of America at http://www.gcsaa.org/resource.environ/watercon.html. July 19, 2001.

Alternative Water Sources

In the future, use of potable water for irrigation on golf courses may be restricted; therefore, alternative sources of irrigation water, such as effluent water, probably will be used. Effluent is partially treated wastewater, for example from a municipal treatment facility or nearby development complex. Effluent water is usually cleansed of major pollutants, but still contains enough pollutants and bacteria to classify it as undrinkable. Dense, well-managed turfgrass can serve as a filtration system for effluent water. The thatch layer in the turf traps and holds particulate pollutants in the water and allows them to degrade naturally. Using treated effluent is more viable in hot, dry regions with high requirements for irrigation such as Colorado. Effluent water use also contains plant nutrients, resulting in lower fertilizer use, and it is generally less expensive than potable water. However, use of effluent water on golf courses may pose challenges associated with high levels of two primary pollutants of concern, industrial waste and salinity. Waste from industry such as heavy metals and toxic contaminants can be a problem and are usually cause to eliminate a particular source of effluent. The biggest ongoing concern is salt (total dissolved solids or TDS). Concentrations of salt can increase significantly in the treatment process and this can be a major problem in areas where concentrations of salt in freshwater are naturally high. It is also a problem during drought. In these cases, salts from effluent can severely damage some grasses. The range of tolerances is fairly wide among grass species and cultivars; however, the tolerances of most grasses on golf courses are at the low end of the scale. High concentrations of salt may also damage the structure of the soil. Superintendents compensate for this problem by mixing fresh water with effluent to achieve concentrations that are within tolerances.

Another alternative water source is recycled irrigation water. To recycled irrigation, the layout and drainage for the course are designed so that all runoff and seepage flow in to containment areas and water is reused for irrigation.

For more information on alternative water sources, visit **www.gcsaa.org** or call (800) 472-7878.

Watering Schedules

Independent of any other factors, golf courses should be watered at night when the temperatures, solar radiation, and wind speeds are lower to decrease ET. Other considerations in watering schedules are species of grass, soil type, slope, site use, and other turf management practices.[3]

Computerized Weather Stations

Less than 20 percent of golf courses in the U.S. have computerized weather stations, but such systems can save 25 percent of the water used at a golf course.[4] Golf courses can

[3] Duble, R. L. "Water Management on Turfgrasses." Document obtained on Internet, June, 2001. On-Line Address: http://aggie-horticulture.tamu.edu/plantanswers/turf/publications/water.html

[4] Pioppi, A. 2000. "Irrigation Systems More Than Conserve H_2O." Golfweek's Superintendent News. Page 8. May 12.

pay off computerized weather stations within 2.5 years.[5] The systems work by gathering data on solar radiation, wind speed, wind direction, and temperature from various sensors strategically located around the golf course to calculate ET rates. A computer uses the ET rate to automatically adjust water output at each sprinkler head. Most systems also can control the water output of individual sprinkler heads or the entire system through a hand-held communicator (such as radios and palm pilots), or an office or home computer.

Most irrigation system vendors can provide computerized weather station equipment and technical assistance.

Global Positioning Systems and Geographic Information Systems

Although their use is not widespread, GPSs and GISs are increasingly being used in golf courses for many aspects of operation, including water conservation. Data collected with a GPS and input into a GIS can be used to manage sprinkler heads, turfgrasses, and many other course features. The data collected from the computerized weather station can be connected to data points from a GPS such as sprinkler heads and used to plan irrigation and control. Other applications beyond water conservation include golf cart inventory, pest management, soil sampling, tree management, record keeping, or calculation of volume (such as for estimating the amount of sand required in traps.)[6]

Most irrigation system vendors can provide GPS and GIS equipment and technical assistance.

Computerized weather stations can save up to 25% of water resources

CASE STUDY: SADDLE ROCK GOLF COURSE

In 1996, during construction of the Saddle Rock Golf Course, located in Aurora, Colorado, the course installed a weather station and computerized irrigation operating system that uses a GPS and GIS to aid in irrigation. Saddle Rock uses a Rain Bird Maxi Sirus operating system. The following table summarizes system costs in 1996 and 2001 dollars.

Component	1996 Cost	2001 Cost
Weather Station	$10,000	$14,000
Computerized Irrigation Controller	$29,000	$40,000
Irrigation Radio Control System	$ 6,800	$ 9,400
Total	**$45,800**	**$63,400**

Because the system was installed during construction of the course, Saddle Rock does not know how much water it would use without the system. Rain Bird conservatively estimates that the system saves about 15 percent compared with a non-computerized system. The total cost for irrigation is calculated as:

Annual Irrigation Costs = Water + Operation and Maintenance (Labor and Equipment)

[5] Pioppi A. 2000. "Technology Takes Guessing Out of Forecasting Weather." Golfweek's Superintendent News. Page 11. May 12.
[6] McCormick, P. L. and Pioppi A. 2001. "Supers Cautiously Adopt GPS/GIS." Golfweek's Superintendent News. Page 7. May 11.

In 2001, Saddle Rock used about 100 million gallons of water per year for irrigation at $1 per 1,000 gallons. Assuming the system saves 15 percent in water use per year (17.6 million gallons), Saddle Rock saves $17,600 per year in water use. For operation and maintenance costs, Saddle Rock estimates that it spends about 40 hours per week to monitor, operate, and repair the system. Based on his 10 years of experience, the Saddle Rock superintendent estimates that without the computerized system, his staff would spend 100 hours per week monitoring the system (40 hours at about $19 per hour, 40 hours at $15 per hour and 20 hours at $8.50 per hour). Based on a 6-month irrigation season per year (24 weeks) the additional labor cost is $18,500 per year.

With a capital investment in the system of $63,400 (2001 dollars), the estimated payback period for the system is 1 year and 9 months. Although Saddle Rock's superintendent knew that the system would pay for itself in water savings alone, he indicated that the system's ease and accuracy in estimating water use needs were reason enough to install the system.

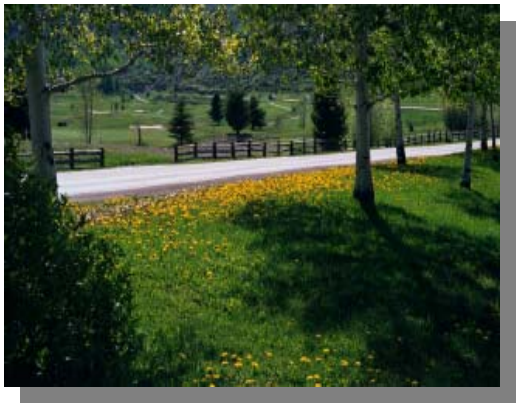
SECTION 5 INTEGRATED PEST MANAGEMENT

Integrated pest management (IPM) is a sustainable ecological approach to preventing or reducing unacceptable levels of damage by pests. An effective IPM program helps golf course superintendents identify pests and evaluate, select, and implement the best possible management options based on reduction in environmental, economic, and human health risk. The IPM decision-making process determines if, where, when, and how pest management practices should be applied. A key concept of IPM for golf courses is to manage turf to optimize its health so it is more resistant to disease and damage. According to GCSAA, about 45 percent of golf courses have written IPM plans. Golf courses that have an IPM plan should continue to look for opportunities to improve on their existing plan and those that do not have an IPM plan are encouraged to write and implement a plan based on their golf course's specific needs and goals. For technical assistance call Tom Kosinski, Section Chief of Pesticides, CDA Division of Plant Industry at (303) 239-4145.

For information on the basic principles guiding IPM and how to develop and effective IPM plan, go to IPM Access at **www.efn.org/~ipmpa** or GCSAA at **www.gcsaa.org**.

IPM Advantages

IPM is a common characteristic of golf courses that have received awards or recognition for maintaining "green" or environmentally friendly grounds. The ecological and economic advantages of IPM outweigh the time it may take to develop and implement a chosen course of action. From an ecological standpoint, IPM uses proven biological, mechanical, and cultural controls to reduce chemical pest treatments.



Furthermore, because many pesticides are expensive, reducing the amount used and opting for more cost-effective, long-term practices can save money. Section 7 of this document summarizes several case studies of successfully implemented IPM plans.

Know Your Surroundings For IPM Success

Before an IPM plan can be developed, specific knowledge of the golf course environmental setting is essential. Full consideration should be given to threatened and endangered species in the region, natural and cultural resources, human health and safety, and laws and regulations that apply to golf courses. Familiarity with the local surroundings will aid in identifying turfgrass pests and diseases in the area. Some common pests and diseases in Colorado are discussed in the next section.

Colorado Turfgrass Pests and Diseases

Colorado's semi-arid climate requires drought-tolerant, hardy grasses. The most common types of turfgrass found in Colorado golf courses are:

- Bentgrass
- Fescue
- Kentucky bluegrass
- Ryegrass

Government agencies and universities, such as the USDA, Agriculture Research Service (ARS) (**www.ars.usda.gov**) and the Colorado State University (CSU) Cooperative Extension (**www.ext.colostate.edu**) provide research-based knowledge and information about turfgrass diseases, pests, maintenance, treatment options, species selection, and new cultivars.

The National Park Service (NPS) website (**www.nature.nps.gov/wv/ipm/manual.htm**) publishes fact sheets on insects, weeds, and diseases that attack turfgrass. The fact sheets have information, such as identifying features of pests and diseases, control techniques and applications, and conditions needed to recognize a potential turfgrass pest or disease problem.

Adult Denver Billbug

Insects, diseases, and weeds affect turfgrass differently but are all essentially undesirable because they impair the aesthetic quality and healthiness of the turfgrass. Unhealthy turfgrass can affect the way the golf ball behaves. Common turfgrass insect pests, diseases, and weeds in Colorado are listed below.

Insect Pests

- White grub
- May and June beetles
- Billbugs
- Sod webworms
- Clover mites
- Brown wheat mites
- Japanese beetle
- Masked chafers
- Armyworms
- Hairy cinch bug
- Banks grass mites
- Black turfgrass ataenius

Diseases

- Snow molds
- Take-all patch
- Ascochyta leaf blight
- Dollar spot
- Fusarium blight
- Brown patch
- Fairy ring
- Necrotic ring spot
- Powdery mildew
- Leaf spot
- Melting out disease

Weeds

- Prostrate spurge
- Ragweed
- Large crabgrass
- Goosegrass
- Annual Bluegrass
- Henbit
- Thistle
- Mullein
- Dandelion
- Milkweed
- Bindweed
- Whiteclover

For more information on common insect pests, diseases, and weeds in Colorado go to the Integrated Pest Management, National IPM Network, at Colorado State University at (**www.colostate.edu/Depts/IPM/csuipm.html**).

THATCH AND MAT

Bentgrass, and Kentucky bluegrass are the predominant formers of thatch in Colorado.

Excessive thatch (greater than ½ inch) is an issue of concern in golf courses. Thatch is an intermingled organic layer of dead and living shoots, stems and roots that develops between the surface soil and green vegetation. It is created when organic matter is developed faster than it is decomposed. Mat is thatch with the addition of mineral matter. Thatch and mat provide an ideal environment for insects that damage turf, such as white grubs and billbugs that feed beneath the layers, and sod webworms that nest in between the layers. Although some thatch and mat are desirable, excessive thatch prevents the infiltration of water and can create localized dry spots and minimize the movement of air and fertilizers, thereby weakening the turf and making it more susceptible to pests and disease.

Reduction in thatch is a long-term process but can be accomplished by following proper cultural practices, for example, by avoiding use of pesticides that harm earthworms or fungicides that reduce microbial populations. Earthworms aerate and break up thatch and mat, and microbes feed on thatch and mat. More information on thatch and mat can be found at **www.colostate.edu/Depts/IPM/index.html**.

Management of Pests and Disease

Pests and diseases are managed through a variety of controls intended to reduce or eliminate pests and diseases. Pest and disease controls are either preventive or curative. Common preventive controls are cultural or genetic modifications and are usually the most cost effective and long lasting. Curative controls generally involve mechanical, biological, or chemical pest and disease management. Some examples of pest and disease controls are provided below.

Preventive

- **Cultural** – Modifying fertilization, fertigation, irrigation, thatch management, cultivation, seeding scheduling, mowing adjustments, and lawn and landscaping equipment maintenance and sanitation. Renovating landscapes to include disease and pest resistant plants, or choosing a less toxic pesticide.
- **Genetic** – Choosing pest or disease resistant turfgrass, shrubs, or trees.

Curative

- **Mechanical** – Physically disrupting the area where pests or diseases are located by tilling, hoeing, hand-pulling, mowing, aeration, burning, and barriers.
- **Biological** – Introducing organisms, often such as earthworms, microbes, or plant pathogens into soil to disrupt weed, disease, and thatch development. Grazing livestock are another form of biological control.
- **Chemical** – Applying herbicide, pesticides, insecticides and plant growth regulators. Growth regulators can both (1) reduce the turfgrass growth rate by inhibiting cell division, and (2) suppress the development of weed seed heads such as annual bluegrass.

For more information on any of these pest and disease controls visit **www.colostate.edu/Depts/IPM/index.html** and **www.gcsaa.org**.

Biopesticides

Application of toxic chemicals can be hazardous to native plants and animals and human health. As an alternative, biopesticides are natural materials or organisms that can act as a pesticide on unwanted insects and plants.

For biopesticide fact sheets and related information, go to EPA's Office of Pesticide Prevention Biopesticide website at **www.epa.gov/pesticides/biopesticides**

Biopesticides can be plants, animals, bacteria, and minerals. A major concern of pesticide application is the affect they can have on non-target species. Biopesticides are generally less harmful than conventional chemical pesticides and usually only affect the target pest. Additionally, biopesticides may be less costly because they can be effective in small quantities and decompose quickly. As with all pesticides, biopesticides must be applied according to the EPA approved label directions. According to NTEP, biopesticide use is limited to preventive applications within a management system. They are not suitable as a curative control.

Pesticide Runoff

Another important part of IPM is the protection of waters, such as ponds, wetlands, or streams in and around golf course greens. Runoff occurs when water is applied to the soil at a faster rate than it can enter the soil. Runoff containing pesticides can cause direct injury to nontarget species, harm aquatic organisms in streams and ponds, and can lead to ground water contamination. Many approaches to this problem borrow from the pest and disease management controls listed above. While the quickest, most cost-effective way to protect golf course waters is the reduction of pesticide use; this may not always be a viable option. Some best management practices for the reduction of chemical pesticide runoff are listed below.

- Reduce the volume of runoff and sediment through a subsurface drainage system (tile drainage), tillage of soil, buffer strips, or contour planting.
- Reduce pesticide migration to surface waters through the use of structural landscaping such as terraces, buffer strips and grassed waterways.
- Reduce pesticide losses by diluting the concentrations of chemicals applied to greens.
- Apply pesticides when weather conditions are generally favorable to optimal application conditions, that is, avoid applying pesticides before and after a heavy rainfall.
- Use pesticides that are less susceptible to runoff losses, such as Fenaxoprop, Prodiamine, Cyfluthrin, or Permetrin.

For more information visit the Water Quality and Golf Course Superintendents website at **www.ces.ncsu.edu/TurfFiles/pubs/wqwm154.html** or read *Best Management Practices and Integrated Pest Management for Protection of Natural Resources on Golf Course Watersheds* available at **www.epa.gov/owowwtr1/watershed/Proceed/peacock.html**.

SECTION 6 EQUIPMENT SHOP WASTE

Golf course equipment maintenance shops generate a variety of solid and hazardous wastes, and air emissions and have many opportunities to reduce these environmental impacts. For example, a typical equipment maintenance shop that implements the environmental strategies discussed in this section can generate little or no hazardous waste. This section discusses best environmental practices for golf course equipment maintenance shops in the topic areas listed below.

- Aqueous cleaning*
- Aerosol product selection*
- Refillable spray bottles*
- Shop spill cleanup*
- Oil bottle draining
- Re-refined oil
- Oil filter management
- Oxygenated fuel

* For step-by-step instructions for how to successfully implement all these best practices, review EPA's video, *"Profit through Prevention: Best Environmental Practices for Fleet Maintenance,"* and fact sheets, *"The Pollution Prevention Toolkit: Best Environmental Practices for Fleet Maintenance."* The video and fact sheets are available by calling (800) 490-9198. Ask for publication number EPA-909-V-99-002 for the video and EPA-909-E-99-002 for the fact sheets. Also, the CDPHE Pollution Prevention Program offers information on various best environmental practices topics discussed in this chapter. For information from the CDPHE Pollution Prevention Program, call Kirk Mills at (303) 692-2977. Finally, the CDPHE Pollution Prevention Program publishes a best environmental practices notebook for the ski industry. Several topics relevant to golf courses will be discussed in further detail in that notebook. For more information, contact the CDPHE Pollution Prevention Program at (303) 692-2977.

Aqueous Cleaning

Mineral spirits is a petroleum distillate solvent commonly used for part cleaning because of its ability to quickly dissolve oil, grease, dirt, grime, burnt-on carbon, and heavy lubricants. Although it is effective for cleaning, use of mineral spirits raises significant concerns that involve the environment and worker health. Switching to less toxic, water-based (aqueous) cleaning solutions can reduce costs for regulatory compliance, waste disposal, and labor as well as regulatory liabilities.

Aqueous part cleaning systems use a water-based solution that, unlike petroleum-based solvents, are typically nonflammable and contain less than 5 percent (50 grams/liter) volatile organic compounds (VOCs.) Instead of dissolving grease and solids, water-based systems rely on the action of heat, agitation, time, and soap to clean parts. Although they clean differently, aqueous cleaning units perform as well as or better than traditional solvents according to many maintenance shop supervisors and mechanics. Properly selecting an aqueous unit based on a shop's specific cleaning needs and adjusting to a different cleaning process are the keys to making aqueous cleaning work in an equipment maintenance shop.

For more information, refer to EPA's Aqueous Cleaning Fact Sheet. Ordering information is provided on the preceding page of this guide. Some vendors of aqueous cleaning units are listed below.

Better Engineering
www.betterengineering.com
(800) 229-3380 ext. 309

Clayton Associates Inc.
www.jclayton.com
(800) 248-8650

Equipment Manufacturing Company
www.equipmentmanufacturing.com
(888) 833-9000

Kleer-Flo
www.kleer-flo.com
(800) 328-7942

Landa
www.landa.com
(800) 547-8672

Orison Marketing
www.orison.llc.com
(800) 460-2403

SELECTION OF AEROSOL PRODUCTS

Golf course equipment maintenance shops use aerosol products for brake cleaning, carburetor cleaning, engine degreasing, lubricating an numerous other miscellaneous purposes. These products contain mixtures of toxic and hazardous substances. Frequent, long-term exposure to some of these substances by inhalation or skin contact can cause liver and kidney damage. Many product characteristics contribute to the environmental or health aspects of a product. Many states, cities, and counties have implemented aerosol product selection criteria. The following web sites have information on some such programs:

> Many chlorinated solvents damage the ozone layer, and all are toxic to some degree. Aerosol products with chlorinated compounds should be avoided.

State of Massachusetts: **www.state.ma.us/osd/enviro**
State of Minnesota: **www.moea.state.mn.us/lc/purchasing/cleaners.cfm**
King County Washington: **www.metrokc.gov/procure/green**
City of Santa Monica: **www.ci.santa-monica.ca.us/environment**
City of San Francisco: **www.sfrecycles.org** (look under "City Government" and then the EP3 project)

At a minimum, golf courses should use the following 4-step approach:

Step 1: Do not use or purchase products that contain known carcinogens, reproductive toxins, chlorinated solvents, or ozone depleting compounds (ODCs). Lists of known carcinogens and reproductive toxins can be found at: **www.epa.gov/iriswebp/iris/index.html**. Chlorinated solvents that maybe found in products used in maintenance facilities include perchloroethylene (tetrachloroethylene), trichloroethylene, methylene chloride, and 1,1,1-trichloroethane. A list of prohibited ODCs as of September 1999 is in the FLIS "Non-Ozone Depleting Substances" report (9/1/99). Also refer to the Federal Clean Air Act, available at **www.epa.gov/docs/ozone/title6/usregs.html**.

Step 2: **Do not use or purchase products that contain chemicals that are F-listed hazardous waste constituents**. These constituents are defined in 40 Code of Federal Regulations Part 261.31 available at the following web sites:

- **www.epa.gov/docs/epacfr40/chapt-I.info/ subch-I.htm**
- **www.access.gpo.gov/nara/cfr/cfrhtml_00/Title_40/40cfr261_00.html**

F-listed chemicals include many common solvents used in industrial cleaning operations and their presence in wastes from such operations cause the waste to be, by definition, hazardous, regardless of concentration.

Step 3: **Apply case-specific selection criteria**. Numerous other criteria maybe considered when deciding upon the environmental preferability of a product. In some cases, the applicability of the criteria depend upon the physical and chemical characteristics of the product and the way the products is used. For example corrosivity is unlikely to apply to many organic based solvent cleaning products. Likewise, flammability is unlikely to apply to many housekeeping-type cleaning supplies. The following table describes guidelines for additional criteria to consider in selecting chemical products.

Criteria	Guideline and Information Source
1) Neurotoxins and Central Nervous System Depressants	Products should contain no more than 1% by weight of any ingredient that is listed by either EPA-IRIS (**www.epa.gov/ngispgm3/iris/index.html**) or NIOSH (**www.cdc.gov/niosh/87104_48.html**) as having a known or probable effect upon the human nervous system.
2) Eye Irritation	Products should cause as little eye irritation as possible. The following categories of eye irritation are listed in order of most to least preferable: Not an irritant, reddening, irritation, severe irritation, corrosive damage. If whole product test data are unavailable, the overall eye irritation effect may be determined as the weighted average of eye irritation effects of each ingredient present above a concentration of 1%. Eye irritant standards for ingredients can be found at **www.epa.gov/opptsfrs/OPPTS_Harmonized**
3) Skin Irritation	Products should cause as little skin irritation as possible. The following categories of skin irritation are listed in order of most to least preferable: Not an irritant, reddening, irritation, severe irritation, corrosive damage. If whole product test data are unavailable, the overall skin irritation effect may be determined as the weighted average of skin irritation effects of each ingredient present above a concentration of 1%. Skin irritant standards for ingredients can be found at **www.epa.gov/opptsfrs/OPPTS_Harmonized**
4) Exposure by skin absorption	Products should have the least possible potential for skin absorption. Categories of skin absorption potential are categorized as low, moderate, and high potential. The following ingredients have high potential for skin absorption and should be avoided if present at greater than 1%. Isopropanol [67-63-0] 2-butoxyethanol [111-76-2] Acetone [67-64-1] 1,1,1-TCE [71-55-6] Methyl Ethyl Ketone [78-93-3] Naphthalene [91-20-3] Ethylene Glycol [107-21-1] Toluene [108-88-3] Diethylene glycol monobutyl ether [113-34-5] Tetrachloroethylene [127-18-4] Monoethanolamine [141-43-5]

Criteria	Guideline and Information Source
	Triethanolamine [102-71-6] Xylene [1330-20-7]
5) Corrosivity	Product should have the lowest possible potential for corrosive action that is a pH between 2.5 and 11.5. Avoid products with corrosivity less than 2.5 or greater than 11.5.
6) Flammability	Products should have as high a flash point as possible. Use the following as a guide: Flash point greater than 200 °F Good Flash point between 140 °F and 199 °F Fair Flash point between 100 °F and 139 °F Poor Flash point less than 100 °F Do not use if possible
7) Endocrine Modifiers	Product should contain less than 1% or less by weight of any ingredient that is a known, probable, or possible endocrine modifier on the Preliminary List of Chemicals Associated With Endocrine System Effects (Illinois EPA, 2/97, with 4/98 Supplement) **www.nihs.go.jp/hse/environ/illiepatable.htm** The EPA "docket #" for the report is: 42189 B1-013; see **www.epa.gov/scipoly/oscpendo/history/docket.htm** In particular, products should contain less than 1% of the following most commonly used ingredients: • Nonylphenol ethoxylate [9016-45-9] • Octylphenol ethoxylate [9036-19-5] • Dibutyl phthalate [84-74-2]
8) Greenhouse gasses	Product should contain less than 1% of any gas designated by the Kyoto Protocol of December 1997 as having a greenhouse impact: • Carbon dioxide • Hydrofluorocarbons • Methane • Perfluorocarbons • Nitrous oxide • Sulfur hexafluoride
9) Biodegradability	Product as a whole, or each ingredient comprising 5% or more of the total, should meet the Organization for Economic Cooperation and Development (OECD) definition of readily biodegradable. For more information, visit • **www.oecd.org/oecd/pages/home/displaygeneral/0,3380,EN-document-524-14-no-24-5647-524,00.html** • **www.epa.gov/docs/OPPTS_Harmonized/835_Fate_Transport_and_Transformation_Test_Guidelines/Series/835-3110.pdf**
10) Volatile Organic Compounds	Product should meet the VOC content requirements established by the California Air Resources Board (CARB) (**www.arb.ca.gov**).
11) Fragrances	Product should contain 0.1% or less of a fragrance that is either a non-functional ingredient or a SARA 313 listed hazardous material (**www.epa.gov/tri/brochure2000.pdf**).
12) Dyes	Product should contain 0.1% or less of a coloring agent that is either a non-functional ingredient or a SARA 313 listed hazardous material (**www.epa.gov/tri/brochure2000.pdf**).
13) Available as a concentrate	Products should be available and purchased in concentrated form either as a powder or a liquid intended to be diluted by at least 8 parts water (1:8 dilution ratio) before use.

Criteria	Guideline and Information Source
14) Available in non-aerosol container	Products should be available and purchased in non-aerosol form.
15) Available in bulk	Products should be available and purchased in bulk form.

Step 4: Obtain samples of products that meet all criteria from Steps 1 and 2 and as much of Step 3 as appropriate and feasible. Test the products to evaluate their performance. Select the product or products that meet Step 1, 2, and 3 criteria and perform in a satisfactory manner.

REFILLABLE SPRAY BOTTLES

Refillable spray bottles

Each year, golf course equipment maintenance shops generate hundreds of used aerosol cans of brake cleaner, carburetor cleaner, lubricant, and other products. An alternative to aerosol cans is refillable spray bottles. There are two basic types of refillable spray bottles: (1) metal bottles that spray product using compressed air, and (2) plastic bottles that use a hand pump to spray product. Refillable metal bottles more closely resemble aerosol cans in terms of their design and performance. These bottles are filled with products such as brake cleaner from bulk containers and pressurized with compressed air. Product can be expelled at pressures ranging from 80 to 200 pounds per square inch (psi). 80 psi is the minimum pressure needed to expel product, and 200 psi is the upper pressure limit of the bottles. Metal refillable spray bottles can be purchased from some auto parts stores such as NAPA or directly from the manufacturer, Milwaukee Sprayer Manufacturing Company, Inc., at (800) 558-7035. Plastic spray bottles can also filled from bulk containers but do not require compressed air; rather, they are operated by pumping a trigger to create a mist or stream of product.

Compared with refillable spray bottles, aerosol cans are more expensive and have greater environmental impacts:

- ✓ Ounce for ounce, spray-on product sold in aerosol cans cost roughly twice as much as bulk product.
- ✓ Most aerosol cans contain 10 to 15 percent propellant by weight. Shops incur the cost of this propellant with every aerosol can purchased.
- ✓ Carbon dioxide, propane, and butane are commonly used aerosol propellants. These propellants are also greenhouse gases that contribute to global warming and smog formation.
- ✓ Used aerosol cans take up valuable landfill space.
- ✓ Depending on contents, used aerosol can be hazardous waste if disposed of as trash before they are empty.

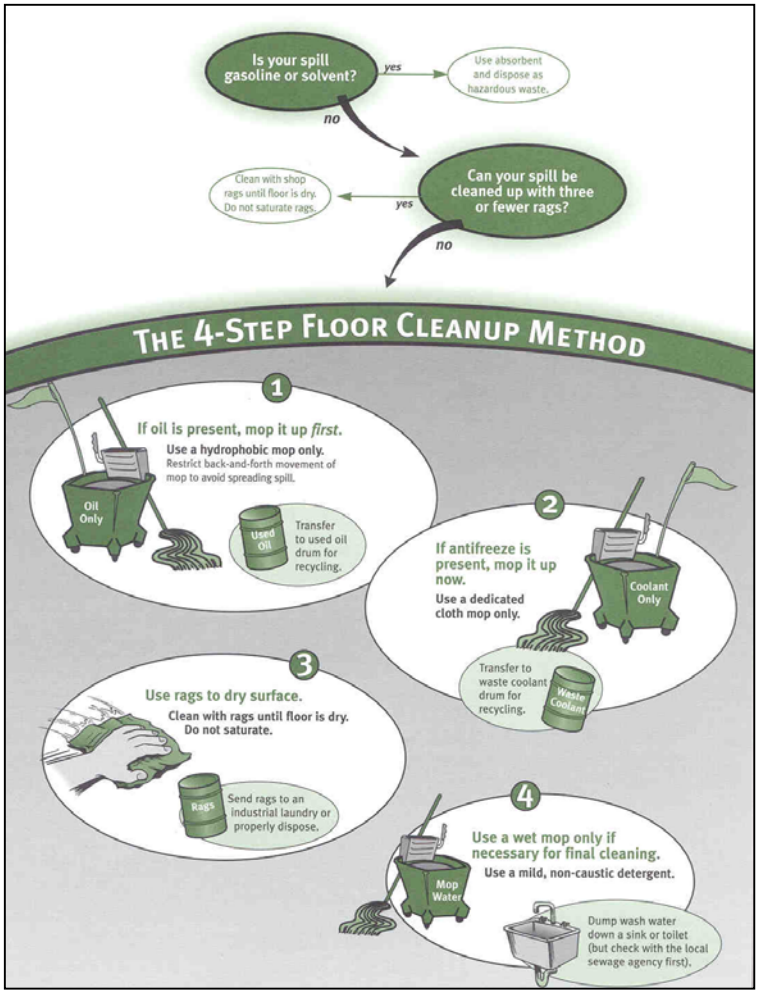
The product in the bottle in an important consideration, too. Be sure to select “greener” bulk products (discussed in previous section) for use.

SHOP SPILL CLEANUP

From time to time, liquids spill in golf course equipment maintenance shops. For large spills (more than 5 gallons), absorbent pigs and blankets should be kept on hand for emergency response and containment. Cleaning up smaller spills of liquids, such as solvent, oil, and antifreeze that contain toxic substances, however, is more problematic. The figure on this page shows the preferred shop floor clean up method and this issue is discussed further below. To order hydrophobic mops referred to in the figure, call Hy-Tec Environmental at (800) 336-4499 or CCP Industries at (800) 321-1050.

Small spills can be tracked around a shop, spreading contamination or causing slips and falls. Furthermore, various environmental issues can arise, depending on how the shop manages spills and floor wash water containing toxic substances. For instance,

- Discharges to septic systems can contaminate soil, groundwater, and drinking water, creating liabilities for site cleanup.
- Discharges to storm drains flow directly to surface water, causing water pollution and damage to aquatic ecosystem.
- Discharges to sanitary sewers result in accumulation of metals in sludge at the sewage treatment plant, preventing beneficial use of the sludge. Also, some contaminants may pass through the treatment plant and be discharged to lakes and rivers.
- Discharges to oil-water separators can contaminate sludge in the separators, causing the sludge to become hazardous waste and increasing disposal costs.



In many cases, shop mechanics clean up small spills with granular absorbent (floor sweep, grease sweep, "kitty litter," rice hull, and so on). Spent granular absorbent is commonly disposed of in trash dumpsters without analysis to determine whether it is hazardous. Because the characteristics of the spilled liquid and the saturated absorbent are difficult to predict, disposing of the absorbent as trash is risky business – the waste absorbent may introduce contaminants to landfills, and improper disposal of hazardous waste is illegal. Furthermore, using granular absorbent is time consuming and expensive. Absorbent should be used only if (1) a spill cannot be cleaned up with shop rags or dedicated mops, or (2) the spill contains gasoline, solvent, or other hazardous chemicals.

OIL BOTTLE DRAINING

"[BOB] gets the prize for the most innovative ecology-minded money-saving product we've seen in a long time.… When you dump the bottle, you don't throw out any oil. We really like this one!"

Dick Berggren, Editor,
Stock Car Racing Magazine

Although it's preferable to use bulk oil delivery systems to decrease generation of solid waste (empty oil bottles), save time, and reduce spills, some golf course equipment maintenance shops maintain a stock of 1-quart oil bottles. "Empty" quart oil bottles contain oil residue, which not only represents wasted oil but can prevent recycling of the bottles. In the U.S., 3.34 billion quart bottles of oil are produced every year. The amount of wasted oil from the residual in the bottles that may contaminate the environment each year is equivalent to 3.5 Exxon Valdez spills.[1] Plastic Oil Products manufactures the Bottom of the Bottle Oil Recovery System or BOB. BOB is a small, plastic device designed to conveniently drain and recover oil residue from oil bottles. After they drain overnight on BOB, plastic oil bottles (which are usually #2 plastic) are recyclable, and the drained oil may be used or recycled. One BOB device costs $9.99. For more information, call Plastic Oil Products at (800) 937-3050 or visit **www.bob2000.com**.

BOB at an equipment maintenance shop

RE-REFINED OIL

Used motor oil may be contaminated with lead, arsenic, cadmium, chromium, polychlorinated biphenyls, and solvents. According to the Buy Recycled Business Alliance, 1.3 billion gallons of used oil is generated each year in the U.S, but only 150 million gallons (8.7 percent) is collected and sold as re-refined oil. Re-refined oil is used motor oil that undergoes an extensive process to remove contaminants and produce a good-as-new base oil. This base oil is sold to blenders that mix in additive packages to produce lubricants such as motor oil, transmission fluid, and grease.

Re-refined oil is subject to the same refining, compounding, and performance standards as virgin oil products and may be used in place of virgin oil in any type of vehicle or equipment. However, not all re-refined oils are certified. The American Petroleum Institute (API) has established standards for engine oil quality. API operates a voluntary Engine Oil Licensing and Certification System (EOLCS). EOLCS licenses and certifies engine lubricants made from crude and re-refined oil. All API-certified oil sold bears either a double circle or a starburst symbol. Many vehicle and engine manufacturers (Mercedes Benz, Ford, General Motors, Chrysler, Cummins, and Detroit Diesel) have issued warranty statements that permit use of re-refined oil that meets API standards. Re-refined oil can be purchased form Safety-Kleen Corporation. Call (800) 525-5739 or visit its web site from more information at **www.safety-kleen.com**.

[1] www.bob2000.com

OIL FILTER MANAGEMENT

According to the Filter Manufacturers Council (FMC), more than 450 million used oil filters are discarded every year. Even after they have been crushed, these filters contain about 3 million gallons of oil. About 30 percent of the 450 million oil filters generated annually in the U.S. are recycled; the rest, about 315 million, are disposed of in landfills. Instead of disposing of used oil filters, golf course equipment maintenance shops should consider recycling used filters. State regulations that govern the disposal of used oil filters vary. However, federal regulations (40 CFR 261.4) require that, at a minimum, filters be either:

- Punctured through the dome or anti-drain back valve and then hot-drained (for 12 or more hours at or near engine operating temperature and above 60 °F)
- Hot-drained (same requirements as above) and crushed
- Dismantled and hot-drained (same requirements as above)

FMC maintains a web site at **www.filtercouncil.org** that lists regulations on filter disposal for all states and a listing of filter management companies. FMC can be contacted at (800) 993-4583.

OXYGENATED GASOLINE

The Clean Air Act Amendments of 1990 mandated use of oxygenated gasoline in areas that did not meet the federal ambient air quality standard for carbon monoxide (CO). Oxygenated gasoline is made by mixing an oxygenate, such as ethanol, with unleaded gasoline and can be used without a retrofit in any engine that uses unleaded gasoline. In most areas, motor vehicles are the primary source of ambient CO, which contributes to smog and is a greenhouse gas. Oxygenated gasoline is designed to increase the combustion efficiency of gasoline, reducing emissions of CO. Equipment that operates using unleaded gasoline releases a variety of other emissions, including hydrocarbons (HC), particulate matter (PM), and air toxics. Using oxygenated gasoline reduces all such emissions. Laboratory and field tests conducted by the Montana Department of Environmental Quality, the University of Denver, the U.S. Department of Energy (DOE), EPA, and the Southwest Research Institute showed that compared with the emissions from regular unleaded gasoline, oxygenated gasoline reduces emissions of CO, HC, PM, and air toxics from 9 to 55 percent. For more information, call Michael O'Toole with the CDPHE Mobile Sources Program in Denver at (303) 692-3139.

SECTION 7 CASE STUDIES

In preparing this guide, four Colorado golf courses were visited and information was gathered on environmental projects. The following table summarizes some of these case studies. Golf courses interested in more technical information should call the contacts listed in the table.

FACILITY/ CONTACT	P2 PRACTICES	BENEFITS
Integrated Pest Management		
Lakewood Country Club Chris Swim (303) 233-5507	**Buffer zones around lakes and creeks** Grow vegetation higher and do not apply pesticides in the buffer zones	Reduce the amount of pesticides that come in contact with surface water
	Use of growth regulator Apply growth regulator twice every spring and fall	Decrease amount of mowing required on course, which decreases labor time, emissions from mowing equipment, use of fuel and oil, and waste generated by maintenance
	Minimized application of pesticides Look for opportunities to reduce use of pesticides by many techniques including weeding by hand and spot application of non-restricted use pesticides. Overall approach is to treat weeds curatively.	Decreased application of pesticides
Water Use		
Saddle Rock Golf Course Joe McCleary (303) 699-3920	**Computerized weather station** See case study on pages 17 and 18 for details	Accurately apply water based on specific site conditions
Cordillera Scott Todd (970) 926-5285	**Course planning and vegetation planting** Minimize amount of turfgrass and increase amount of natives plants on golf course	Decreased water use Decreased pesticide application
	4-Step Water Use Planning: (1) Have a computerized weather station (2) Visually observe course every afternoon (3) Collect and analyze soil cores for proper water field capacity (water, oxygen, and pore space) (4) "Know" the golf course	Decreased water use Healthier turf grass

FACILITY/ CONTACT	P2 PRACTICES	BENEFITS
Other		
Lakewood Country Club Chris Swim (303) 233-5507	**Compost pile** Have a location on site to compost flowers, leaves, sand without rocks, and organic matter collected from wash rack. Grass and some leaves are mulched in place, not placed in the compost pile.	Reduce amount of solid waste sent to landfill
Saddle Rock Golf Course Joe McCleary (303) 699-3920	**Fertigation** Apply fertilizer through irrigation system	Eliminate need to use vehicle to drive and apply fertilizer Decrease worker exposure to chemicals

SECTION 8 OTHER POLLUTION PREVENTION OPPORTUNITIES

In addition to the numerous opportunities for waste reduction discussed in Sections 2 through 7 of this guide, golf courses have waste reduction opportunities in the areas of food service, building design, lighting, and purchasing. This section briefly discusses P2 opportunities in these areas and provides references for further information.

Food Service

A restaurant's profit is typically only 3 to 9 percent of total revenue; therefore, money saved through reductions in operating costs (i.e. through reduced energy consumption and water use) can significantly increase the profit margin.[1]

Fallbrook Golf Course's Club House Restaurant and Lounge (California) is a member of the Green Dining Association

While some restaurants have already taken advantage of the many P2 opportunities available to them, a survey by the National Restaurant Association shows that for some of the most common P2 techniques and best practices, there is still room for improvement across the industry. For more information, visit **www.restaurant.org/pressroom/pressrelease_print.cfm?ID=280**.

The Green Restaurant Association (GRA), helps member restaurants through 12 "eco-steps" to lower their environmental impact; the 12 steps are listed below.

1. Elimination of Polystyrene Foam (commonly known as Styrofoam)
2. Comprehensive Recycling
3. Waste Reduction and Reuse
4. Biodegradable Plastic
5. Recycled Products
6. Non-Chlorine Bleached Paper Products
7. Non-Toxic Cleaners, Landscaping and Pest Management
8. Energy Efficiency
9. Water Efficiency
10. Composting
11. Green Electricity
12. Employee Education Program

For more information, visit **www.dinegreen.com**.

Buildings

Environmental opportunities for the design and operation of buildings are numerous. One organization, the U.S. Green Building Council (USGBC) is dedicated to such issues. The USGBC is a coalition of leaders from across the building industry working to promote buildings that are environmentally responsible, profitable, and healthy places to live and work.

[1] EPA's EnergyStar Restaurant Services website: www.epa.gov/smallbiz/restaurants.html

The USGBC developed the Leadership in Energy and Environmental Design (LEED™) Green Building Rating System, a self-assessing system designed for rating new and existing commercial, institutional, and high-rise residential buildings. It evaluates environmental performance from a "whole building" perspective over a building's life cycle, providing a definitive standard for what constitutes a green building. It is a voluntary, consensus-based, market-driven building rating system. Different levels of green building certification are awarded based on the total credits earned for environmental performance in various criteria. The system is designed to be comprehensive in scope, yet simple in operation. For more information visit **www.usgbc.org**.

Lighting

Golf courses maintain many buildings such as club houses, equipment maintenance, pro shops, and restaurants, all of which are lighted, often with non-energy efficient lamps. Switching to energy efficient lamps is a simple way to decrease environmental impacts and save money. Energy efficient lamps may be placed in all lighting fixtures in place of fluorescent and incandescent bulbs. Energy efficient lamps have a higher capital investment than conventional fluorescent lamps and incandescent bulbs, but consume 33 to 75 percent less energy and last up to 18 times longer. Switching usually results in a payback of less than 3 years, depending on how many hours per day the light is on. Additional cost savings will be realized from reduced maintenance costs since the energy efficient lamps last so much longer. Although the cost savings will be less dramatic, it is less capital intensive to replace light bulbs by attrition. Further, with technological advancements, many of the quality issues previously associated with the lamps have been eliminated. For example, they come in many shades of white from warm to cool, many sizes and shapes to fit different lighting situations, have flicker free starts, and are available for 3-way and dimming applications. For more information, visit the following web sites: **www.energystar.gov**, **www.gelighting.com**, and **www.lighting.philips.com**.

Purchasing

Golf courses purchase numerous items for daily operation including janitorial products, paper supplies, and office equipment. Each of these topics are covered briefly below. For more information on environmentally preferable purchasing, refer to the following web sites: **www.pprc.org/pprc/pubs/topics/envpurch.html, www.epa.gov/cpg, www.epa.gov/opptintr/epp,** and **www.coopamerica.org**.

Janitorial Products

Golf courses use a variety of chemical products, including janitorial supplies, kitchen supplies (such as dish and oven cleaners), and vehicle and equipment maintenance products that contain mixtures of toxic and hazardous substances. The human health effects of these mixtures are not well understood; however, frequent, long-term exposure to some of these chemicals by inhalation or skin contact can contribute to or cause a variety of ailments including cancer.

The general approach for purchasing "greener" and safer janitorial products involves screening products against one or more selection criteria. Many cities and states have created environmentally preferable chemical purchasing criteria; examples of how selection criteria are being used in practice can be found in purchasing programs initiated by various city, state, and federal organizations. Examples of selection criteria are listed below as product characteristics that, if present, are grounds for not purchasing a product.

For more information about chemical product selection, see the following web sites **www.epa.gov/iriswebp/iris/index.html** and **www.westp2net.org**.

Paper Supply

Golf courses use many types of paper products including office paper, toilet paper, paper towels, tissue paper, forms, score cards, paper cups, and brochures. The environmental preferability of a paper product is determined by (1) the process by which the paper is whitened and (2) the recyclability and post-consumer content of the paper. Important terms to understand related to environmental preferability of paper are defined below. For more information on this topic, refer to **www.chlorinefreeproducts.org**.

- Elemental chlorine (EC) is the traditional manner in which paper is whitened using chlorine gas. Chlorine gas generates dioxins as a by-product, an organochlorine that is persistent in the environment and can bioaccumulate to toxic levels in fatty tissues.
- Elemental chlorine free (ECF) paper is whitened using chlorine derivatives such as chlorine-dioxide and generates less dioxins.
- Totally chlorine free (TCF) paper is paper whitened using a combination of oxygen delignification and hydrogen peroxide or ozone. It can not be made from recycled paper because the paper may have been made with EC or ECF.
- Processed chlorine free (PCF) paper contains recycled content paper that has been whitened using a non-chlorine compound. All virgin paper used in PCF is TCF.
- Unbleached paper uses no whitening process.
- Recyclable means that a product can be recycled, in other words, it can be diverted from permanent disposal (landfill or incineration) for recycling.
- Post-consumer waste (PCW) or post-consumer content is material or product that has served its intended use and has been discarded for disposal or recovery. If paper contains 100 percent post-consumer waste or content, the entire contents of that paper have been recycled at least once.

Depending on local market conditions, the cost for various types of paper may vary. Based strictly on environmental considerations, the following table lists the order of environmental preference of paper products. To assist in developing recycling and recycling markets, paper

from PCW is preferable to paper recycled from pre-consumer sources. Contact suppliers to determine which paper best matches both environmental, quality, and cost considerations when selecting paper.

PAPER TYPE ORDER OF PREFERENCE	EXAMPLE PAPER PRODUCTS
Unbleached (for circumstances when white paper is not required) with 100 percent post consumer content	• Simpson Paper Co.: Quest (100% PCW) • Domtar Fine Papers, Sandpiper (100% PCW) • International Paper: Hammermill Unity DP/Springhill Incentive 100 (100/50)* • Mohawk Paper Mills Vellum P/C 100 (100% PCW)
PCF with the highest post consumer and recycled content possible	• James River Paper Company Eureka! (100/70)* • Rolland Inc.: New Life Dual Purpose 100 (100/75),* New Life Opaque (50/20),* Evolution 100 (100/75)* • Riverside Paper Co. Ecology Copy Bond (100/35)* • Simpson Paper Company Equinox (100/50)* • Zanders USA: Ikonofix 50/20 (50/20)*
TCF	• Mohawk Paper Mills: Options TCF • Zanders USA, Inc: Ikonofix TCF • Lyons Falls: Pathfinder
ECF with the highest post consumer and recycled content possible	• Cross Point Paper: Genesis (100/100),*Passport (50/20),* Worx Multipurpose (50/20)* • Neenah Paper Environment line (100/30)* • Georgia-Pacific: GeoCycle (20/20)* • New York Recycled Paper: Earth Day Bond
EC paper should be avoided	

*(percent recycled content/percent post-consumer waste)

Paper made of alternative materials such as kenaf, bamboo, and sugar cane is also available. This type of paper may be more expensive than paper made from wood products and post-consumer waste. For more information about alternative paper products visit the following web sites: **www.futuresolutionsinc.com** and **www.treeco.com**.

Office Equipment

All office equipment such as copiers, fax machines, computers, monitors, scanners, and printers are available with energy-efficient characteristics. Energy Star® is an EPA-sponsored initiative with many energy efficient-related programs. It provides specifications for energy efficiency requirements that should be included in a bid process for office equipment. These specifications are available on the Internet at **www.epa.gov/nrgystar/purchasing**; from here, navigate to products and select the type of equipment for which bid specifications are desired. The same information may be obtained by calling 1-888-STAR-YES. Alternatively, simply require that any office equipment purchased comes with the Energy Star® label.

Energy Star® also has partnerships that are voluntary agreements between EPA and U.S. businesses. Businesses agree to identify and implement energy-efficient alternatives. In exchange, businesses involved in the partnership have access to extensive information about energy efficiency opportunities including compact fluorescent light bulbs, office equipment,

transformers, windows, and exit signs. Energy Star® also provides technical assistance, tools for promoting the business's involvement in Energy Star® to the public, technical manuals, workshops, presentations, and software for completing a comprehensive energy and economic analysis of E2 opportunities. All golf courses can benefit from involvement in this Energy Star® partnership. For more information, visit **www.energystar.gov**.

ENVIRONMENTAL BEST PRACTICES FOR COLORADO GOLF COURSES SCORECARD

Colorado Department of Public Health and Environment

Score your golf course in each of the items on the checklist. Mark NA for any activities that are not applicable to your facility. Use the following scoring system to score your golf course for each item:

5 = Well established practice/equipment installed throughout the golf course

3 = Some practice/equipment in place, but not in all areas

1 = Budgeted initiative, planned for implementation within one year

0 = No activity in this area

Use the steps below to rate the performance of your golf course.

A		Number of questions that do not apply to your golf course (all questions that you marked NA)
B		Number of questions that apply to your golf course. (57-A)
C		Total possible point at your golf course (B x 5)
D		Your grand total score on the bottom of page 5
E		Overall Score = D ÷ C x 100

If your overall score is less than 25:

Poor. *Many pollution prevention opportunities are available that are easy to implement and can result in immediate cost savings and reduced environmental impact at your golf course*

If your overall score is between 26 and 50:

Fair. *Although it may take a little bit of work, many P2 opportunities exist that can result in cost savings and reduced environmental hazard at your golf course*

If your overall score is between 51 and 75:

Good. *But there is still room for improvement*

If your overall score is greater than 76

Excellent! *Keep up the good work and continue to look for opportunities to reduce waste at your golf course.*

For a more information on the best practices in this scorecard, contact Kirk Mills at (303) 692-2977 or kirk.mills@state.co.us and request the Environmental Best Practices Guide for Colorado Golf Courses.

Regulations	
_____ points	1. Request a voluntary compliance audit by a state or local environmental agency, compliance assistance provider, professional consultant, or perform a self-audit. Implement recommended P2 practices.
_____ points	2. Determined if your golf course generates hazardous waste and properly disposes of it.
_____ points	3. Determined if your golf course generates universal waste and properly manages it.
_____ points	4. Maintain the condition and integrity, proper labeling, and storage of all used oil containers; and respond to releases.
_____ points	5. Used oil is recycled or sent to a regulated disposal facility.
_____ points	6. Fertilizer storage, pesticide use, storage, mixing, and loading areas, pesticide application, and general, restricted use pesticides, and worker protection are all in accordance with the EPA Office of Pesticide Programs (OPP) and the Colorado Department of Agriculture (CDA) Division of Plant Industry (DPI).
_____ points	7. Individuals applying restricted use pesticides or their employer's have a qualified supervisor's license in the appropriate category and a limited commercial applicators registration with the CDA. . Restricted use pesticides are only applied by or under the direct supervision of trained and certified qualified supervisors or certified operators.
_____ points	8. If a golf course has discharged dredged or fill material or constructed a dam, levee or other support structure in a water body, have EPA Section 404 permit.
_____ points	9. Know of and adequately protect any endangered species potentially on the golf course.
_____ points	**Regulations Subtotal**
Certification, Awards, and Program Involvement	
_____ points	10. The golf course is a certified Audubon Cooperative Sanctuary.
_____ points	11. The golf course has received recognition or an award as a "green" or environmentally friendly golf course
_____ points	12. The golf course is a member of an organization dedicated to conservation efforts such as Water Alliance for Voluntary Efficiency or WasteWise.
_____ points	**Certification, Awards, and Program Involvement Subtotal**
Water Conservation	
_____ points	13. Use deficit irrigation practices
_____ points	14. Select turfgrass and vegetation based on drought resistance
_____ points	15. Use effluent (partially treated wastewater) for irrigation
_____ points	16. Water more than 95 percent of course watering at night
_____ points	17. Consider soil type, soil conditions, and surface conditions affect on water use to maximize water conservation.

Water Conservation (continued)	
_____ points	18. Hand water when appropriate to save water.
_____ points	19. Use a computerized weather station to determine irrigation needs
_____ points	20. Use a GPS and GIS system with computerized weather station
_____ points	**Water Conservation Subtotal**
Integrated Pest Management	
_____ points	21. Implement a written Integrated Pest Management (IPM) plan.
_____ points	22. Reduce pesticide migration to surface waters through the use of structural landscaping such as terraces, buffer strips, and grassed waterways.
_____ points	23. Reduce the volume of runoff and sediment through tillage, contouring, or tile drainage of soils.
_____ points	24. Reduce pesticide losses by diluting the concentrations of chemicals applied to greens.
_____ points	25. Apply pesticides when weather conditions are generally dry to decrease the risks of runoff losses.
_____ points	26. Use pesticides that are less susceptible to runoff losses
_____ points	27. Use cultural pest and disease management practices such as irrigation, cultivation, or adjusting mowing height
_____ points	28. Use mechanical pest and disease management practices such as tillage, hand-pulling, or aeration.
_____ points	29. Use biological pest and disease management practices such as introducing earthworms or plant pathogens.
_____ points	30. Use biopesticides in place of chemical pesticides.
_____ points	31. Manage turf to optimize its health so it is more resistant to disease and damage.
_____ points	32. Have used IPM to reduce chemical pesticide use by 50% or more.
_____ points	33. Using genetically cultivated turfgrass that is pest and disease resistant.
_____ points	34. Have less than 5% thatch and/or mat or do not have any thatch/mat problems.
_____ points	**IPM Subtotal**

EQUIPMENT MAINTENANCE	
Aqueous Cleaning	
_____ points	35. Use a water-based parts cleaning system. **Must complete all of the following to receive the total points**: • Use a water based cleaning solution that contains less than 5 percent volatile organic compounds (VOCs). • Do not contaminate the cleaning solution by washing parts that have been sprayed with chlorinated cleaners or petroleum distillates. • Properly manage spent solution and filters to ensure regulatory compliance
Aerosol Use	
_____ points	36. Buy spray-on products in bulk and use refillable, pressurized spray bottles.
_____ points	37. Use products that do not contain carcinogens, reproductive toxins, chlorinated solvents, or ozone depleting compounds.
_____ points	38. Use products without that do not contain F-listed hazardous waste constituents.
Floor Cleanup	
_____ points	39. Seal off all floor drains and prevent all shop fluids from entering storm drains. Properly manage all waste fluids to ensure regulatory compliance.
_____ points	40. Eliminate use of powdered or granular absorbent for routine cleanup. Use only for emergencies.
_____ points	41. Use the following best management practices for floor cleaning: <u>Small Spills</u> • Use shop towels or rags for routine cleanup. Send reusable shop towels to an industrial laundry service for cleaning and properly manage disposables. <u>Medium and Large Spills</u> • Use a hydrophobic mop for spills that contain oil. Wring out the mop head in a dedicated mop bucket labeled as “Waste Oil.” These mops can be used as the first step in a combined spill (oil/water or oil/antifreeze) cleanup. Send oil for recycling. • Use a regular mop for spills that contain antifreeze. Wring out the mop head into a dedicated mop bucket labeled as “Waste Antifreeze.” Send antifreeze for recycling. • Alternatively, use a squeegee and dust pan to collect spilled liquids. Segregate waste fluids and send for recycling (where possible). • Use a shop towel to clean up any residuals on the floor. Floors may be wet-mopped only after the above floor cleanup procedures have been implemented. Wastewater from wet mopping may be discharged to the sanitary sewer provided the wastewater meets local discharge limits.
_____ points	42. Use progressively finer grates and screens over all floor drains and trenches to collect solid debris.

_____ points	43. Seal shop floor with an impermeable coating such as epoxy.
Oil Bottle Draining	
_____ points	44. For oil not purchased in bulk, drain oil from bottles for at least 12 hours and recycle plastic bottles after draining.
Re-refined oil	
_____ points	45. Use re-refined oil instead of virgin oil in all vehicles and equipment.
Oil Filter Management	
_____ points	46. Recycle used oil filters after the filters are: • Punctured through the dome or anti-drain back valve and then hot-drained (for 12 or more hours at or near engine operating temperature and above 60 °F) • Hot-drained (same requirements as above) and crushed • Dismantled and hot-drained (same requirements as above)
Oxygenated Gasoline	
_____ points	47. Use oxygenated gasoline in all vehicles and equipment.
Antifreeze Recycling	
_____ points	48. Recycle all of your waste antifreeze.
Spill Prevention	
_____ points	49. Use an overhead bulk fluid delivery system.
_____ points	50. Use pump and spigot for dispensing bulk product.
_____ points	51. Use roll-up oil caddies or drip pans to collect oil.
_____ points	52. Use drum funnels on waste drums to control spills.
_____ points	53. Use secondary containment, for all bulk product and waste fluid drums.
_____ points	54. Locate the storage areas for all hazardous materials and waste away from storm and sanitary sewer drains, and protect from weather.
Oil/Water Separator Maintenance	
_____ points	55. Use microbes to digest the oil in your OWS, or collect and recycle the oil.
_____ points	56. Regularly inspect OWS for sludge buildup and clean out sludge before it blocks the wastewater outlet pipe. Properly dispose of sludge.
_____ points	57. Refill the OWS with clean water after sludge cleanout to ensure proper separation/operation.
_____ points	**Subtotal for Equipment Maintenance**

OTHER P2 OPPORTUNITIES	
Food Service	
_____ points	58. Implement Green Restaurant Association 12 eco steps.
Buildings	
_____ points	59. Self assess buildings with US Green Building Council Leadership in Energy and Environmental Design (LEED™) Green Building Rating System.
_____ points	60. Construct new buildings that are LEED™ certified.
_____ points	61. Retrofit existing buildings to become LEED™ certified.
Lighting	
_____ points	62. Replace all lights with energy efficient lighting alternatives.
Purchasing	
_____ points	62. Create environmental preferable purchasing guidelines.
_____ points	62. Purchase environmentally preferable janitorial products.
_____ points	62. Purchase environmentally preferable paper products for office and dining areas.
_____ points	62. Purchase environmentally preferable office equipment.
_____ points	**Subtotal for Other P2 Opportunities**
_____ points	**Grand Total for All Subsections**