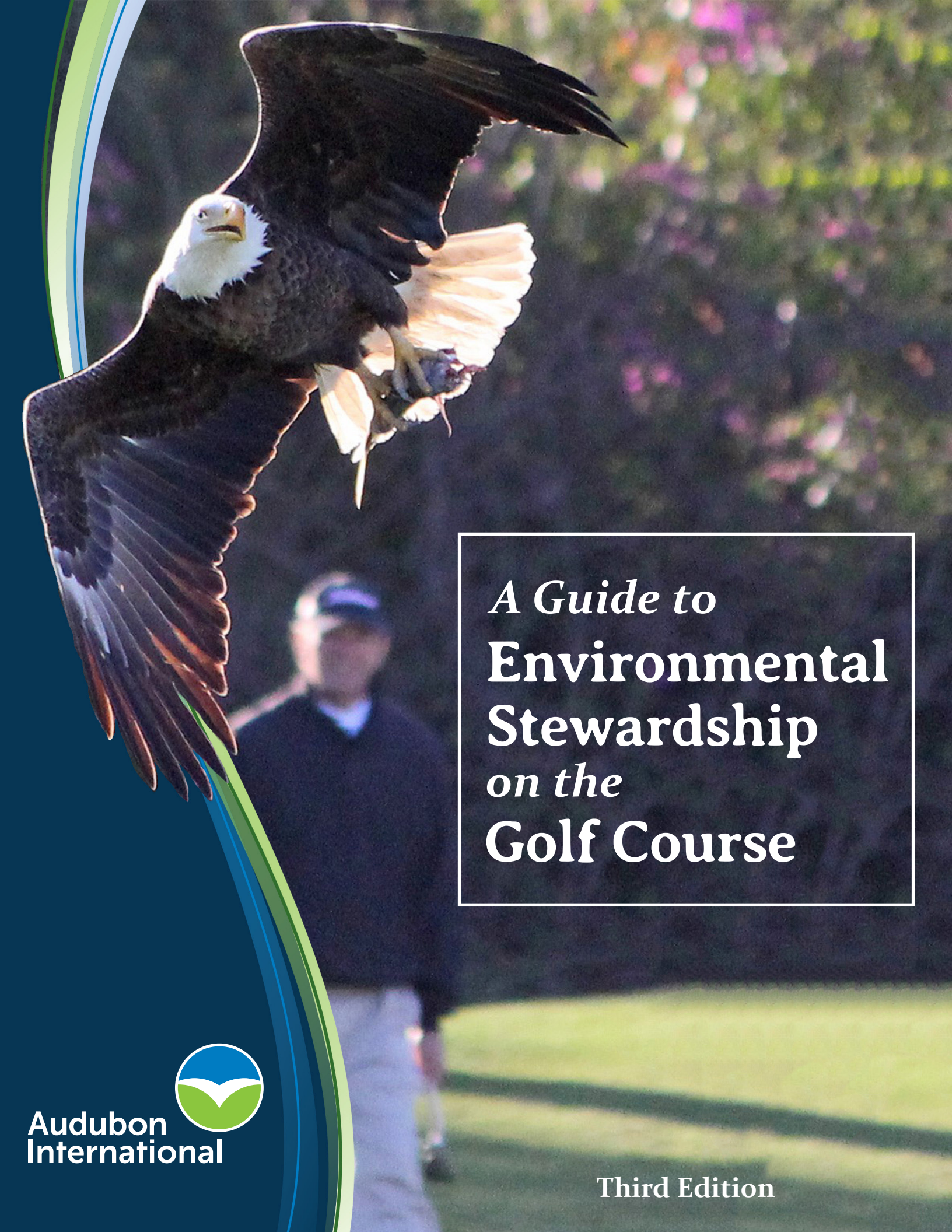

A Guide to Environmental Stewardship *on the* Golf Course

Audubon International

Third Edition

Acknowledgements

This newly revised third edition guidebook incorporates knowledge gained through Audubon International's 30 years of work to help golf courses serve as ecologically valuable green spaces throughout North America and the world, while reducing potential environmental impacts associated with golf course operations. It reflects the expertise and experiences of the thousands of golf course superintendents, as well as golf industry professionals, environmental organizations, university researchers, and others, who have participated in Audubon International's Cooperative Sanctuary Program for Golf Courses since it began in 1991. The cooperative nature of the program has enabled us to learn much from each other and to draw upon innovative ideas, successes, struggles, and day-to-day experiences to strengthen the program and help thousands of golf courses achieve tangible environmental benefits.

We especially thank the individuals who reviewed this third edition and offered suggestions and insights to improve it. Their expertise and assistance have been invaluable.

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Cover Photo – The Sanctuary Golf Club, Sanibel, FL, by Kyle Sweet

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Introduction

What can you do, right now, to be the best environmental steward you can be and implement environmentally sustainable practice on your course?

For people who manage and maintain golf courses, environmental sustainability includes using appropriate cultural and integrated pest management methods, monitoring water quality, and conserving golf course wildlife and their habitats. But these activities must take place within the context of managing a golf course and meeting expectations for playability, aesthetics, maintainability, and fiscal responsibility.

This guidebook is designed to help you blend environmentally sustainable practices into the day-to-day operations of golf course management. From evaluating your resources to developing an environmental plan and taking action, it will give you pertinent information, direction, and concrete instructions for creating a successful Audubon Cooperative Sanctuary golf course.

WHAT'S INSIDE?

Inside this guidebook you'll find information and resources to help you implement a variety of environmental management strategies and achieve certification as an Audubon Cooperative Sanctuary. The book is comprised of seven chapters that cover each environmental component of the Audubon Cooperative Sanctuary Program. A Self-Assessment Checklist is provided at the end of each chapter to help you check your knowledge and assess current management practices. The Appendix includes a variety of resources, such as nest box construction plans, wildlife inventories, sample IPM scouting records, and water quality management guidance.

AUDUBON INTERNATIONAL SUPPORT AND GUIDANCE

Audubon International staff members are available to help you every step of the way. Think of us as resource people whom you can call upon when you need information, have a question, or just want to talk about one of your projects. We are available weekdays from 9 a.m. to 5 p.m. EST. Or if you prefer, contact us via email at acsp@audubonintenational.org.

THE AUDUBON COOPERATIVE SANCTUARY PROGRAM FOR GOLF COURSES

The Audubon Cooperative Sanctuary Program for Golf Courses helps golf courses to enhance wildlife habitats and protect natural resources for the benefit of people, wildlife, and the game of golf. The program is designed to give golf course managers the information and guidance they need to implement environmentally sustainable practices projects and receive recognition for their efforts.

The Golf Program is part of the Audubon Cooperative Sanctuary System, a nationwide network of conservation partnerships that includes colleges, corporate and business properties, and golf courses. It is administered by Audubon International, a non-profit environmental organization that spearheads education and conservation programs that promote environmental stewardship and sustainability.

We'd like to thank the thousands of members, sponsors and individuals whose donations support Audubon International's Cooperative Sanctuary Program for Golf. Very special thanks go to the United States Golf Association for its foresight and early financial support which helped us to develop and establish this award-winning program.

CERTIFICATION OVERVIEW

Achieving certification as an Audubon Cooperative Sanctuary demonstrates your leadership, commitment, and high standards of environmental management and sustainablity. Your first step toward receiving this high honor is to fill out and return your completed Site Assessment and Environmental Plan in the Certification Handbook to Audubon International. Upon acceptance of your plan, your golf course will achieve a Certificate of Recognition in Environmental Planning. In addition, the person principally responsible for developing the plan will receive a Certificate of Recognition. Your Certification Handbook provides all necessary details about gaining certification in each of the remaining environmental components of the program. Once you have implemented your environmental plan and documented your stewardship activities, your golf course will achieve national recognition as a Certified Audubon Cooperative Sanctuary. An additional Certificate of Recognition in Environmental Stewardship will be awarded to the person who is principally responsible for completing all components of certification at a single golf course. This recognition may be used to promote your commitment to stewardship and competency in implementing a comprehensive environmental management program.

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A successful environmental plan balances the needs of golfers with the course's responsibility to care for the environment.

Chapter 1: Environmental Planning

CONTENTS

Overview

The purpose of environmental planning is to balance the demands of golf with your responsibility to the natural environment. Your plan will help you safeguard the quality of the environment and care for the water, land, and wildlife habitats of your golf course in a responsible, sustainable manner.

Many conservation projects can be pursued that benefit wildlife, protect natural resources, and still allow you to manage your golf course with a high degree of playability. Projects include managing woodlands, ponds, and golf play areas with the needs of wildlife in mind, implementing integrated pest management techniques and Best Management Practices (BMPs), conserving water, keeping your maintenance facility environmentally sound, and incorporating new conservation-related technologies when possible.

The best way to get started is to develop an environmental plan to direct and guide your efforts. This section provides an overview of how to assess the available resources and create and implement a successful environmental plan.

Environmental Planning involves assessing your course's natural resources, formulating strategies for environmental improvements, and identifying people who can advance your stewardship efforts.

Golf and the Environment

Ecosystems provide services that benefit both humans and wildlife. This includes provisioning services such as food and water, regulating services such as temperature moderation and stormwater management, recreational services, and supporting services such as nutrient cycling, water cycling, and provisioning of habitat. Ecosystems provide and maintain the conditions necessary to sustain life on Earth. As our world becomes increasingly urbanized, environmental stewardship of developed land takes on increased importance in preserving ecosystems. The management of natural resources within developed environments directly relates to the quality of life, health, and the area's economy.

Developed environments are characterized by a higher density of homes, buildings, streets, and other infrastructure that support human habitation and economic activity. These characteristics significantly influence environmental quality. For example, impervious surfaces do not allow for water infiltration and therefore significantly increases stormwater runoff to local waterways. Developed landscapes typically feature fragmented green space, heat island effects, and degraded habitat for native species. In addition, human activity can lead to over-reliance on nutrients and pesticides, increased erosion and sedimentation, and increased water usage. These, in turn, can degrade environmental quality, including water quality, reduce habitat availability, lead to population declines for native species, and impact pollinator health. Human health can also be compromised by exposure to pesticides and contamination of drinking water.

Golf courses, which are large expanses of green space in otherwise developed areas, can by their very nature contribute significantly to environmental outcomes that greatly benefit people and wildlife. Because the majority of lands occupied by golf facilities are comprised of pervious surfaces, golf courses can cycle water efficiently by allowing for infiltration and can reduce heat island effects of developed environments. In addition, golf courses can provide expanses of habitat that would otherwise largely unavailable in urban areas. In North America, the average golf course covers 150 acres, yet just 30 percent is generally used for greens, tees, fairways, and buildings, leaving 70 percent as rough, woods, water, and other habitat (source: United States Golf Association Green Section). In addition to offering habitat, these areas provide corridors that link to other natural areas. They also filter pollutants, produce oxygen, and stabilize soils.

At the same time, golf courses have been called on to address environmental concerns related to water consumption and the impacts of chemical use on local water sources, wildlife species, and native habitats. New golf course developments raise additional land use concerns, but also present excellent opportunities to showcase sustainable design and development. Certification in the Audubon Cooperative Sanctuary Program (ACSP) provides an

opportunity to maximize the ecosystem benefits that golf courses can provide and to minimize any potential environmental concerns. The program also serves as a blueprint to help superintendents achieve environmental sustainability goals.

General Knowledge

Environmental planning is the process of facilitating decisions about land management activities with consideration given to the natural environment in the context of the other factors (social, political, economic, etc.) as well. An environmental plan provides a holistic framework to achieve environmentally sustainable outcomes.

Your environmental plan and efforts will serve as a blueprint for maximizing environmental assets and minimizing environmental problems on the golf course. This involves determining what resources and opportunities for environmental improvement exist on your course, evaluating current management practices and any liabilities, and outlining a plan of action based on realistic goals and objectives.

THE MANAGEMENT CONTEXT

Every golf course is unique in terms of its setting, but also in terms of its organizational structure, policies, golfers or members, staff, and budget. This management context provides a backdrop for all golf course maintenance decisions and activities. In addition, every golf course operates with an environmental management context that includes the course's natural landscape features, such as trees, shrubs, water bodies, and terrain, as well as the surrounding landscape and ecological region.

For management decisions and practices to have the greatest benefit for golf and the environment, they must take place not only within the context of the course itself, but also within the broader landscape in which the golf course is connected. Your environmental plan will help you account for the needs of your staff, the needs of golfers, and the needs of wildlife and the environment before you implement specific projects. A plan must take these factors into account:

- **Golf Course.** The location, style, and layout of the course itself, combined with the quality and quantity of natural habitats, such as woods or open fields, constitute the primary site features that influence the environmental context in which you are working. The golf course management context also includes golf activity, traffic, speed of play, golfer expectations, and club politics.
- **Surrounding Land Use.** Urban, suburban, or rural characteristics, plus actual neighboring land uses have a strong influence on plant communities, wildlife species, water, and other environmental aspects of the golf course.
- **Natural Plant Communities.** Natural plant communities, such as forests, grasslands, and wetlands, are made up of distinct native, or indigenous,

plant species. These are species that originated in your region, rather than being introduced from Europe, Asia, or other continents. Native plants are part of complex communities of plants and animals that thrive together and give each region its unique character and biological diversity.

- **Watershed.** A watershed is the area of land that drains into a body of water, such as a river, lake, estuary, and eventually the ocean. Watersheds are bounded by the highest ridgelines around stream channels and where they meet at the bottom or lowest point is where water flows out of the watershed. Identifying and defining watersheds depends on the scale at which the landscape is examined. At the scale of a golf course, a watershed will most likely be small and represent a single tributary within a larger system (such as a sub watershed). It is important to understand the location of your golf course within its watershed, as upstream land use activities can affect your irrigation and stream water quality, and downstream water bodies can potentially be affected by your practices.

- **Ecological Region.** An ecological region, or ecoregion, is defined as a relatively large area of land or water that contains geographically distinct natural communities. Natural features, such as geologic history, soils, landforms, topography, vegetation, and climate, define ecoregions. The ACSP membership packet contains information regarding the ecoregion in which your golf course is located.

ENVIRONMENTALLY SENSITIVE GOLF COURSE MANAGEMENT

To maximize environmentally sensitive management, key staff members, including the superintendent, assistant superintendent, golf pro, club manager, greens committee and management executives, must work with golfers to accomplish what is good for both the game of golf and the environment.

A number of additional efforts are underway to help superintendents identify key practices for environmentally sensitive and sustainable golf course management. For example, some states now have a specific Best Management Practices (BMP) document specifically designed for that state's golf courses. BMPs, the methods or techniques found to be the most effective and practical means of achieving an objective such as preventing water pollution or reducing pesticide usage, have been primarily formulated to protect water quality. Many BMPs reduce stormwater volume, peak flow, and nonpoint source pollution through evapotranspiration, infiltration, detention, filtering, as well as biological and chemical actions. Though the general principles of BMPs for golf courses are included in this handbook, superintendents are encouraged to review their state's BMP document (if available) and the environment page on the Golf Course Superintendents Association of America (GCSAA) website.

Whereas BMPs address individual problems, some golf courses have developed a facility-wide Environmental Management System (EMS). An EMS is a set of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency. Like participation in the ACSP, an EMS encourages an organization to continuously improve its environmental performance. If an EMS is in place at your facility, it can be used to help develop the environmental management plan for Audubon certification.

Developing an environmental plan and participating in the ACSP paves the way for dialogue, policies, and practices that support sound environmental management.

Develop an Environmental Plan

Preparing an environmental plan has multiple benefits. It will help you coordinate your environmental activities, illustrate how environmental conservation activities complement one another, and pave the way for greater efficiency. Your plan also will help you better communicate your stewardship efforts to fellow employees, management, and the public. Further, you will have written documentation of your environmental goals and accomplishments and a means to evaluate your progress.

Although your plan can be relatively simple or very complex, it should include environmental management strategies in key areas:

- Wildlife and Habitat Management
- Chemical Use Reduction
- Chemical Safety and Maintenance Operations
- Water Conservation
- Water Quality Management
- Green Infrastructure and Energy
- Outreach and Education

Developing a plan involves a step-by-step approach that will take you from evaluating your resources to implementing projects to evaluating your success.

EVALUATE RESOURCES AVAILABLE FOR THE PLANNING PROCESS

To set realistic goals and outline a plan for achieving them, you should first determine your key resources and any site constraints, as well as management strengths and weaknesses. In addition, it helps to visually identify and record your resources by creating a map and taking photographs of your golf course. Together, a site assessment, map, and photographs will serve as valuable baseline information and help you effectively communicate with others about the basis of your plan.

CONDUCT A SITE ASSESSMENT

The *ACSP Certification Handbook* includes a Site Assessment form to guide you in evaluating your site. The Site Assessment asks for general information about the golf

course and management context, as well as information about key landscape features, such as turf surfaces, gardens, natural plant communities, and water sources, and high priority areas to protect, such as listed species habitat or areas with soil or geological characteristics more prone to water quality impacts. These site features along with golf course facilities, finances, equipment, and personnel represent your primary resource base.

As you consider your environmental plan, think about your property, its specific characteristics, and how much time and money you have to invest. You also may wish to draw upon information from the golf course architect, irrigation engineer, United States Golf Association (USGA) Turf Advisory Service reports, or local environmental organizations and consultants. The strengths, weaknesses, and unique qualities of your property highlighted in your Site Assessment need to be factored into your plan.

An important part of assessing your golf course is to create a property map to highlight existing resources and project opportunities. Use your map as a baseline from which to work. It should serve as a record of what currently exists and be used to sketch plans for habitat enhancement or other environmental improvement projects. Over time, update your map as needed, but be sure to keep a copy of your original so that you have a record of what you've accomplished. Your map can be a useful tool for visually communicating your plans and charting your progress.

Step 1: Create a map.
You may use an existing site map (an irrigation map or scorecard can work very well), a digital map, or sketch a paper map that includes the major features of your site. For digital maps, free programs are available online for map creation (such as Scribblemaps.com). Your map should include the following components:

- Property boundaries.
- Existing turfgrass and major habitat areas, such as woods, meadows, water bodies, and other natural features. If the property is relatively small, sketch and label existing trees and shrubs.
- Any known environmentally sensitive areas, such as:
  - Habitat for listed or rare species or species of special concern.
  - Steep slopes that lead to surface water.
  - Areas with a shallow depth to groundwater.
  - Areas with karst topography or other geologic features more susceptible to water quality impacts.
- Existing low/no maintenance areas.
- Any degraded habitats, such as those with extensive invasive species encroachment.
- Buildings and other permanent structures.
- Roads, walkways, and service corridors.

- Above- and below-ground utility rights-of-way and irrigation lines, if applicable.

Step 2: Label features and indicate north-south orientation.
You may also want to note existing drainage patterns on your baseline map, especially if seasonal drainage will affect naturalization plans. Identify where water (i.e. streams, creeks, etc.) enters your property and where it leaves.

Step 3: Check your map.
Walk your property to be sure that your map is accurate. You may note items that need to be added or corrected. Make adjustments as needed, so that your map provides a good visual record and reference for your work.

GATHER EXISTING INFORMATION

Some existing information may be available that will serve as a valuable reference during the planning phase. Examples of the kinds of information that may exist include the following:

- Previous water quality monitoring reports from your course or adjacent areas.
- Water quality data available from government sources (e.g. your state environmental agency, the United States Geological Survey, a county agency, or a Soil and Water Conservation District).

- Existing plans and records for your course, such as a nutrient management plan or integrated pest management (IPM) plan and accompanying records.
- Your state golf course BMP document (if available).

During the process of creating your environmental plan, you may want to develop a water monitoring program, create new plans (such as a nutrient management plan, IPM plan, or water conservation/drought plan), or update existing plans. Having a dedicated area where this information is stored increases the likelihood that these valuable references will be available when needed.

Define Goals and Objectives (Environmental Policy)

A goal is a broad statement of what you ultimately want and value most and concisely expresses the reasons you're doing this and what you want to accomplish. A golf course may choose to develop an environmental policy as a club in order to internally clarify these goals with stakeholders and to publicly communicate these goals and principles of action in relation to the environment. Setting an environmental policy involves active discussion with club members and employees and becomes a foundation for identifying objectives – the measurable steps that must be completed to achieve each goal – and strategies for achieving each objective.

An environmental policy may include a stated commitment to:

- Continually improve environmental performance and sustainability.
- Comply with relevant regulations.
- Minimize the impact on the environment of all activities within the golf course by using Best Management Practices.
- Optimize efficiency of resource use.
- Facilitate communication at all levels at the course.
- Increase environmental awareness among the users of the golf course and the wider community.

This guidebook and the A*CSP Certification Handbook* set forth broad goals in each environmental component, objectives for each goal, and strategies to guide you toward implementing sound environmental management practices. You also may choose to modify or develop new objectives and strategies to meet your site-specific needs and available resources.

IDENTIFY SPECIFIC STRATEGIES

Each section of this guidebook, along with the Environmental Planning Form in the *ACSP Certification Handbook*, suggests conservation activities and environmental management strategies that provide a benchmark for environmental sustainability on the golf course. These projects and practices will help you to meet the goals set forth for each environmental component of

the program. Review the checklists in the Environmental Plan, or at the end of each section of this guidebook and identify projects to extend your current stewardship efforts.

As you develop your plan, remember that all the environmental quality areas addressed in your plan are interrelated. For instance, water quality affects the types of wildlife that are able to thrive in ponds, lakes, and streams; birds utilizing nest boxes can reduce insect activity and be part of your integrated pest management strategy; the pesticides you use may affect the wildlife you attract; and educating people about your efforts can create public support for your efforts. The more comprehensive and carefully prepared your plan, the greater the benefit for wildlife, the environment, and your golf course.

DEVELOP A TIMETABLE

Look at your schedule and the yearly calendar and develop a realistic time frame for implementing projects. Use winter months for planning, research, indoor conservation activities, and documentation. Concentrate planting projects, water quality activities, and outdoor conservation during spring and

Strategy Example

Goal: To evaluate, plan, and document environmental management practices that balance the demands of golf with our responsibility to the natural environment. To safeguard the quality of the environment and responsibly care for the land, water, wildlife, and natural resources in a sustainable manner.

Objective: Plan projects that ensure overall environmental quality and evaluate progress on a yearly basis.

Strategies:

1. We have reviewed the Guide to Environmental Stewardship on the Golf Course and understand that this resource will help us to conduct various environmental projects and practices.
2. We have started a Resource Advisory Group to help plan and implement environmental projects and educational efforts on the golf course.
3. We evaluate progress at least once per year.
4. We train all employees regarding the importance of environmental performance and specific techniques for ensuring environmental quality.
5. We regularly communicate to employees, customers, stakeholders, and community members about environmental goals, issues, project implementation, and progress.

summer. Fall is an excellent time for planting projects, waste management, end-of-season wrap-up, and evaluation.

ASSIGN TASKS

Keep in mind that environmental projects are most successful when many people support them. Involve fellow employees, regular golfers or members, or neighboring homeowners when possible. Though one person may be the driving force behind developing and implementing an environmental plan, the work involved in maintaining an environmentally sustainable golf course cannot be borne by one person alone. The plan must have broad support to be sustained for the long term. Assigning tasks to various staff or members of a Resource Advisory Group is an effective way to share the responsibility and the enjoyment of environmental management projects.

EVALUATE EFFECTIVENESS

Whether you are just getting started or are actively involved in environmental management, review your Environmental Plan and progress on implementing it on a yearly basis. This will ensure your success and guide your stewardship efforts. Many golf courses arrange a meeting at the end of the season to formally evaluate what worked, what got accomplished, what didn't go well, and why. This is the time to review the strategies for achieving your goals and objectives and to add to or amend the strategies as needed to increase their effectiveness.

Encourage Involvement

FORM A RESOURCE ADVISORY GROUP

To help you get started and share the work involved in participating in the ACSP, gather a group of people who can help you implement projects or provide technical advice along the way. This resource team should be a group of people who will volunteer their time and energies to develop and implement projects. Your group could include employees, managers, board members, and at least one person from the local community with expertise in the types of projects you wish to pursue.

Your resource team may want to meet on a regular basis to organize and plan projects, or they may simply be available via telephone to answer questions and serve as a reference for technical information. Think of it as a resource for information and support for your efforts. Members of the Resource Advisory Group can also become Audubon Steward Network members.

Whomever you select, the group should have several functions or purposes:

- **Planning.** With staff guidance, the resource team members can help determine short-term and long-term goals. Share your environmental plan with them and ask for suggestions. Determine what can be accomplished in logical steps and in a manageable time frame.

- **Technical knowledge.** Resource people can provide the technical knowledge needed to develop species

lists, provide wildlife information specific to your area, consult on chemical reduction strategies, or provide on-site consultation with other projects. Reaching out to local experts is an excellent way to expand your knowledge and meet people from your community who support conservation.

- **Volunteer work.** Resource people may volunteer time and help to implement and monitor specific projects. They can check nest boxes, record wildlife species, or develop an informative brochure that describes your work. The more people involved, the more quickly your projects will take shape.
- **Publicity.** Sometimes it is awkward for you to take credit for positive projects by writing press releases and advertising the good things you are doing. Resource advisory members or your marketing department can help publicize your environmental efforts.
- **Continuity.** Though staff assignments may change, the commitment to the environment at your golf course should remain constant. Your Resource Advisory Group will provide continuity and ensure that you achieve your long-term goals.

GET PEOPLE INVOLVED

You can involve golf course employees, including maintenance staff and club personnel, and Resource Advisory Group members every step of the way from environmental planning to project implementation. Here's a simple outline of how to get people involved:

Potential Resources

- Club members and employees
- Property neighbors
- Cooperative Extension agent
- Local nature center staff
- Local Audubon Society member
- Local watershed group members
- Ducks Unlimited member
- Wildlife rehabilitator
- Local nursery owner
- School teacher
- Garden club member
- Soil and Water Conservation District employee
- University or college professor or students
- Federal, state, or local conservation officer

Step 1: Provide information and invite participation.
Inform employees and potential Resource Advisory Group members of your participation in the ACSP. Tell them that you are going to review environmental practices and expand environmental programs in the following primary areas:

- Wildlife and Habitat Management – natural areas and outdoor landscaping.
- Chemical Use Reduction – turf health and management, IPM.

- Chemical Safety and Maintenance Operations – management operations that protect human health and the environment.
- Water Conservation – water use efficiency.
- Water Quality Management – water quality and water features.
- Green Infrastructure and Energy – facility conservation technologies and measures.
- Outreach and Education – employee and community participation and public relations.

This section includes a sample memo you can use to inform people of your involvement and invite their participation. Interested staff can help complete the *Site Assessment and Environmental Plan*. You should seek out people with specialized skills to contribute to specific projects, such as conducting a wildlife inventory or water quality testing.

Step 2: Ask for input and list strengths.
As you plan projects in each environmental component, ask employees for their suggestions. List efforts that are in place, can be built upon, and will serve as positive models.

Step 3: Assign tasks and implement projects.
Inform employees and members of your Resource Advisory Group of all projects you are initiating and be specific about how you want them to participate. You can distribute a copy of your environmental plan and assign specific tasks. Rather than take the lead role in implementing all ACSP projects, many superintendents serve as facilitators who get the ball rolling and coordinate tasks. This eases work involved and spreads ownership and enjoyment of participating in the ACSP.

Sample Memo

To: All staff

From: Project Manager

RE: Participation in Audubon Cooperative Sanctuary Program for Golf Courses

We have recently decided to participate in an exciting environmental improvement program for our golf course. The Audubon Cooperative Sanctuary Program (ACSP) provides information, guidance, and support to help golf courses conduct proactive environmental projects that benefit people and the environment. We have many sound environmental practices in place already, and this program will help us expand upon these and gain recognition for our efforts.

The program addresses key environmental quality areas: Wildlife and Habitat Management, Chemical Use Reduction, Chemical Safety and Maintenance Operations, Water Conservation, Water Quality Management, Green Infrastructure and Energy, and Outreach and Education. Our first step is Environmental Planning. During the next month, we'll be filling out a Site Assessment and Environmental Plan to tell Audubon International staff about our organization and the types of projects we want to pursue. They will then have a better sense of who we are and what our goals are.

Once we have implemented a variety of projects in each environmental component, we can apply to become a Certified Audubon Cooperative Sanctuary. This exemplary distinction is a national recognition of environmental excellence bestowed on organizations that are taking a leadership role in environmental sustainability. We believe we can achieve certification within the next year, but we need everyone's involvement to achieve success!

As we begin this program and start the planning process, we welcome your input. We will be hosting a short information meeting on date/time for all interested employees. If you have ideas to share or just want to hear more about this program, please come!

Environmental quality and sustainability are important to our golf course. We hope you'll support this effort every step of the way.

Self-Assessment Checklist

A comprehensive environmental plan is your road map to a successful environmental management program. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

- Fill out the *Site Assessment and Environmental Plan* from Audubon International and develop a map of the property that highlights wildlife habitat, water sources, and management zones to use for environmental planning and project implementation.
- Evaluate progress toward goals and objectives at least once per year.
- Train all employees regarding the importance of environmental performance and specific techniques for ensuring environmental sustainability.
- Regularly communicate to employees, members or golfers, stakeholders, and community members about environmental goals, issues, project implementation, and progress.

Non-play areas of the golf course can be managed to attract desirable species and provide needed habitats for native plants and wildlife.

Chapter 2: Wildlife and Habitat Management

CONTENTS

Overview

Habitat management enhances natural areas and landscaping on the golf course to protect and improve native habitats and the species that depend on that habitat for survival.

Because of the large expanses of undeveloped areas at golf courses, the opportunity to manage and increase the amount of natural areas and biodiversity is an important, yet sometimes challenging, part of creating an environmentally sustainable golf course. Focusing on four primary goals helps maximize the benefits of your efforts:

1. Continually expand your knowledge of the habitats present on your course and the plant and animal species that inhabit these areas.
2. Enhance habitat for a variety of native species in non-play and landscaped areas, primarily with native plants.
3. Create habitat that offers the necessary resources for desirable species and provides corridors that connect these areas.
4. Protect habitats on your course and restore degraded areas, including identifying and removing invasive species.

Whether you have a tight layout or large expanse of existing natural areas, a restricted budget or more significant sources of funds, a small staff or larger one with volunteers too, there are a variety of projects that can suit your site, budget, and maintenance operations. This section will help you understand the needs of wildlife, identify the places on your course that currently provide the best habitat, and choose appropriate projects for your site.

General Knowledge

Golf courses provide valuable open space for people and wildlife, especially in urbanized and suburbanized landscapes with limited green space and fragmented habitats. Equipping yourself with some basic knowledge of the ecology of your region, the types of existing habitats found within your facility and adjacent to it, the species already present, and the plants native to your region will help you manage these areas with confidence, Your staff is a valuable resource in these efforts and will likely welcome the addition of a sustainability component to your management efforts.

ECOREGIONS

Ecologists divide landscapes into ecological regions, or ecoregions, which are defined by natural features, such as geologic history, soils, landforms, topography, vegetation, and climate. Within each broad terrestrial ecoregion are distinct plant communities that give each part of the region its unique natural character. Though boundaries between plant communities grade into each other, characteristic trees, shrubs, and wildflowers, and wetland species emerge to define the landscape. For more information on ecoregions and maps to identify your ecoregion, see the following resources: the U.S. Forest Service Ecoregions web page that

links to ecoregion maps of the United States, North America, and the world, and the World Wildlife Fund Ecoregions web page.

Within each terrestrial ecoregion are distinct plant communities. For example, the Tallgrass Prairie/Great Plains region includes Oak/Hickory forest, Maple/Basswood forest, Bluestem Prairie, Oak Savanna, Beech/Maple forest, and Elm/Ash forest. Each plant community has characteristic species that predominate, as well as associated species commonly found within the plant community. Researching the native plant species for your ecoregion helps to identify the plants to protect and conserve on your course and the potential native species additions.

When you landscape with plants that are characteristic of your area, you help to preserve not only the unique local character of your area, but the overall biological diversity. Working with the natural characteristics of your region can have far-reaching environmental benefits, such as:

- Conserving and restoring the biological diversity of plants and animals.
- Maintaining or potentially improving water quality.
- Increasing land use sustainability.
- Improving aesthetics.
- Lowering maintenance costs.
- Creating positive, progressive, and constructive attitudes about the natural world.

HABITAT REQUIREMENTS

To sustain diverse animal populations (including animals, insects, reptiles and amphibians), individuals must be able to find suitable food, ample water, and safe cover. The physical area that provides these resources for animal species is known as its core habitat and includes:

- **Space.** The amount of space required by animals varies greatly. The layout of your course, size of existing natural areas, and surrounding land uses determines how much suitable habitat your golf course provides for sustaining biodiversity.
- **Food.** All animals need a food source. For example, nuts, berries, and seeds are especially valued food sources for many birds and small mammals. Pollinators need a variety of flowering plants, shrubs, and trees. Amphibians typically eat insects and other invertebrates such as spiders, snails, slugs, and earthworms.
- **Water.** In addition to being a basic need to sustain life, water sources, such as ponds, wetlands, and streams serve as a vital habitat for fish, salamanders, frogs, and aquatic insects.
- **Cover.** This general term includes places that provide protection for species to carry out life functions, such as breeding, nesting, sleeping, resting, feeding, and travel.

BIODIVERSITY

Golf course settings can provide different types of habitats, such as wetlands, woods, open fields, deserts, and ponds. On a golf course, native habitats in non-play natural areas combined with water features, gardens, and landscaped areas, provide the primary food, water, and cover sources for species that inhabit or travel through the facility. What are the best habitat areas present right now on your golf course? Do you have some acreage of woods, tall grasses or prairie, desert, or wetland? Consider these areas to be your core habitats. By protecting these areas from disturbance, you will go a long way toward supporting biodiversity on your course.

In addition to identifying current habitat areas, projects that enhance, expand, or connect these areas increase the quality and quantity of habitat available. In addition to knowing the available habitat on your property, it's important to think beyond property boundary lines. Retaining natural corridors that may span across property boundary lines should be a high priority, as corridors can help to mitigate the effects of habitat loss and fragmentation. For example, an adjacent wetland area can be connected by a corridor to a wetland on your property, which will benefit many species, such as amphibians. Conversely, if you are surrounded by housing or commercial development, certain species that are sensitive to landscape fragmentation and need larger areas to achieve a sustainable population size will not be regularly observed on your property.

Keeping in mind this big picture, the key to successful management for sustaining biodiversity is using and enhancing the space you have, creating habitat, and restoring degraded habitats. The greater the variety of plants and habitats on your course, the more species of wildlife you will attract. Ultimately, the keys to managing a property for wildlife are diversity and sustainability.

WILDLIFE INVENTORIES

Gathering baseline data about your property resources includes inventorying the species inhabitants. You don't need to be an expert to begin. A good field guide, species inventories for your area/region (check your state or regional natural resources agencies to start), and binoculars will help you get started. Volunteer groups, such as local birding clubs or university classes, may also be interested in conducting inventories. Any historical information, such as absence of previously seen species or identifying keystone species, can be included in the inventory as well. A keystone species is a species that helps define an entire ecosystem and is typically a predator. Without its keystone species, the ecosystem would be dramatically different.

Inventories provide important documentation of the species of birds, mammals, amphibians, reptiles, and some insect groups that utilize habitat on your course. Baseline inventories provide a species list of common inhabitants on your course. Periodic inventories provide important biodiversity data that can be analyzed. Sightings of rare, endangered, or unusual animals should be recorded whenever they

occur. In addition, conducting breeding season surveys identify those species that reproduce on the property. Breeding habitat should be a high priority for your conservation and enhancement efforts.

Your inventories should include at a minimum the following information:

- **Species Name.** Identify each species, grouped according to general categories, i.e. mammals, birds, insects, amphibians, and reptiles.
- **Location.** This information helps identify the preferred habitats of each species. Over time, the area utilized on your site by a species can be identified from location records.
- **Date, Time, and Special Comments.** The date, time and other information related to behaviors (such as feeding, nesting, or migration) help you understand how habitat is utilized on your property.

Over time, the information in your inventories can help to identify trends, such as changes in wildlife population levels or habitat utilization. Refer to the Appendix for wildlife inventory checklists to record species on your course. In addition, consider joining citizen science efforts to record sightings of different species, such as the Audubon International's BioBlitz, The Great Backyard Bird Count, Bumble Bee Watch, FrogWatch USA, and Cornell University's NestWatch to name just a few.

NATIVE PLANTS

Another key management strategy for preserving the rich biological diversity of your region is to landscape primarily with native plants. Native plants originated and grow naturally in a particular region or habitat. Landscaping with native plants can be done on any golf course, regardless of size. They can be planted in flower gardens, natural habitats, and landscaped areas around buildings, entry roads, or property borders. Unlike many non-natives, these plants are well adapted to local climate and soils and provide good sources of food and cover for wildlife.

LANDSCAPE DESIGN

Landscaping with native plants is not much different from landscaping with common naturalized or exotic garden trees, shrubs, and flowers. But your success with natural landscaping and native plant gardening

Sample Wildlife Inventory

	Date	Location—Habitat	Comments
Category: Bees			
Mason bee	5/10/18	Native wildflower area	Nesting in bee block
Common eastern bumblebee	5/25/18	Landscaped area near clubhouse	Pollinating flowers
Golden northern bumblebee	6/1/18	Native wildflower area	Using bumblebee nest box

The Benefits of Landscaping With Native Plants

- Maximizes the effectiveness of habitat management efforts.
- Provides food and cover for native wildlife species.
- Provides a full complement of species in the plant communities on the course.
- Reduces water, fertilizer, and chemical inputs.
- Reduces the need for high intensity maintenance.
- Preserves the unique biological diversity of your region.
- Helps the golf course become a valued part of local green space networks.

may depend upon thoughtful planning and landscape design. Consider the full spectrum of landscaping as a continuum from highly artificial designs to those that carefully recreate an ecological community. The choice of plant material, design, and purpose of each varies widely and each carries a distinct aesthetic appeal.

When you plan additions to your landscape this year, let the following questions guide your overall design and plant selections:

- What type of landscape design do you and your stakeholders prefer?
- What is the current landscape aesthetic of your property – traditional, formal, informal, natural?
- What are some of the areas on your property that lend themselves to natural landscaping?
- Are there areas that could be shifted from high intensity management to lower intensity management?
- What are some of the native trees, shrubs, and flowers on your property that have the greatest aesthetic appeal?
- What native plants could be added that fit well with the current landscape design and add to the property's structural diversity and overall wildlife habitat?
- Do your landscape or naturalization plans fit with existing site conditions, such as climate, topography, hydrology, soils, and vegetation?

Audubon International recommends that at least 80 percent of golf course plantings be native. The Audubon International New Member Packet provides a regional native plant list and native plant source list to all ACSP members. Not all nurseries sell native plants, though many carry the most common varieties. You may have to seek out nurseries that specialize in native plants to find certain species, especially shrubs and wildflowers unique to your region, keeping in mind that nursery stock grown in your area tends to be better adapted to local growing conditions. Local native plant societies may also be a source for planting stock. The Lady Bird Johnson Wildflower Center can provide full lists of native plant shops in North America.

Landscape Design Considerations

	Plant Type	Design Considerations	Plant Selection
Traditional Landscaping	Use of non-native and possibly native species	Arrangement in formal or informal designs	Plants chosen for aethetic value only
Natural Landscaping	Use of native plants	Designed to simulate natural areas and enhance wildlife habitat	Plants chosen for aesthetic and wildlife value and to preserve integrity of the site
Ecological Restoration	Use of full complement of native plants	Designed to recreate a natural community and stimulate community ecologial processes	Plants chosen to maximize ecological community structure and functioning

Though native plants are preferred, we recognize that native plants may not always match the aesthetics you are trying to create. Alternatives to native plants come in two forms: naturalized plants and ornamental plants. Naturalized plants are those that have established themselves in an area distant from their origin. Many of North America's non-native, naturalized plants came on the boots and cargo of immigrants and have successfully established themselves throughout the country. Ornamental plants are those that have been bred throughout the years, usually from non-native stock, for aesthetic appeal. Ornamentals are commonly found in nurseries and, if chosen wisely, can be used as both food sources and aesthetically pleasing landscape plants.

When buying ornamentals, you should verify that they are not classified as exotic or invasive plants, since these plants are growing outside of their place of origin and can outcompete native species. Many natural resource agencies and native plant societies maintain lists of plants known to exhibit invasive characteristics in the area. For example, the Natural Resources Conservation Service (NRCS) lists noxious weed species by state. Audubon International can also help you to identify plants to avoid for your specific location.

INVOLVING STAFF

Just as the golf course crew is trained to cut the grass, aerate turf, and maintain equipment, your crew needs to know what areas on the course are considered most valuable for sustaining biodiversity and how they can participate in efforts to protect it. During training sessions or staff meetings, provide examples of management practices that positively enhance or adversely impact biodiversity.

Involve employees in developing and carrying out your habitat management

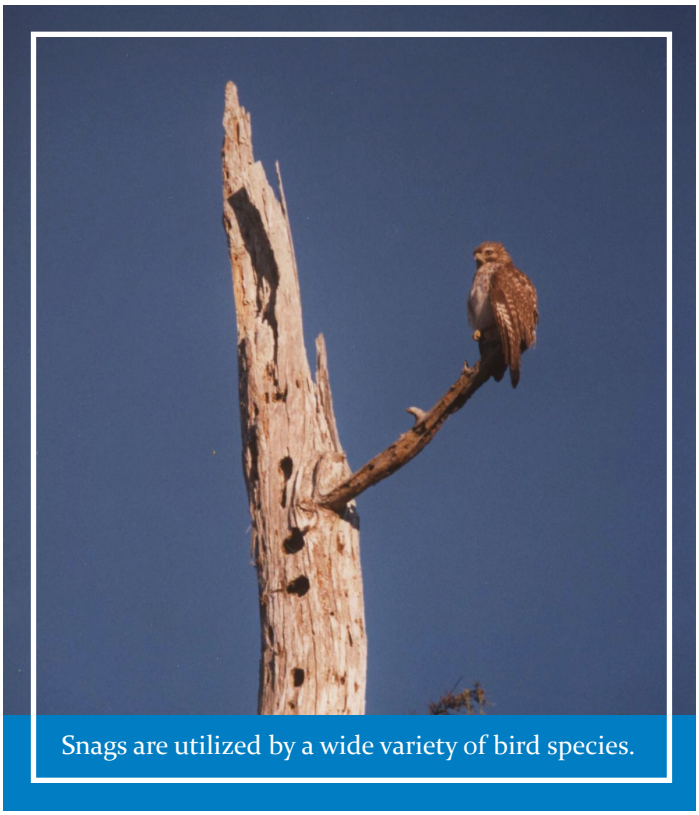
plan so that they are familiar with your goals and priority management practices. Many superintendents have found that getting their maintenance crew involved in natural resource management activities and inventories improves their overall job satisfaction since it heightens the value of their work.

Enhance Existing Habitats

A variety of existing habitats may be present on your course, such as:

- Landscape areas and gardens
- Woodlands
- Prairies/grasslands/fields
- Wetlands
- Surface waters (ponds, lakes, and streams)
- Deserts

Having a general understanding of these habitats, including the types of species that are found based on your inventory results and the types of plants native to these habitats in your region will help you identify ways to enhance these habitats. Enhancement efforts can focus on any number of efforts that are not time intensive or expensive. Examples of these types of enhancements are provided below, but with a little bit of effort, you can come up with any number of efforts that will provide additional resources for one or more of the basic wildlife needs (space, food, water, cover, nesting sites).



Snags are utilized by a wide variety of bird species.

EXAMPLE 2: SUPPLEMENTAL NATIVE PLANTING

Utilizing the information on native plants to your area, you can select supplemental plantings to increase the food and cover needs of wildlife. Consider your goals with supplemental native planting and incorporate ecological principles into your planning, such as ensuring the habitat includes ground, low, medium and tall vegetation and planting clusters of vegetation rather than isolated plants. Your considerations can be specific to the wildlife you want to attract as well. For example, pollinators can use a diversity of flowering plants, including flowering shrubs and trees, in different areas of your golf course, such as the landscape areas and gardens, prairies/grasslands/fields, and wetlands. Some species, such as monarchs, will require

very specific plant species (e.g. milkweed for monarchs). See the website for Monarchs in the Rough, which is a partnership between Audubon International and the Environmental Defense Fund, to learn more about helping this species that has experienced significant population declines.

EXAMPLE 3: BRUSH PILES

Wildlife brush piles provide shelter for small mammals such as red fox, woodchucks, weasels, skunks and chipmunks as well as garter snakes, salamanders, and more, including numerous bird species. Good sites for wildlife brush piles are along forest edges, in woodland openings, at field edges and corners, and beside streams and wetlands. Brush piles are most effective when placed near food and water sources.

Several strategically placed medium-size piles, roughly 10 feet in diameter and 6 feet high, are better than one large brush pile. Native vines can be planted as an attractive cover for the brush pile and they can also be screened with shrubs that provide additional food and cover.

EXAMPLE 4: ROCK PILES

Cold blooded species such as amphibians and reptile species (e.g. frogs, lizards, salamanders and snakes) benefit from rock piles. Besides providing shelter and basking areas, the rocks absorb heat during the day and radiate warmth at night.

EXAMPLE 5: ADD NESTING SITES

Several ways exist to create habitat for nesting and roosting species. This can be as easy as creating a space of bare ground on a southeast-facing slope in pollinator-friendly habitat for ground nesting bees or by selectively preserving roosting trees (such as snags) for species such as bats.

Erecting nest boxes and other nesting structures, such as birdhouses, osprey platforms, bee boxes, and bat houses, is another option. The steps below describe a process for successfully adding nest boxes or structures to your facility.

Step 1: Identify species and suitable nesting locations.

To begin a nesting structure project, review the species you have identified in your wildlife inventory that are likely to be breeding on or near your property, consider suitable locations to place structures and how many you would like to install, and identify the resources needed to build, monitor, and maintain the structures.

Once you have identified one or more species you would like to provide nesting sites for, research the ideal characteristics for placement of the nest structures for that species. For example, bat houses should be sited in a location with at least seven hours of direct sun, near water (within about 1,500 feet), and in close proximity to woods (within about 30 to 90 feet) for protection from predators. As another example, bluebirds prefer to nest in open areas; therefore, nest boxes can be placed in a lawn or field area, with the entrance hole facing east toward the open habitat.

Step 2: Choose a suitable nest box or structure.

Nesting structures can be purchased or built. Either way, understanding the requirements for the species you have selected is important. For example, if you choose to purchase a nest box for birds, check the dimensions carefully to make sure it is built for the birds you want to attract. Many non-profit conservation organizations have recommendations for specific species. While many lawn and garden stores sell nest boxes and other nesting structures (such as bat houses), make sure that these commercially available boxes and structures fit the needs for your selected species. For example, many bat houses at lawn and garden stores may not be sized adequately for bat colonies.

Plans are also widely available for constructing your own boxes and other nesting structures. Based on your research of species-specific preferences, review available plans and directions. For example, golf courses near ocean shorelines can construct osprey nesting platforms, which should be at least 3 feet x 3 feet, but can be constructed using a variety of designs to meet ospreys' needs. For bees, *Making Room for Native Pollinators* offers a variety of designs for both solitary nesting bee species and bumble bees. A number of sources provide plans for basic songbird nest boxes that will house a variety of species or for nest boxes with precise specifications (such as nest boxes for bluebirds). For many bird species, a predator guard is needed to protect the nest occupants from predation, such as by cats and raccoons, which can otherwise severely limit the success of your efforts.

Step 3: Mount your nest boxes or structures.

Following species-specific preferences, orient and mount your nesting structures prior to the nesting season for that species in your area at an appropriate height for that species. Take into consideration the territorial requirements for that species when mounting the nest structures; for example, mountain bluebirds prefer a greater distance between nest boxes than eastern bluebirds. Bat houses can be mounted in clusters that provide just slightly different conditions and may be utilized differentially to meet bats' needs. The predator guard, if needed, should be installed at the same time.

Step 4: Monitor your nest boxes or structures.

Once you put up nest boxes or structures, it is important to monitor them on a regular basis. Audubon International recommends not installing nest boxes if box monitoring is not conducted, as these nest boxes may otherwise provide habitat for invasive species. Bird nest boxes should be monitored about once a week during the nesting season, until chicks are close to fledging (e.g. about 12 to13 days for bluebirds). Disturbing the chicks during the time could result in nestlings leaving the box before they are able to fly. If you are unsure of the age, refrain from checking the box for two weeks. Once chicks have fledged, clean out the box so that the birds can use it a second time during the season.

While monitoring, check for evidence of predation or unwanted nuisance species. For

example, the non-native, nuisance species house sparrow will kill adult and nestling bluebirds and destroy eggs. Therefore, have a plan in place for controlling nuisance species to help the nesting success rate of your desired species. Native birds may utilize a bluebird nest box (e.g. chickadees, titmice, nuthatches, tree swallows, etc.) and should be welcomed, as these small cavity nesters need help, too.

Record information about your nest boxes and structures to learn more about the species using them. For bird species, keep track of the number of birds successfully fledged. Use whatever method you have selected to record nesting information, such as the Nest Box Survey included in the Appendix, a notebook, or submit the information online to a citizen science monitoring effort, such as NestWatch. If your structures aren't being utilized within two to three years after they are mounted, consider moving them to a different location.

Step 5: Maintain your structures.

Nesting structures should be inspected at least once a year for any maintenance needs. When the structures aren't being used, they can be cleaned. If there are gaps in the seams or holes in nest or bat boxes, such as holes created by woodpeckers these should be resealed. Repaint, if needed, but not more than every two to three years. Predator guards should be inspected as well to make sure they are still functioning as designed.

Create Habitat

Because of the nature of the game, golf courses have managed turf areas for each hole; manicured turf on greens allow balls to roll and to be hit again. However, lawn areas can be minimized by planting of native vegetation in areas between holes and cutting across holes. Water hazards for wildlife habitat also minimize lawn areas. Incorporating features such as these also create character and uniqueness to each hole, while providing opportunities for observing wildlife while playing the game.

NATURALIZING LAWNS AND LARGE NON-PLAY TURF AREAS

Large lawns, expanses of non-play turf, and hard-to-maintain slopes or mounds may be good candidates for naturalization. Naturalization simply means making the landscape more natural. Not every golf course has room for large-scale naturalization, but many courses find that they do have spaces – between golf holes, along the edges of rough, near woodland edges, on steep slopes, under clumps of trees – that can be improved to provide better habitat.

When thinking about making your course more natural, consider potential locations and types of projects you want to pursue. If you are new to naturalization, it may be wise to start slowly, learn from any initial mistakes and gain approval from course management prior to undertaking large-scale enhancement or restoration projects.

No matter what type of naturalization project you choose, there are several factors you must keep in mind:

- **Location.** This is the most important consideration in terms of plant selection, visual appeal, and acceptance by golfers, employees, and surrounding property owners. Look for areas that you currently maintain with mowed grass or that are visually unappealing and target them for naturalization. Areas under small stands of trees, near wooded edges, or along the property border may be suitable. These areas do not have to be large—you can start small and expand over time where possible.

- **Plant Selection.** Utilizing native species should be your first choice in selecting plants. Your second choice should be well-adapted trees, shrubs, and herbaceous vegetation. Selection of specific plants should be based to the extent possible on the natural ecosystems and native plants in the area. In addition, consider the site-specific characteristics such as sun exposure, light intensity, wind conditions, drainage, and temperatures of the area to be naturalized. Lastly, consider species-specific characteristics such as the ultimate sizes and growth rates of trees, shrubs, and ground covers to reduce the need for future pruning and debris removal. Plants that produce food and cover placed near water sources increase the attractiveness of the area to wildlife species.

The Benefits of Naturalization

Environmental Benefits

- Maintains a diversity of plants and animals.
- Improves water quality.
- Minimizes erosion.
- Protects ecosystems and ecological communities.
- Maintains the gene pool of particular plant and animal species, promotes hardiness, disease resistance, and adaptability.
- Supports an aesthetic appreciation of natural beauty.
- Creates positive, progressive, and constructive attitudes about the natural world.

Maintenance Benefits

- Lowers maintenance costs and reduces the need for high-intensity maintenance.
- Reduces equipment wear and maintenance.
- Reduces the need for gasoline, pesticides, fertilizers, and water.

Golfing Benefits

- Adds distinctive contrast and natural beauty.
- Increases wildlife sightings for golfers.
- Defines play and non-play areas.

- **Site Preparation and Plant Care.** Another important point to consider is that, while native species are extremely tough and hardy and will eventually thrive better without inputs at all, they do benefit and establish faster with some site preparation and post-planting care.
- **Mulching, weed barriers, and supplemental irrigation helps to ensure establishment success.** Providing some form of mechanical weed control is a necessary component of native area plantings, especially during the first year, and is critical to success. Once established, a naturalized wildlife habitat can be sustained for years.
- **Communication.** Changes to the golf course landscape generally require approval by various committees before being implemented. Communicating goals and site plans with golfers and committee members is often key to the success and acceptance of such projects. Be prepared to respond to questions about project costs, benefits, and effects on the game of golf.

The type of naturalization project you undertake can vary significantly in time and effort. Three examples of naturalization projects in increasing order of complexity include the following:

Example 1: Designating No-mow Areas

Many golf courses have successfully created habitat and eliminated high intensity maintenance by simply not mowing in designated, non-play areas. Taller grasses and wildflowers soon grow to replace the close-cropped turfgrass monoculture. Such areas

Addressing Common Concerns

Slow Play. If slow play is a concern around naturalized areas, you can address this concern by properly locating naturalized areas and, if necessary, employing a well-trained and persistent marshal staff. It is also noted that under USGA rules, a naturalized area can be marked as a penalty area and allow for relief options to play a ball from outside of the area to avoid forcing players to search for their ball.

Conflicting Aesthetics. Some golfers perceive naturalized areas as unkempt and unsightly. Most golfers are won over, however, when they understand the many reasons for and benefits of a naturalized landscape.

Golfer Expectations. Naturalization doesn't mean poor playing conditions. In fact, you may find that you have more time to devote to maintaining playing surfaces when you take non-play areas out of routine maintenance.

improve habitat diversity and provide a more natural aesthetic.

When designating no-mow areas, look for places where taller grasses will complement existing habitat, such as along woodland edges or pond shorelines. You can also use tall grasses to create corridors that connect isolated habitat areas. This will increase the overall space that is available for wildlife.

Most courses simply stop mowing to begin the naturalization process. This is easy and inexpensive but may look unsightly for a few weeks while growing in. Use signs or rope off areas to keep people out and inform them that the area has not been neglected. Another strategy is to add plugs of wildflowers into the no-mow area. This increases color and diversity, while not requiring major site preparation or plant care. It may take a couple of years for the area to be fully naturalized.

Your no-mow area will need to be maintained. It's not a no-work zone. However, it will not require regular, weekly inputs to mow, fertilize, or control weeds. Many superintendents report that these areas are less stressful to maintain, since thresholds are much higher, and they do not demand attention during the height of the golf season. Naturalized areas need to be mowed or be subject to a controlled burn to prevent woody growth from establishing. Annual mowing tends to favor grass species and gives the area an even appearance, while less frequent mowing (about every three years) diversifies the number of plant species in the no-mow area. You may choose to experiment with different mowing regimes (e.g. every fall, spring, every other year, etc.) to determine what works best for your golf course, or decide to create different naturalized areas of the course. Controlled burns can allow germination of seed-bearing annuals, increase plant species diversity, control unwanted woody vegetation, and open up the stand for movement of small animals and birds. Burns either after the flowering season or well before the flowering season tends to favor wildflowers, while burns closer to the flowering season tends to favor the development of warm season plants and control cool season grasses and brush. Great care should be taken when utilizing controlled burns. Seek the input and help for people with expertise and experience.

Finally, you can map your naturalized areas, so you can easily identify them and to ensure they become part of your course, similar to your in-play areas. Utilizing GPS mapping systems is an easy way to map naturalized areas.

Example 2: Planting a Wildflower Area

Meadow flowers and flowering trees and shrubs add beauty that appeals to golfers, pollinators, and wildlife. With some thought in the planning process and maintenance efforts, a flowering meadow can provide close to a full season of multicolored blooms, adding beauty and a changing mosaic of color to the golf course landscape.

Seedbed preparation is the critical first step in the establishment of a successful wildflower area. To reduce weed competition and ensure the survival of your flowering

plants, existing vegetation should be removed, either with a non-selective herbicide or via mechanical means. During establishment and for the first two to three years, you will need to remove weeds to reduce competition and avoid encroachment.

Plant selection depends on your region and goals. Numerous organizations provide regional recommendations for pollinator-friendly planting. Incorporating a diversity of flowering colors, plant heights, and blooming seasons provide a food source throughout the growing season attractive to a large number of pollinators.

To establish the area, superintendents typically plant directly from seed. When

Pollinators

Pollinators (such as bees, butterflies and some species of birds, moths, beetles, ants, and flies) around the world face several threats that have reduced populations of many species. For example, pesticides can have negative effects ranging from impacting individuals to impacting entire colonies. Habitat loss is another threat faced by pollinator species.

Golf course superintendents can help pollinators in a number of ways. First, reduced use of pesticides through integrated pest management efforts and careful use of pesticides when they are needed reduces the potential for impacts to pollinators. Creating and enhancing habitat through such efforts as planting wildflowers, shrubs, and trees with a diversity of flowering species and flowering times can provide a food source. Many regions have pollinator-specific plant recommendations, such as the ecoregional planting guides for the United States and Canada published by the Pollinator Partnership.

Leaving dead trees, stumps, posts, and exposed patches of bare soil can also benefit pollinators that require this kind of nesting habitat. Providing bee blocks for solitary nesters (such as mason bees) or artificial nesting boxes for bumble bees gives these species additional areas to nest in. Lastly, water must be available. This can take the form of either natural or human-made water features, such as running water, pools or ponds with shallow shores, and small containers of water.

Monarch butterflies are one of the pollinator species that have experienced declines throughout its range. Therefore, Audubon International and the Environmental Defense Fund have teamed up with North America's golf courses to reverse the decline of this species. The Monarchs in the Rough program is establishing essential habitat for butterflies, increasing awareness of conservation challenges and providing technical support for projects on the ground. This program is open to any golf course in Canada, Mexico, or the United States.

planting directly from seed, choose seeds that are at least regionally adapted. Native wildflower seed mixes are more costly than generic mixes but contain plant species that preserve the natural history of your region. For small areas, you can also purchase or grow wildflower plants and add them to no-mow areas or prepared beds. This method often results in greater plant survival and quicker establishment. Under no circumstances should soil tillage occur as this brings many weed seeds to the surface. The wildflower seeds will be outcompeted and will not establish.

Wildflower areas are not maintenance free, but they do not require the daily maintenance of manicured turf areas. Temporary irrigation can be installed during the establishment of the planting and then removed after the first season. Like no-mow areas, wildflower areas need to be mowed or burned every few years to keep perennial plants thriving and to maintain the habitat.

More detailed information on establishing and maintaining a wildflower area can be found on the Xerces Society website and the Lady Bird Johnson Wildflower Center website.

Example 3: Forested Riparian Buffers

A riparian buffer is a vegetated area next to a stream or other water resource that helps protect water resources, stabilizes stream banks, and provides aquatic and wildlife habitat. Riparian buffers form a transitional zone between upland and aquatic habitat and can be composed of grasses, trees, or both types of vegetation. Forested riparian buffers provide additional benefits over grass buffers, including stream bank stabilization due to the roots of herbaceous and woody plants strengthening the stream bank and preventing erosion. Additional benefits include roots and downed trees slowing the flow of stormwater and forming a physical barrier to the stream or river, which allows sediment to settle out and be trapped. Forest canopies shade water, moderating water temperature. Woody plants also provide habitat and food for aquatic and terrestrial wildlife. For example, trees increase the amount and quality of streambed habitat, supporting significantly more aquatic organisms in the same amount of space than a stream with a grass buffer.

Creating a forested riparian buffer represents a greater time and management commitment during the establishment phase then most other naturalization efforts. However, once mature, the buffer should require relatively little maintenance, regenerating naturally.

The minimum width needed for an effective riparian buffer depends on the function the buffer is meant to serve. At the narrow end, stream bank stabilization and stream shading can be achieved with a buffer width in the range of tens of feet. At the wider end, providing upland habitat requires a larger buffer, on the order of hundreds of feet. Wider riparian buffers can protect more habitat for more species, serve as wildlife corridors, preserve sensitive upland habitats such as vernal pools (prime breeding areas for many amphibian species), and protect water quality and aquatic habitats.

Riparian buffers are usually conceptualized as consisting of three zones: from the water's edge (Zone 1) moving progressively upland (Zones 2 and 3). Each zone has a different mixture of trees, shrubs, or grasses. A series of steps are needed to create a riparian buffer, which will take time to complete. These include the following:

- Selecting appropriate species.
- Protecting young trees from damage, such as from deer, with tree shelters.
- Protecting roots from animal-related damage, such as from voles.
- Removing noxious and invasive plant species.
- Replanting as needed. When required, replanting should only be done after addressing the cause of the initial failure (such as root predation and/or competition from other plants).

Many regional regulatory and nonprofit agencies have guidance on creating riparian buffers that will not only provide guidance, but also offer suggestions for plant selection appropriate to your region. For example, the Maryland Department of Natural Resources publication *Riparian Forest Buffer Design and Maintenance* has detailed guidance on creating a buffer and specific plant recommendations pertinent to the Chesapeake Bay Watershed region.

WILDLIFE CORRIDORS

Among the problems facing wildlife today is the fact that so much of our existing habitat is cut into small fragments and isolated parcels. This is the case on the regional level as well as on individual properties, where woods, fields, and water sources are often disconnected. Habitat corridors, sections of undisturbed or restored habitat that connect two or more larger natural areas, are crucial for enabling many wildlife species to have access to food, water, and shelter.

As much as possible, you should connect isolated habitat areas by utilizing natural corridors. This will allow wildlife to safely travel throughout the property or from your property to neighboring habitat by minimizing their exposure to predators. It will also help to increase the number of available breeding sites, increasing the opportunities for previously isolated wildlife populations to interbreed. Amphibians are especially dependent upon wildlife corridors that connect different habitats, as described in the USGA publication "Golf Courses Could Bolster Amphibian Communities." Each year, frogs and salamanders migrate between breeding ponds and upland wooded areas where they spend most of their lives. Connecting wetland and wooded habitats via corridors of protected vegetation is key to the survival of amphibian populations.

Review the course map created during your initial inventory and identify any isolated "islands" of habitat. How can these areas be connected to adjoining blocks of habitat? You may be able to connect areas by extending trees or shrubs, or by leaving unmown areas between stands of trees. Streams make good corridors, too. Property

borders may also benefit from naturalization to improve travel between your land and neighboring habitats. Likewise, buffers of aquatic and shoreline vegetation around pond margins and other natural vegetation that connects aquatic habitats with upland woods is vital to facilitating safe wildlife movement on the golf course.

Ideally, all-natural features should be incorporated into a coherent network on your property, as well as connected to surrounding natural areas.

Restore Habitat

In addition to enhancing and creating habitat, some habitats may be in such a degraded condition that they need additional attention to restore basic ecosystem functionality. Two common examples of degraded habitat are areas that have been overtaken by invasive species and eroding shorelines of ponds, streams, or other water bodies. Restoration projects generally require technical expertise and site-specific planning, as well as capital expenditures. Specific recommendations are beyond the scope of this guidebook. However, examples are provided below that explain in general three types of restoration projects.

Example 1: Invasive Species Management

Non-native species that cause harm are collectively known as invasive species. Invasive species often displace native species through displacement or predation. They can also alter ecosystem processes, transport disease, interfere with crop production, or cause illnesses in animals and humans, affecting both aquatic and terrestrial habitats. For these reasons, invasive species are of national and global concern. Examples of common invasive plant species are kudzu, purple loosestrife, Japanese honeysuckle, and melaleuca. Animals can also be invasive species. In many tropical countries, cane toads have been introduced, have then invaded many areas and have become a pest, displacing and even eating native amphibians.

Invasive species management may be needed at one time or another on any area of your golf course, including already-restored habitat such as wetlands, lakes, ponds, and buffer areas. Therefore, your habitat management plan should note any known or potential invasive species on your property and management methods to prevent them from spreading or to eliminate them entirely.

To combat invasive species, their presence must first be detected. Researching invasive species known to be present in your region and making this information available to staff is the first step to detecting

Restoration Tip

When possible, combine restoration projects with other types of golf course renovation work. The availability of equipment and labor, combined with a disruption in golf play, often presents an ideal situation in which habitat restoration can be accomplished.

their presence. Many regional regulatory agencies and non-profits maintain lists of invasive species. In addition, national and international organizations also maintain databases of invasive species information. For example, in the United States, the Natural Resources Conservation Service maintains the Introduced, Invasive, and Noxious Plants web page and publishes information on invasive land-dwelling species and invasive aquatic species. As another example, the European Alien Species Information Network provides information about invasive species of concern in Europe.

Management strategies and control options for invasive species include the identification of any areas on the golf course these species currently inhabit; efforts to prevent them from spreading, if possible; controlling them through eradication, suppression, or containment efforts; and restoring the habitat. Integrated pest management (IPM) and cultural practices methods are non-chemical methods that should be evaluated first in efforts to control invasive species. For example, controlled burns may control terrestrial invasive species in naturalized areas. If necessary, chemical control methods may be warranted, following chemical control recommendations to prevent potential environmental impacts from their use. An example of different kinds of control methods for invasive aquatic plants is described in the USGA article "Common and Troublesome Weeds of Golf Course Ponds."

Restoring degraded habitat by replacing invasive plants with native plant species or removing invasive animal species encourages native species to move back into the area. Once an area is restored, monitoring is a critical part of ensuring that invasive species do not encroach on the habitat needs of the native plants and should be an ongoing part of your habitat management efforts.

Example 2: Shoreline Stabilization

One of the most common problems for golf courses is eroding stream or pond banks resulting in degraded water quality, wildlife habitat, and aesthetics. Erosion problems often stem from improper design or management of lake, pond, and stream margins. For example, when short mown turf is maintained to the edge of the water source, its roots often are not strong enough to hold the soil in place. The riparian buffer project described earlier is one way to avoid shoreline erosion from occurring, as the roots of woody plants will help to hold the soil in place.

Newer techniques for stream bank stabilization incorporate more natural channel design and consideration of how stream shape influences water and sediment movement in a stream. A stream bank stabilization project should incorporate as many of the following principles as follows:

- Retain or restore the natural channel.
- Retain woody debris in the stream to provide cover and nutrients for fish and wildlife.
- Retain or restore native vegetation (especially trees) within the stream corridor and the floodplain.
- Minimize maintenance activities/

human traffic in the floodplain and, particularly, within the aquatic buffer.

- Apply natural channel-design approaches to control ongoing streambank erosion and gravel deposition.
- Redesign stream crossings (e.g. bridges and culverts) to better accommodate flood waters and minimize biological impacts (e.g. allow for fish passage).

An example of a stream bank restoration project is published on the USGA website. Hydrologists may need to be retained to undertake an extensive or complex stabilization project. Simpler projects can often be accomplished with existing staff.

Example 3: Species-Specific Habitat Restoration

Golf courses can offer unique opportunities for some species-specific conservation efforts. If your course offers potential habitat for a particular species in need of conservation in your region, proper planning and management can turn your course into high-quality habitat. For example, monarch butterfly populations have been in decline, in large part due to habitat loss. With large open areas available in out-of-play areas, golf courses can provide high quality habitat specifically for monarchs with restoration efforts designed specifically to meet their needs, such as the planting of milkweed species. Additional information is available through Monarchs in the Rough. For other species, the same steps in understanding the specific requirements for food, shelter, and cover will guide your restoration efforts.

Protect Habitat From Disturbance

Wildlife, water, and natural systems can be adversely affected when golfers inadvertently traipse through natural areas, when maintenance practices are done carelessly, or when improperly trained golf course personnel, managers, or owners fail to implement proper safeguards or sound management practices. It is the job of the golf course superintendent, working together with employees, owners, and golfers to protect natural areas on the golf course responsibly. There are a variety of effective means to educate people about habitat protection. Choosing a combination of strategies and repeatedly following up may be necessary to raise awareness and promote actions that do not harm the environment.

PROTECTION STRATEGIES

Mount signs. One of the most effective ways to protect special habitats is to post signs. In certain areas, you may choose to use the official USGA designation -- Environmentally Sensitive Area -- or use Audubon International signage. Other areas may simply warrant an explanation of your expectations (e.g. No Carts/Keep Out), a statement of why the area is significant (e.g. Wildlife Habitat, Nesting Area, or Native Prairie), or both.

Rope off areas. Sensitive habitat areas may need to be roped off to discourage golfers or maintenance staff from intruding. When roping off areas, make sure to inform both employees and golfers why access is being restricted.

Signs can be an effective way to protect habitats and provide information to golfers.

Communicate with golfers and homeowners. Look for ways to inform people in greater detail about sensitive habitats or species in need of protection. Many courses have successfully educated golfers via newsletter articles, bulletin board notices, meetings, social media, and seasonal site tours. If a homeowner association is involved, communicate in writing or in person so that neighbors have an opportunity to ask questions, express concerns, and remain informed and involved. This can be particularly important when no-mow areas of the course abut residential areas.

Educate maintenance workers. Routinely review environmentally sound maintenance practices with the maintenance crew. Set high expectations and follow up on careless or inappropriate practices.

Avoid disturbance to known nest or den sites. Since all wildlife species must successfully breed and raise young to survive, it is important for golf course personnel to avoid disturbing nests, den sites, or other breeding habitat, especially during the spring when breeding activity peaks. In fact, it is illegal under the federal Migratory Bird Treaty Act to "take" native bird nests, eggs, or young without a permit. You may choose to flag or stake ground nests (e.g. killdeer nests) or avoid thinning woods during the spring. In tall grass areas, do not mow until after young birds have left nests, or around July 31 for most parts of the country.

Minimize traffic. Limiting traffic in habitat areas minimizes disturbance and fragmentation. Route vehicular and foot traffic away from any environmentally sensitive areas. If necessary, confine cart paths to the edges of core habitats, rather than cutting paths through the interior.

DESIGNATED CONSERVATION AREAS

The sensitive habitats on your property should be identified on your management plan. Label the location of habitats on a map to clearly communicate with staff how they are to be managed.

Core wildlife habitats and unique plant communities or wildlife species should receive the highest status in your habitat management plan. These areas should be considered "conservation areas" where disturbance from golfing and maintenance activities should be avoided. USGA rules allow Environmentally Sensitive Areas to be

designated on the course so that golfers are warned to keep out while not being penalized for errant shots.

NUISANCE WILDLIFE MANAGEMENT

Dealing with wildlife problems comes with the turf of successful wildlife management on a golf course. From time to time, most superintendents struggle with wildlife species doing things or entering places we would prefer they did not. When a wildlife species causes damage or becomes a significant nuisance, it's time to take action. But effective action and long-term solutions require not just knowledge of control measures, but a good understanding of why the species has become a problem in the first place.

If you are experiencing problems with a particular wildlife species around your golf course, your first concern may be solving the issue. But before choosing a solution, it's worth asking a few additional questions:

- What are the conditions and natural life supports that are sustaining the wildlife species?
- Why is the problem occurring now?
- How might current management practices or landscape conditions actually be contributing to the problem?

Golf Course Activities That Can Damage Natural Habitats

- Golfers trampling native plants while searching for a ball.
- Carts straying into naturalized areas.
- Weed trimming or mowing too close to tree trunks.
- Dumping debris or leaves into ravines or wooded streams.
- Removing shrub layers or leaf litter in woods.
- Removing wetland, streamside, or pond vegetation.
- Ignoring eroding stream banks.
- Planting exotic plant species.
- Removing trees from streamside habitats. (It alters water temperatures and streamside habitat.)
- Improperly using or storing chemicals.
- Mowing fields prior to the end of nesting season for ground nesting birds.

Every species is connected to a life support system made up of food, cover, and water sources, and exists within a complex food web that includes natural enemies and predators. Your job is to find out more about the habitat and life habits of your "problem" wildlife species so that you better understand why the species is causing trouble. For instance, is there an overabundance of food, lack of predators, or lack of suitable habitat?

It is also important to look for underlying conditions or management practices that are causing or exacerbating a problem. Once you have identified the root cause, you'll be able to identify a variety of control options, such as altering food, cover, or water sources that sustain the species, increasing natural predators, or altering management practices.

Wildlife like alligators can be problematic on a golf course. Having an effective plan to manage nuisance wildlife is of critical importance for avoiding unwanted situations.

In addition, keep in mind that human values, needs, and perceptions provide a context for all wildlife conflicts. As you try to solve wildlife problems, evaluate your own needs and goals, and define your tolerance for living with various species. Striking a workable balance, rather than totally eradicating a particular species, is often a preferred and more achievable solution.

The following step-by-step approach to dealing with problems works with wildlife species and will help you effectively deal with rodents, birds, deer, mosquitoes, houseflies, grubs, or other problem species you encounter. When you take the time to ask the right questions, you'll find solutions that really work.

Step 1: Understand the species and its habitat.

Find out about the species' preferences for food, cover, and water sources, as well as breeding requirements and territory size. An Audubon International staff ecologist can provide species information if you need help.

Step 2: Evaluate and define the problem specifically.

What *exactly* is the problem? The more specific you can be, the easier it will be to narrow down solutions. Try to define what, where, and when, as well as why the problem is occurring. For example, "Canada geese are on the property" is not a very informative problem definition. "Canada Geese are eating turf grass and leaving a substantial mess during March and April" is much more specific.

Step 3: Survey your property and determine how you contribute to the problem.

Review your landscape management practices to determine whether something you or your golfers are doing causes or exacerbates the problem. For example,

people feeding geese would be an obvious contributing factor. Landscape management practices such as removing shoreline vegetation around ponds or eliminating understory vegetation that may support natural predators would be additional practices that favor geese.

Step 4: Review solutions and choose the most effective.

Evaluate a variety of control options. Consider your needs, your property, and the nature of the wildlife species, along with short and long-term effectiveness, when choosing your response to the problem. For example, you might choose to increase pond vegetation to deter geese, enhance habitat overall, and hire a company that utilizes dogs to discourage geese from breeding on the property.

Step 5: Communicate about the species and your actions.

Share your knowledge about the wildlife species, the nature of the problem, and adherence to any regulatory requirements. This will provide a valuable context for the control measures you choose. People are apt to support your efforts when they know you fully understand the problem and are taking action to solve it.

Self-Assessment Checklist

Proper habitat management has dramatic consequences for maintaining an enjoyable, environmentally friendly golf course. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

GENERAL KNOWLEDGE

- Identify core habitats, such as mature woodlands, wetlands, or stream corridors, and special habitat concerns, such as endangered or threatened species on the property.
- Train staff to understand that management practices may positively enhance or adversely impact wildlife species and habitats on the property.
- Identify the dominant indigenous (native) plant community and ecological region in which the golf course is located.
- Maintain an ongoing written inventory of at least bird and mammal species to document and track wildlife use of the property. Additional inventories may include amphibians, reptiles, fish, and other wildlife, and plants, such as trees, shrubs, and herbaceous species (non-woody plants).

WILDLIFE HABITAT: SPACE, FOOD, COVER, AND WATER ENHANCEMENTS

- Maintain natural wildlife habitat in at least 50% of all unused or minimally used portions of the property.
- Connect wildlife habitat areas, such as woods, meadows, stream corridors, and ponds, to facilitate wildlife movement on your property and to adjacent properties.
- Maintain or plant varying heights and types of plants, from ground cover to shrub and tree layers, in habitat areas such as woods, desert, or prairie (e.g. in woodlands, leave intact understory, including shrubs, herbaceous (non-woody) plants, debris, and leaf litter).
- Leave dead trees standing when they do not pose a safety hazard.
- Maintain a water source for wildlife with aquatic plants and shrubbery or native landscaping along the shoreline (i.e. not turfgrass). This could be a pond, stream, wetland, or river corridor.
- On smaller properties, this may also include a birdbath or created “backyard” pool.
- Naturalize at least 50% of out-of-play shorelines with emergent-aquatic and shoreline plants. Special attention should be given to shallow water areas (less than 2 feet deep) since wildlife is most abundant when shallow water includes emergent aquatic vegetation.
- Choose flowers for gardens or container plants that will provide nectar for pollinators.

- Maintain nesting boxes or other structures to enhance nesting sites for birds, bats, and bees.

HABITAT PROTECTION AND BIODIVERSITY CONSERVATION

- Protect wildlife habitats and any endangered or threatened wildlife or plant species from disturbance by golfers and maintenance activities. Mount signs or designate an Environmentally Sensitive Area as per USGA rules, if appropriate.
- Establish and maintain at least 80% of the landscaped trees, shrubs, and flowers, excluding turfgrass, with plants indigenous to the property's ecological region.
- Purchase landscape plants from locally grown sources, whenever possible, to support the genetic integrity of local native plant communities.
- Avoid disturbing known bird nests or den sites until after young have dispersed. Stake or flag such areas when needed (e.g. roping killdeer nests and not mowing fields until after bird nesting season).
- Avoid removing shrubs or trees during bird nesting season if nests are present.
- Restore degraded habitats, such as eroded slopes, compacted soils, and polluted water sources.
- Clean up trash from habitat areas when necessary.
- Where possible, confine roads, cart paths, trails, and necessary vegetation removal to the edges of existing habitats to minimize disturbance and fragmentation.

Maintaining optimal turf health, while reducing risks associated with chemical storage, application, and disposal are keys to a golf course environmental management program. Most ACSP certified courses are able to reduce inputs on the course and realize a savings in their maintenance budgets.

Chapter 3: Chemical Use Reduction

CONTENTS

Overview

Chemical use has dramatically altered maintenance practices in the golf industry, allowing superintendents to meet aesthetic and playability expectations of golfers and continually increase those standards. However, the widespread use of chemicals has not come without a price. Risks associated with chemical use threaten human health and the environment and negatively influence the public's perception of golf courses.

Pesticides and fertilizers can potentially have significant adverse impacts on surface water and groundwater quality. Pesticides, which belong to numerous chemical classes that vary greatly in their toxicity, can present a human health risk through exposure, as well as impacting non-target species. Nutrients in fertilizers, such as nitrogen and phosphorus, can affect water quality if they reach groundwater or surface water in high enough quantities. Because of these issues, pesticides and, to a lesser extent, fertilizers, are often a focus of regulatory attention and public concern.

Reducing reliance on chemicals can be accomplished by maintaining healthy turf less susceptible to pests and establishing an integrated pest management (IPM) program. In fact, reducing chemical use is one of the most important ways that golf course personnel can show their commitment to environmental stewardship. The effort can often result in cost savings as well. Therefore, this section focuses on helping you reduce chemical usage by achieving these two important goals:

- Maintaining turfgrass in a vigorous and healthy state through sound nutrient management and cultural practices to lessen the potential for weeds, pests, and disease outbreaks.
- Using chemical controls only when other control methods are not effective.

General Knowledge

Golf course superintendents must understand the potential risks associated with chemical use and must abide by regulations related to fertilizers and especially pesticides.

When golf course personnel, club greens committees, and management companies understand the potential risks, they are better equipped to make sound management decisions, adequately invest in storage and handling facilities, and improve accident response protocols. Likewise, employee training, especially for seasonal employees and pesticide applicators, must pay proper attention to chemical safety and environmental issues. Employees should understand the potential risks to workers, the golf course, its guests, and natural resources.

REGULATORY ISSUES

Compliance with all regulations is not only the law, it also helps protect the environment. Therefore, golf course

superintendents should be aware of the regulations related to the purchase, storage, handling, and application of fertilizers and pesticides and ensure that staff are appropriately educated about compliance. For example, in the United States, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates the active ingredients (toxins) and inert ingredients (e.g. solvents, surfactants, and carriers) of pesticides. State laws also regulate pesticides, as do some local laws.

ENVIRONMENTAL FATE AND TRANSPORT

Understanding the potential for fate and transport of potential contaminants, such as the active ingredients in pesticides, as well as nitrogen and phosphorus will help you to minimize the risk of off-site movement of fertilizers and pesticides. These are:

- **Runoff.** The movement of water across the turf and soil surface typically following a storm or heavy irrigation. When runoff flows along the ground, it can pick up contaminants (including but not limited to fertilizers, pesticides, and petroleum).
- **Leaching.** The downward movement of water-soluble plant nutrients or chemicals through the soil. Leaching becomes an environmental concern if it transports these contaminants to ground and surface water.
- **Drift.** The physical movement of pesticide droplets or particles through the air at the time of pesticide application or soon thereafter from the target site to any non- or off-target site.
- **Sedimentation.** The movement of soil particles (sediment) and any fertilizers, pesticides, or other chemicals attached to the soil particles through surface runoff that are then deposited into surface waters.
- **Spills.** Unintended releases of chemicals during transportation, storage, and routine maintenance operations that can become a source of contamination if not appropriately contained and cleaned up.

ENVIRONMENTAL IMPACTS

Off-site movement of chemicals can lead to a number of environmental impacts. These impacts include the following:

- **Nutrient enrichment** of surface waters (eutrophication), which promotes the excessive growth of aquatic algae and plants. This, in turn, leads to dissolved oxygen depletion. Nitrogen loading is the greater concern for marine environments, while phosphorus is of greater concern for fresh waters.
- **Toxicity** impacts to non-target species, at the application site, off site through drift, or in surface waters from runoff.
- **Sedimentation** due to eroding soils degrades aquatic habitats. It can occur when soil is disturbed, typically during construction and major renovations or during significant storms.

HUMAN HEALTH RISKS

Human health risks associated with pesticides is evaluated as a function of both a pesticide's toxicity and the level of exposure. Pesticide labeling includes appropriate personal protective equipment (PPE) to avoid exposure and first aid information specific to the product.

Drinking water impaired by nitrogen leaching from fertilizers, though rarely attributed to golf course operations, can adversely affect human health if nitrate or nitrite levels are above the health-based risk values established by regulations. Pesticides in drinking water above allowable levels is also a human health concern.

GOLF RISKS

Not only can improper chemical use pose human health and environmental risks, but it can also increase liability and affect public opinion. In addition, chemical use has increased pest resistance, a serious concern for turf managers. Risks include:

- **Liability.** Improper storage or handling of chemicals increases golf course liability. Contamination can result in costly environmental cleanup and fines.
- **Poor public opinion.** The public has repeatedly voiced concern regarding chemical use on golf courses and its environmental and health effects.
- **Pest resistance.** Target pests can develop resistance to a chemical that is used repeatedly, resulting in the need to use increasingly toxic chemicals to control the pest.

Growing Healthy Turf

Sound nutrient management and cultural practices are key to maintaining healthy, vigorous turfgrass. Combining these management practices with an IPM program will ensure favorable playing conditions while protecting natural resources and demonstrate your commitment to environmental quality.

NUTRIENT MANAGEMENT PLANNING

Growing healthy turfgrass requires the use of fertilizers to meet turf nutrient needs. Understanding these needs minimizes the chance for nutrients to reach groundwater or surface water. Developing a nutrient management plan is an excellent way to:

- Address the site-specific nutrient needs in different areas of the course.
- Identify areas most prone to surface runoff (such as steep slopes or proximity to water bodies) or prone to leaching (such as areas with sandy soils over shallow water tables).
- Plan for expected application needs.

PLANT NUTRITIONAL NEEDS

Different areas on the course have different nutritional needs. For example, putting greens have increased needs due to the lower height of cut and excessive traffic damage. Conversely, fairways and roughs have lower nutrient needs because of the increased height of cut, less traffic, and clippings returned in these areas.

Turf plants need both macro nutrients, such as nitrogen, phosphorus, and potassium, secondary macronutrients, and micronutrients. They get these nutrients from the soil, organic matter (such as clippings), and fertilizers. Soil pH influences the entire soil chemical environment and fundamentally determines nutrient availability, fertilizer response, and soil biology. In general, a neutral pH is considered adequate for most turfgrass needs but can vary depending on the specific variety. Ensure your soil has the correct pH for your specific turfgrass.

The amount and frequency of fertilizer needed to meet plant nutritional needs will vary seasonally and can change from year to year. The goal is to provide enough nutrients to sustain healthy grass and maintain playability levels. This approach saves time and money and decreases the potential for runoff or leaching following application. One approach to setting goals to reduce fertilizer use is the Minimum Level for Sustainable Nutrition (MLSN) guidelines. These guidelines were developed by PACE Turf and the Asian Turfgrass Center. In addition, many university turf programs publish nutritional ranges, which should also be consulted for recommendations.

SOIL AND TISSUE TESTING

Soil tests estimate nutrient availability and predict a plant's response to an applied nutrient. Accurate and consistent sampling and analysis provide useful soil test information over time to monitor changes. Soil testing is best to provide guidance for soil pH, organic matter content, plant available phosphorus and potassium, and salinity and soil sodicity. Plant tissue analysis can provide additional information on the nutritional status of a turfgrass stand but should be used only in conjunction with soil testing.

EQUIPMENT CALIBRATION

Properly calibrated sprayers or spreaders are critical for applying fertilizers. Incorrectly calibrated equipment can apply too much or too little. Sprayers and spreaders should be calibrated upon first use and regularly after that (e.g. after every fourth use). Penn State Extension provides guidance on proper calibration techniques.

FERTILIZER APPLICATIONS

Because of the potential for nutrient enrichment of surface water and groundwater, the application of fertilizer must take into consideration the site and prevailing conditions. For example, sandy soils often have a lower potential to fix phosphorus and are therefore more prone to leaching. Fertilizer applications should be avoided whenever possible on steep slopes and should not be allowed on impervious surfaces, such as paved cart paths and parking areas. Fertilizer should also not be applied when soils are at or near field capacity or following rains that are heavy enough to leave the soil wet.

Cultural Practices

Sound cultural practices help to grow healthy turfgrass and are also at the root of every good IPM program. Using common sense and doing your best to ensure healthy soils, good drainage, and healthy turf should be your number one priority.

TURFGRASS SPECIES AND VARIETIES SELECTION

Selecting the best adapted species or variety to match site conditions is an excellent opportunity to reduce turf susceptibility to stresses and pests. Well-adapted species require reduced amounts of inputs, such as supplemental nutrients, pesticides, and potentially water. The National Turfgrass Evaluation Program (NTEP) distributes information on the testing and adaptation of the major turfgrass species in the United States by state and in Canada. University turf programs also often publish species/variety recommendations that can be found online.

TURF ESTABLISHMENT

Disturbed soils present a significant risk to water quality because of the increased potential for soil erosion. Therefore, practices should be implemented that reduce this risk until turf is established. These measures can include mulching new seedlings and sodding sloped areas. In addition, silt fences and other sediment barriers can be used at the bottom of slopes or adjacent to surface water bodies. During establishment, limiting fertilizer and chemicals applications reduces the chance for leaching and runoff, but enough phosphorus should be applied to meet growing needs at this time.

TURF MAINTENANCE

Mowing practices, clipping management, and cultivation all contribute to the maintenance of dense, high-quality turfgrass.

Mowing: The most basic cultural practice, mowing has a profound impact on turf density, texture, color, root development, and wear tolerance.

One of the most important changes that can be made in the maintenance of turf areas is the heights at which they are mown. Mowing height and frequency are directly related to the turfgrass species and growth rate of the plant. To minimize stress on the plant, no more than one third of the leaf blade should be removed with any one mowing. On greens, cutting heights consistently 1/8" or less can place the turf under severe stress during weather extremes. Increasing the mowing heights slightly will also create a better filter for water that moves through the course.

Audubon International provides mowing height recommendations by area (fairways, greens, tees, etc.) in our certification review guidelines. Out-of-play areas should be designated low- to no-management areas with reduced, or no, mowing. No-mow areas that form a filter strip of at least 15 feet or more around water bodies and wetlands slows the movement of surface water and promotes infiltration.

Equipment must be maintained as dull blades affect the quality of the cut and can

shred leaf tissue, which increases water needs and potential for disease development. In addition, using lightweight mowers on greens and fairways tremendously reduces the effects of soil compaction on turf growth.

Clipping management: Clipping return promotes nutrient cycling and eliminates the need to deposit clippings to other areas of the course. When not possible, such as on greens, collecting and composting in a suitable location, away from surface water or wetlands, is the best solution. The resulting compost can be used as a soil amendment or topdressing.

Cultivation: Organic matter accumulates in the top 3 to 6 inches of the soil. Though organic matter has the desirable impact of providing nutrients and water-holding capacity, over-accumulation can restrict water infiltration and gas exchange. Therefore, cultivation techniques, such as aeration, vertical mowing, deep drilling, etc. can be used to manage organic matter.

The timing and type of cultivation technique utilized should be based on traffic intensity, level of soil compaction, and the amount of accumulation of excessive thatch and organic matter. Topdressing after cultivation can aid in recovery, as well as improve surface firmness. Because cultivation stresses turf, it should never occur during times of stress, such as extreme heat or drought.

TREE MANAGEMENT

Trees can play a strategic role in golf course design and are a valuable asset in the golf course landscape. However, tree placement should be carefully considered since shaded areas can often result in turfgrass that is weakened and more vulnerable to disease. In order to prevent shading problems:

- Increase light penetration through the tree canopy by selectively thinning the crown and pruning lower tree limbs.
- Enhance air movement in pocketed areas by judicious removal of shrubs and trees in the avenue of prevailing winds.
- Root-prune trees along fairways and greens that are competing excessively with the turfgrass for water and nutrients.

When necessary, trees can be selectively removed to improve turf health and reduce water needs. Keep in mind that trees do provide for carbon sequestration (the capture of atmospheric carbon dioxide), which has a positive effect on climate change.

TRAFFIC CONTROL MEASURES

As the number of golfers and the use of golf carts increase, traffic must be carefully monitored to decrease potential wear and soil compaction problems. The easiest methods to control traffic problems are:

- Rotating traffic patterns by planned movement of cup and tee markers.
- Distributing cart and foot traffic over wide areas.
- Using cart paths where traffic is highly concentrated.

- Instituting a 90-degree rule for golf carts entering fairways from cart paths.
- Where chronic wear problems exist, employing a landscape architect in long-range planning for more than one way on and off playing areas.

Integrated Pest Management

IPM involves using a variety of management measures to keep turfgrass pest populations below levels that are economically and aesthetically damaging, without creating a hazard to people and the environment. IPM helps you to answer these questions: What is the problem? Why is it occurring? Has the threshold for pest numbers or damage been exceeded? Is intervention necessary? What is the best method of control?

Over time, you will get to know which pests occur, when, and where and to how identify hot spots that indicate when trouble is brewing.

The basic components of IPM include these steps:

- Monitor pests and their damage, recording all information.
- Identify pests and understand their biology.
- Set acceptable threshold levels.
- Consider a variety of control strategies.
- Evaluate the IPM program.

Golf courses should develop a facility-specific, written IPM plan. Available resources for information on IPM plans include GCSAA's IPM information and Greengolfusa.com. Employing an IPM program necessitates that the superintendent and key maintenance staff adhere to IPM principles, are knowledgeable about turf pests, and commit to regular monitoring and diligent recordkeeping.

MONITORING

An essential part of an IPM program is developing and maintaining a regular monitoring routine to collect information about pest activity. Regular monitoring provides an excellent record of active insect, weed, and disease populations and any resulting damage. It also provides follow-up information on the success of control measures.

Determine who will monitor: Monitoring can be done by a golf course employee who has formal training in field identification of weeds, diseases, and insects and a thorough understanding of pests. This person must be a good observer, reliable, and able to communicate the findings. Though this person may have other duties to perform as a golf course employee, the primary responsibility should be to the IPM monitoring program.

How to monitor: Monitoring methods include visual inspection, soil sampling, soap flushes, and trapping. Determine the most effective methods for the pests you need to monitor.

When to monitor: Weather tracking, degree day monitoring, and pest forecasting techniques and programs can help predict potential disease and pest outbreaks and can influence your scouting schedule. An example scouting schedule:

- Putting greens – daily or every other day.
- Tees and fairways – weekly.
- Roughs and landscaped areas – twice monthly.

Monitoring frequency can be increased when environmental conditions favor pest outbreaks, such as sustained hot and humid weather. Computer programs and applications are now available to help forecast pest population levels, incorporating degree days to predict the stage of development of insects and weeds. In addition, university turf programs also often provide information on disease and other pest outbreaks across the state as they occur.

Record keeping: Measure and document what you see, such as number of insects per unit area or percent area. Photographs, maps of pest boundaries, date, weather conditions, recent cultural practices, and recent nutrient applications should also be documented. This information can help establish a record of when, where, and under what conditions your course experiences pest issues.

IDENTIFYING PESTS

Once detected, pests must be properly identified in order to be managed. Many common species are recognizable, but when you are unsure of the identification, pest-related references appropriate for the geographic area should be consulted or samples submitted to diagnostic labs, such as at a land grant university. In addition to identifying pests, understanding the biology of key species and their vulnerable life stages assists in later control efforts. Knowing beneficial organisms and their life cycles is also important to avoid impacting them while managing pests.

SETTING THRESHOLD LEVELS

Threshold setting is a key part of an IPM approach. Thresholds are based on the pest population size and stage, the life stage of the plant, and the aesthetics necessary to meet player expectations. Thresholds should be set at the number of pests or level of damage that justifies treatment to prevent unacceptable turf loss. When possible, the IPM plan should document these thresholds – e.g. six to ten white grubs per square foot of turf. Audubon International staff, the USGA Turf Advisory Service, and Cooperative Extension staff can provide additional information on setting threshold levels or referrals.

CONTROL STRATEGIES

A number of strategies can be considered before determining that chemical pesticide use is warranted.

Cultural Controls

Cultural practices, such as those discussed previously, can often be used effectively to address underlying conditions that cause

disease, weed, or insect pests to reach problem levels. Raising the mowing height, altering irrigation, or improving soil health may adequately address certain problems in times of stress.

Physical/Mechanical Controls

Mechanical or physical control methods (such as hand pulling weeds) exclude or remove pests. However, these methods are time consuming and work best when pest populations are low.

Biological Controls

Biological controls include the release and/or conservation of beneficial natural predators, such as parasites and pathogens. Areas on the golf course, especially in landscaped areas, can also be modified to better support natural predators and beneficial organisms, especially in landscaped areas.

Chemical Controls

When warranted and when other methods will not alleviate the pest problem, chemical

While handpicking weeds can be labor intensive, it can reduce chemical inputs.

control is an acceptable IPM practice. In some cases, spot treatments will be all that is needed to control a problem. Proper timing is essential for chemicals to work effectively given the life cycle of many insects and diseases and in some instances, re-application may be warranted.

Curative and Preventative Applications

There are two main approaches to applying chemicals on the golf course: curative and preventive. Which strategy you choose depends on the type of pest or disease and the likelihood of its occurrence. By employing a comprehensive IPM program, many golf courses have moved away from using preventive treatments. A primarily curative approach, with preventive treatments only for those diseases that are more effectively controlled before an outbreak, has proven to be an effective management strategy.

When chemicals are applied on a curative basis, they are used only to solve current pest problems. This approach often allows a golf course to reduce the amount of chemicals being used, since only damaged areas are targeted. This limits the amount of chemical resistance any organism will acquire and limits the effects on non-target species. When using a curative approach, it is important to monitor the health of each playing surface, as well as conditions that favor the spread of a pest or disease. When damage threshold levels are exceeded or when weather conditions favor disease spread, the superintendent must take action to control further damage.

Applying chemicals on a preventive basis may be needed to control certain types of turf diseases and pest problems. For certain diseases, preventive treatment may reduce the amount of overall pesticides needed or the toxicity of products used on a course. When applying chemicals preventively, areas that have no current pest problems and *may not develop problems* are sprayed. Such broadcast spraying of chemicals not only increases the likelihood of chemical resistance, but also can harm non-target species. Chemical resistance may result in the use of more toxic pesticide products later. However, if spraying preventively will stop an outbreak or reduce the need for more hazardous chemical usage, it may be the preferred treatment option. Sites receiving preventive treatments would likely have a history of pest occurrence or exhibit conditions favorable for pest development.

Selecting Pesticides

The options for chemical control include reduced-risk pesticides, biopesticides, and conventional pesticides. Reduced-risk pesticides and biopesticides provide a number of advantages over conventional pesticides and should be considered first if applicable to the pest problem.

When control by conventional pesticides is needed, a selection process should be followed to select the most environmentally friendly but effective product. Considerations should include the following:

- The product must be registered for use in the area.

- It must demonstrate to be effective in treating the pest.
- Chemical resistance issues should be considered.
- The degree of environmental risk must be assessed.

Evaluating the environmental risk can include the use of a screening tool, such as the Windows Pesticide Screening Tool (WIN-PST), an environmental risk screening tool for pesticides developed by the NRCS that evaluates the potential of pesticides to move with water and eroded soil/organic matter and to affect non-targeted organism. Other evaluation tools include Cornell's Environmental Impact Quotient (EIQ), which was developed to rate the risk of pesticides to human health and non-target organisms.

EVALUATION

Keeping legible, regular records is crucial to a successful IPM program. Documentation is an important tool for recording the history of pest problems, cultural practices, weather, and the results of any action. Set up a clear, concise method of recording all pest information to which all staff involved with scouting can contribute, including smartphone applications to make real time monitoring notes easy for staff. We recommend keeping three types of records:

Field data (scouting) sheets. These sheets serve as a tool to record what, where, and how many pests are present during scouting. This should include basic information, such as the scout's name, scouted location (a map works best), weather, and basic observations of turf growth and health.

Control information. Similar to field data sheets, control information should include the date, control method used, pesticide application information (as needed), expected results, proposed date for scouting the area again, and summary of control method effectiveness.

Weekly summaries. The results from the field data should be compiled on a weekly basis. The location of incidents and population of each type of disease, insect, or weed should be recorded. These weekly summaries can serve as a valuable reference for the course, helping you to detect trends and make sound management decisions.

Regular scouting and monitoring help golf course employees become familiar with pests and address problems once threshold levels have been exceeded.

Increasing Support Via Communication

STAFF

For an IPM program to work effectively, employees must understand the basic tenets of IPM and learn ways to reduce pest and disease problems via sound golf course maintenance strategies.

Monitoring and identification practices should be explained to key employees, so that they can help during their normal rounds. This will also give employees a sense of ownership in the IPM program. One easy way to reinforce training is to mount a poster in the maintenance facility of the different pests commonly found on your golf course. This will help employees become more familiar with the appearance of specific pests and allow them to inform you of a problem on a timely basis.

GOLFERS

All too often, golfers forget that the sport they love is played on living plants. Demands for fast greens and perfect conditions, combined with carelessness in repairing ball marks, divots, and cart tracks, undermine sound maintenance strategies. Communication is essential for educating course officials, committees, and golfers about the impact of golfer demands on environmentally sound golf course maintenance.

A number of communication methods are available to educate course officials and golfers about IPM strategies and explain why they are being undertaken. The club newsletter is a good forum for addressing pertinent issues. Likewise, posting information regarding course conditions in the pro shop, in locker rooms, or on the course website has proven effective for many superintendents. Informing officials of sound management techniques can help promote your stewardship activities. Letting golfers know you practice IPM helps them better understand and accept management decisions.

Effective Communication Strategies

- Signs
- Newsletter articles
- Presentations to golfers, garden clubs, community groups
- One-on-one conversations
- Bulletin board messages
- Communication with the golf pro
- Social media (Twitter, Facebook)
- Websites

THE PUBLIC

The public often doesn't appreciate the role of golf courses in providing open space

in the community. Educate the public on these services and the role of management activities and practices in reducing chemical use and protecting natural resources. Garden clubs, community groups, watershed groups, etc. will be interested to learn more about your efforts.

IPM practices have been employed successfully at thousands of golf courses around the world. Following proper nutrient management and cultural practices, carrying through with a well-conceived maintenance plan and communicating with staff, golfers, and the public will ensure quality golf course conditions with the least impact on people and the environment and will foster goodwill in the community.

Self-Assessment Checklist

Growing healthy, dense turf is the first line of defense against pests. Nutrient management planning and cultural practices assist in these efforts. However, even with diligent attention, pests do occur, especially in times of stress. An IPM program will help you to assess pest problems before they irreparably damage turf and will assist in reducing chemical usage. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

General Knowledge

- Comply with all local, state, and federal pesticide regulations and any fertilizer regulations that may also apply.
- Understand the different types of environmental fate and transport mechanisms that can cause the chemicals and nutrients used on golf course to have a negative impact on the environment, as well as the potential environmental impacts.
- Understand the human health risks of pesticide use and how to avoid exposure.

Nutrient Management

- Develop a nutrient management plan for different areas of the course, taking into consideration any sensitive areas (such as steep slopes).
- Test soils regularly.
- Assess nutrient fertilizer needs based on soil test results. Consider plant tissue analysis in selected areas (such as putting greens) that are most prone to nutrient imbalances.
- Apply minimum levels of nutrients while still meeting turf goals and stakeholder expectations. Consult published guidelines as needed for nutrient rate, timing, and frequency recommendations.
- Calibrate equipment on first use and regularly throughout the season.

Cultural Practices

- Select the best adapted species or variety to match site conditions. Consult the National Turfgrass Evaluation Program database or state university turf programs for recommendations.
- Reduce the potential for soil erosion from disturbed soils during turf establishment.
- Use mowing practices, clipping management, and cultivation techniques to maintain dense, high-quality turfgrass.
- Alter traffic patterns as needed to avoid damaging turf.

Integrated Pest Management

- Develop a written IPM plan.
- Follow an approach that takes into account basic IPM principles, such as monitoring, pest identification, threshold setting, and evaluation of

different non-chemical and chemical control measures. Incorporate record keeping and evaluation of program effectiveness.

- Evaluate the potential effectiveness of non-chemical control methods to treat pest problems first.
- When chemical control is warranted, research availability of reduced-risk pesticides and biopesticides for the pest problem.
- When conventional pesticides are needed, follow a selection approach that includes evaluation of potential environmental and human health impacts.

Communication and Education

- Regularly train and encourage continuing education for maintenance staff, including state licensing, professional association training, and IPM certification. If applicable, provide non-English speaking employees with training in their native languages.
- Communicate with employees, golf club members, and the public regarding the IPM program to maintain a dialogue regarding thresholds, pest outbreaks, and control measures in relation to environmental quality.
- Communicate with the greens committee, club manager, and club pro, as appropriate, to coordinate and assure support for needed golf maintenance activities.

One of the most important components of an environmentally sustainable maintenance program is a modern fully functional maintenance facility.

Chapter 4: Chemical Safety and Maintenance Operations

CONTENTS

Overview

One of the most important aspects of ensuring chemical safety on a golf course is the maintenance facility. Whether you are working with a low-budget/no-frills facility or a high-end natural resource management center, basic standards apply. The facility should be orderly and clean. Any potentially hazardous substances must be safely stored, handled, and disposed of.

Evaluate your facility and potential workplace hazards using the following checklists. Conduct a walk-through inspection, check records, and determine what chemicals and practices could pose threats to worker health or environmental quality. For instance, higher toxicity chemicals could be re-evaluated and possibly replaced with lower toxicity chemicals. Identify problem areas and develop a plan to eliminate them.

Environmentally responsible chemical storage and handling not only requires good management, but also depends on the infrastructure available at the golf facility. When expensive repairs or upgrades are needed, consider the cost of liability against the cost of investment in safer facilities. Such arguments are often the most persuasive in gaining approval for capital expenses for a better maintenance facility.

This chapter will help you meet the following goals to protect human health and the environment:

- Prevent the unintended release of chemicals into the environment in all of your operations involving storage, handling, mixing, washing, and disposing of chemicals and waste materials.
- Dispose of chemicals and hazardous waste safely.
- Safely and effectively contain unintended releases of chemicals if and when they occur.

General Knowledge

Maintenance operations encompass all aspects of transporting, storing, handling, and disposing of the chemicals and other hazardous materials used on golf courses. Safeguarding the health of employees, the public, and the environment is of paramount concern here. Written policies, staff training, and limited access to chemical storage areas are essential to this aspect of maintenance operations.

REGULATORY ISSUES

Strict adherence to chemical safety guidelines for all chemicals used on the golf course – pesticides, fertilizers, fuels, etc. – should ensure compliance with regulations that protect both the environment and public safety. In addition to the Federal Insecticide, Fungicide, and Rodenticide Act (as discussed in the "Chemical Use Reduction" chapter), state and federal regulations address fertilizer storage, fuel storage, and hazardous waste management. And while the Environmental Protection Agency (EPA) regulates pesticide use in the field, the Occupational Safety

and Health Administration (OSHA) has regulatory authority over workers not in the field who may be exposed to pesticides and over workers in the field who may be exposed to hazardous chemicals other than pesticides. For example, both the EPA and state agencies regulate underground fuel storage tanks because of the potential for leaking tanks contaminating groundwater.

POINT SOURCES

Adhering to the practices described in this guidebook, such as creating no-spray zones around water bodies and reducing your chemical use, will dramatically reduce the potential for nonpoint source pollution at your facility. However, the centralized nature of maintenance operations can potentially lead to a pollution point source. Point source pollution, described as a single source of pollution whose origin can be identified, can occur when there is an unintended release of chemicals, such as a pesticide spill in a storage area. Therefore, the central area of golf courses where chemicals (including pesticides, fertilizers, fuel, paints, etc.) are stored and handled is an important focus for your attention to prevent point source pollution. When spills do occur, structural measures and plans should be in place to contain the spill. Lastly, if a spill cannot be contained, superintendents should be aware of the reporting requirements to local, regional and/or national authorities.

HAZARDOUS WASTE

Golf courses may generate a number of different types of wastes that require management, including, but not limited to, some that may be classified as hazardous, such as waste oil, lead-acid batteries, solvents, and antifreeze. A waste is considered a hazardous waste if it exhibits a specific characteristic (ignitability, corrosivity, reactivity, toxicity). For example, many fluorescent bulbs are hazardous wastes due to their mercury content. Hazardous waste is typically regulated, such as by the EPA in the United States, and thus cannot just be discarded with other waste materials. Therefore, understanding the hazardous waste that your facility generates is imperative. Taking steps to reduce potential hazards should be part of your maintenance planning, such as replacing fluorescent lighting.

Prevent Unintended Release of Chemicals

Maintenance facility specifications in the following sections are considered standard for environmentally responsible chemical storage and handling. Because they involve infrastructure standards, we strongly recommend them to all golf courses but do not require all of them for ACSP certification. Use the following information to audit your facility and make improvements where necessary.

CHEMICAL STORAGE

Storage facilities that are well designed and well maintained protect people from exposure, reduce the potential of environmental contamination, protect chemicals from extreme temperatures and excess moisture, and, in general,

reduce liability concerns and potential environmental risks. Very old or inadequate storage areas do not need to be replaced with a new building, but plan for improvements over time to meet the following guidelines:

- Structurally separate from office and general work areas.
- Locked and properly posted with warning signs.
- Fire proof with explosion-proof lights.
- Ventilation to exhaust any fumes in the event of a spill.
- Raised berm on all sides and an impervious surface for containment of at least 25% of the volume of all liquid chemicals and fertilizers stored.

Modern chemical storage structures with secondary containment provide a safe way to store chemicals.

- Flooring sloped to a drain.
- Equipped with spill containment materials and fire extinguishers.
- Human-safety features such as a water supply, wash station, and first aid kit at or adjacent to the storage area for emergencies. (Note: Personal protective equipment, or PPE, should be stored nearby, but not in, the storage facility.)

Inside storage areas, the following practices should be instituted:

- Pesticides should be stored separate from fertilizers.
- Store herbicides, insecticides, and fungicides in separate areas within the storage unit.
- Pesticides and fertilizers should be kept dry and out of the way of activities that might knock over a container or rip open a bag.
- Liquids should be stored below dry chemicals.
- Store chemicals on metal or plastic shelves. Do not store chemicals on wooden shelves, as this is not only a fire hazard, but wood can absorb chemical spills and render the shelving a hazardous waste.
- Storage of liquid pesticides in cold weather should be avoided to prevent freezing that can crack or rupture containers.

Chemical Management Strategies

- **Maintain an accurate inventory.** Knowing precisely what chemicals you have, their quantity, and date of purchase is a key strategy for efficient chemical management.
- **Keep a database of Safety Data Sheets.** Create a database of SDS for each chemical in your inventory. Store the information on-site (not in the storage room) and make it easily accessible in case of an emergency.
- **Buy only what you need.** This minimizes the amount of chemical products that need be stored, avoids waste, and increases the likelihood that each chemical application will be evaluated carefully.
- **Use older products first.** Adopt a "first in-first out" strategy, using the oldest products first to ensure the product shelf life does not expire.

MIXING AND LOADING

Groundwater contamination can result even from small spills in the mixing and loading area. For example, small quantities spilled regularly in the same place can go unnoticed, but pesticides can build up in the soil and eventually leach to groundwater. Mixing and loading on an impermeable surface, such as concrete, makes it possible to contain and reuse most spilled pesticides.

The two best ways to improve pesticide mixing and loading are to build a mixing and loading pad or to better manage your existing mixing and loading site. Regardless of whether you have a new mixing and loading area or an older one, the following guidelines will protect natural resources:

- Do not mix or load chemicals in the vicinity of any wells or surface waters, including wetlands. A safe distance is typically 100 to 150 feet downslope. If necessary, use a nurse tank to transport water to the mixing and loading site.
- Mix materials according to label directions to avoid having to dispose of excess.
- Mix and load chemicals over an impermeable surface such as a concrete pad. If no concrete pad is present, pick the most impervious surface available, such as a clay surface. Utilize a berm (permanent or portable) on the downslope side to contain any spills.
- Always supervise sprayer filling. For restricted-use pesticides, a trained and certified applicator must supervise operations.
- Either use anti-backflow devices when mixing pesticides or maintain a 6" air

gap between mixing container and water source.

- Use rinse water for mixing subsequent loads of the same pesticide. Spray the last rinse load on the field.
- Pump sumps dry and clean at the end of each day if your pad has a sump.

If the mixing and loading area is shared with a wash pad area (not recommended), care must be taken during mixing and loading to ensure that any spills can be contained. For example, a plug can be put over the drain during mixing and loading and removed prior to washing equipment.

WASHING EQUIPMENT

Maintenance equipment should be cleaned in a manner that does not allow chemicals to move into waterways. Installing a wash pad with a filtering or recycling system is the preferred method for minimizing contaminated wash water from mixing with surface water and groundwater. Ideally, pesticide equipment is washed in a closed system where rinse water can be reused. However, pesticide application equipment may also be cleaned directly over turf where that chemical was needed. The cleaning area should be rotated frequently.

When evaluating your wash pad area and operations, the following should be considered:

- Use compressed air to blow off grass clippings prior to washing. Because clippings contain nutrients that contribute to eutrophication of surface waters, removing them before washing equipment reduces the nutrient load in wash water.
- Wash pads should be an impervious material (e.g. concrete) to prevent leaching of any contaminants.

Portable low cost containment systems can provide an effective way to provide containment.

- A roof to cover the wash pad area keeps rain off the pad and prevents excessive water from going into the recycling storage tanks.
- Wash pads should have triple screen baskets to prevent an excess of grass clippings from entering the drain.
- Use a minimum of detergents, and when needed, select biodegradable, non-phosphate detergents.
- If no recycling system is available, then wash water should drain into a grassed retention area or swale at least 25 feet wide and at least 100 feet from a water body, in adherence with the treatment train approach to water quality management.
- Wash water should be recycled with contaminating materials, such as grease, oil, and gasoline, filtered from this recycled water.

Closed loop systems provide not only protection against discharge of nutrient rich wash water but also help conserve water.

- Wash water should not be discharged to surface water either directly or through ditches, storm drains, or canals. Equipment wash water can contain soaps, fertilizer residues, solids, and lubricating oil residues, which can contaminate water sources.

An example of a wash pad that has the potential to discharge nutrient rich wash water directly to a water body.

EQUIPMENT STORAGE AND MAINTENANCE AREAS

Equipment storage and maintenance facilities should also be designed to prevent the accidental discharge of chemicals, fuels, or contaminated wash water that could reach water sources. Properly storing and maintaining equipment, such as storing it in an area protected from rainfall, also extends the useful life of machines and reduce repairs. Ideally the equipment storage and maintenance area should have the following features:

- Protection from rainfall to prevent any chemical residues from becoming a stormwater runoff contaminant.

Design features like raised curbing can provide containment in case of a chemical spill.

- An impervious surface in the area where maintenance activities are performed.
- Locked cabinets for safely storing solvents, degreasers, and other maintenance-related chemicals. These chemicals should be included in the chemical inventory and SDS sheets kept on-site.
- Collection areas for used solvents and degreasers before they are recycled or properly disposed of.

FUELING FACILITIES

Fueling areas should be properly sited, designed, constructed, and maintained to prevent petroleum products from being released into the environment through spills or leaks. Ideally the fuel storage area should have the following features:

- A roof over the tanks to increase their longevity.
- An impermeable surface (e.g. concrete with a sealant), with spill containment and recovery features. Spill containment should be designed to hold 110% of your largest tank.
- Catch basins should be directed toward an oil/water separator or sump to prevent petroleum from moving outside of the containment structure.
- Floor drains, if present, should drain to containment pits or storage tanks, if not eliminated entirely.
- Above ground tanks should be used to store fuels to minimize the potential of

Commercially available products such as these under the drums can provide effective containment.

Having an Emergency Spill Kit available will allow for immediate action in case of a spill.

subsurface contamination; leaks are significantly easier to detect in above ground tanks.

- If underground storage tanks are used, they should be equipped with a leak detection system.
- A spill containment kit readily available to clean up any spills.

Dispose of Chemicals, Containers and Other Waste Properly

Containers that hold chemicals either for storage purposes or spill containment purposes should be dealt with in a manner that eliminates the risk of on-site or off-site contamination of water bodies. Proper disposal of hazardous wastes is imperative.

The safest way to dispose of leftover pesticides is to use all of the chemical according to directions on the label. This includes the wash water from pesticide equipment washing, which must be used in accordance with the label instructions. By reducing the amount of chemicals used on the golf course and by employing strategies to manage chemicals effectively, you should not accumulate much in the way of unwanted pesticide or expired pesticide products. However, if this occurs, you should follow regulations or regulatory agency guidance to safely dispose of the products.

Empty pesticide containers should be handled properly as well. In the United States, pesticide containers must be properly rinsed under FIFRA regulations. Once properly rinsed, empty containers can be considered non-hazardous waste. Some packaging material can be recycled (e.g. glass or plastic). Information on proper rinsing techniques, either pressure rinsing or triple rinsing, is widely available online. Purchase in bulk packaging when possible to reduce packaging waste but do so only if you will not have to store the pesticide for longer than its shelf life.

In addition to pesticides and pesticide containers, you will need to review your procedures for disposing of other unwanted, expired, or accumulated items, including chemicals, paints, tires, batteries, used oils, solvents, certain light bulbs, paper products, plastic or glass containers, and aluminum cans. The first step is to reduce your use of these items, whenever possible. The second step is to reuse any materials that can be

safely reused. Lastly, recycle all items that can be recycled, to prevent waste from reaching landfills. When recycling is not possible, dispose of non-hazardous materials the same as other wastes generated at your facility. For hazardous materials, review the regulatory requirements and procedures for disposing for each type of waste.

Be Prepared for Emergencies

Spill containment should be guaranteed throughout all areas of the maintenance facility, especially in the mix/load area and the fueling station. An emergency response plan should be developed that documents the emergency protocols in place that addresses the three C's: control, contain, and clean up. If the release is too big to contain, migrates off-site, or threatens human health and safety, emergency services should be notified immediately. Training on the response plan and protocols should be well understood by all employees and include all the health, safety, and environmental concerns associated with the chemicals used at the facility.

Review the materials in your spill kit to ensure that you are prepared to quickly and safely contain chemicals. Examples of spill kit materials and descriptions of the kinds of sorbent materials are available online, such as this New York State Best Management Practices information on spill kit materials appropriate for golf courses.

The Three C's

Control. As quickly and safely as possible, stop the release of the chemical.

Contain. Keep the chemical from spreading. For example, when the spill is on a hard surface like concrete, use an absorbent material from your spill kit to contain the spill. It is important to prevent the spilled material from entering any body of water, including storm sewers or drains.

Clean Up. After containing and cleaning up the spill, properly dispose of any materials that were cleaned up or used in the clean-up process.

Self-Assessment Checklist

Minimizing the use of chemicals and safely storing, applying, and handling the chemicals you use will reduce actual and potential environmental contamination. In addition, manage your equipment washing, storage, and maintenance areas and operations to prevent contaminants from reaching surface water or groundwater. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

General Knowledge

- Understand and comply with all regulations that pertain to your maintenance operations.
- Avoid any potential for point source releases of chemicals from your operations.
- Identify any materials at your facility that are considered hazardous waste.
- Train all key maintenance staff to recognize that chemical manufacturing, use, storage, and disposal may pose risks to human health and the environment.
- Communicate with the greens committee, club manager, and club pro, as appropriate, to coordinate and assure support for needed golf maintenance activities.

Chemical Handling

- If possible, follow all guidelines for chemical storage structures. If older storage areas are still in use, make strategic improvements over time that focus on preventing a spill from becoming a point source of pollution, such as:
  - Chemical storage area has a sealed metal or concrete floor.
  - Sump located near the middle of the floor to contain any spills, and a curb along the edges.
  - Raised berm on all sides and an impervious surface for containment of at least 25% of the volume of liquid chemicals and fertilizers stored.
- Maintain an accurate chemical inventory and employ strategic management practices to minimize the amount of chemicals you must store, such as a “first-in, first-out” strategy.
- Create a database of SDS information that is easily accessible to staff for each chemical stored in the storage area. The SDS is your primary tool to determine the physical and health hazards, routes of entry, toxicity, and other information about each chemical in your workplace in case of a spill.
- Properly store all chemicals. Store pesticides and fertilizers on plastic or metal shelving to keep them off the floor.
- Store liquid products below dry materials.
- Mix and load chemicals over an

impermeable surface and dispose of any excess chemicals in a manner consistent with its intended use.

- Mix and load chemicals away from any wells or surface waters. A safe distance is typically 100 to 150 feet downslope.

Fueling Facilities

- Fueling facilities should feature an impermeable surface (e.g. concrete with a sealant), with spill containment and recovery features.
- Fueling facilities should have a roof, which lengthens the lifespan of storage tanks and prevents precipitation from becoming contaminated with petroleum products.
- Use above ground storage tanks to store fuel, whenever possible, and monitor for leaks. If underground storage tanks are used, they must be monitored for leakage.
- If a storage tank is found to be leaking, contact regulatory authorities for guidance.

Equipment Washing, Storage, and Maintenance

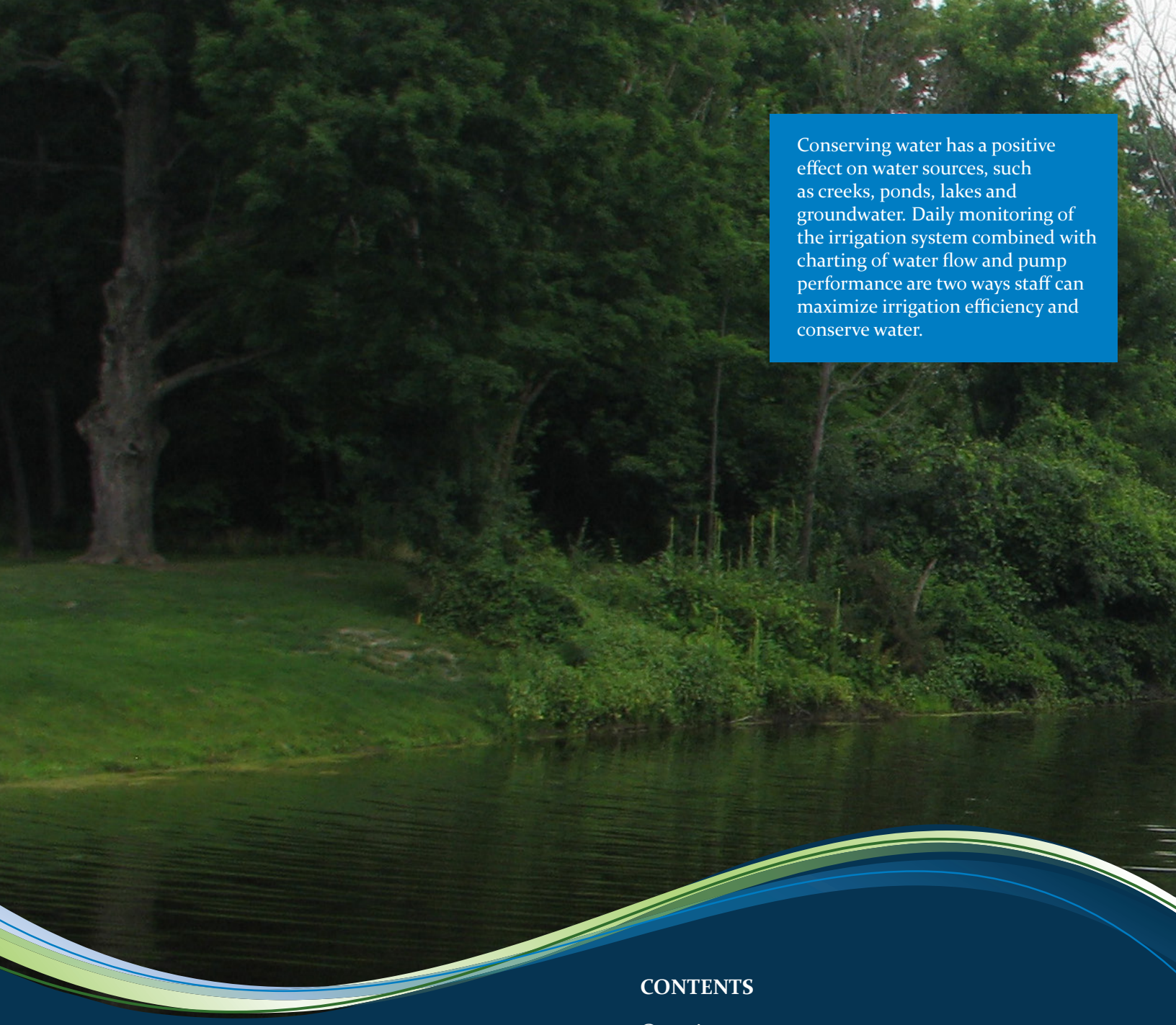
- Prevent gasoline, motor oil, brake and transmission fluid, solvents, and other chemicals used to operate and maintain equipment and vehicles from contaminating soils, surface water, or groundwater.
- When cleaning and maintaining equipment, no direct contact of wash/waste water with surface water should occur. Use a wash water collection and recycling system if possible.
- Use compressed air to blow grass clippings off equipment before washing, or instead of washing.
- Use a catch basin to collect grass clippings, grease, and oils and maintain properly.

Disposal

- Follow guidelines for rinsing pesticide containers. Either triple rinse or pressure rinse before recycling or disposing of containers.
- Review procedures for disposing of all products used at the facility. Use a reduce-reuse-recycle paradigm for source reduction of materials and products used at the facility.
- Identify materials classified as hazardous and dispose of properly.

Spills

- Have an emergency response plan in place and make sure staff are trained on all protocols.
- Follow the three C's: Contain, Control, and Clean up.
- Have a spill kit with safety equipment and absorbent materials readily available.
- Do not let released chemicals enter drains or surface waters. If they do, contact proper authorities immediately.



Conserving water has a positive effect on water sources, such as creeks, ponds, lakes and groundwater. Daily monitoring of the irrigation system combined with charting of water flow and pump performance are two ways staff can maximize irrigation efficiency and conserve water.

Chapter 5: Water Conservation

CONTENTS

Overview

The purpose of water conservation is to ensure adequate water supplies for irrigation, but also for the healthy ecological functioning of water bodies, such as rivers, streams, wetlands, lakes, and ponds.

Water consumption is a key environmental concern for golf courses. Having a comprehensive water conservation program in place helps to show your course's commitment to judicious water use and environmental stewardship. This section reviews water-saving strategies that you can employ as part of your ongoing turf maintenance routine. These practices will help you meet three key goals:

- Identify water sources for the golf course and use alternative water supply sources to conserve freshwater drinking supplies.
- Maintain irrigation equipment for maximum efficiency and minimal water waste.
- Implement water conservation practices.

Using water at optimal efficiency can be achieved through a combination of equipment, operational, and behavioral changes. This chapter explores how these changes can help you attain these three key goals. In addition, monitoring your use of water and tracking yearly trends can help you gauge the success of water conservation efforts. You should track water use and tally the number of gallons used monthly and yearly. You can use these records to set realistic conservation targets, detect trends, plan for drought, and promote your successes.

General Knowledge

One of the greatest environmental concerns facing golf courses is water usage. Water use on golf courses varies widely depending on climate (e.g. annual rainfall amounts, length of growing season) and other factors such as water use restrictions. However, an Environmental Institute for Golf (EIFG) study called *Golf Course Environmental Profile – Volume II: Water Use and Conservation Practices on U.S. Golf Courses* reported the following: An 18-hole golf course in the U.S. uses an average of 152.5 acre-feet of water per year to irrigate 80.7 acres of turfgrass for an average of 1.9 acre-feet of irrigation water per irrigated acre.

Water usage is increasingly becoming a concern across the globe. In many areas, golf course superintendents can expect increasing restrictions on water usage for irrigation as well as increasing expenses for using water. In addition, depending on the water source, irrigation practices can negatively impact local drinking water supplies, decrease the amount of water available for plants and wildlife that rely on local water sources, and decrease groundwater recharge rates. Lastly, over-irrigating on golf courses can increase the potential for surface runoff and leaching and also result in poor playing conditions. Therefore, water conservation practices are

critical for ensuring adequate irrigation supplies that do not tax or degrade vital water sources. Developing a conservation ethic in yourself and your fellow employees is the cornerstone of a successful environmental management program.

Understanding a few site-specific characteristics of different areas of your course, such as soil textures that influence infiltration rates and dynamic characteristics like root zone depth and evapotranspiration rates, will assist in the precise and efficient application of water to promote healthy turf on your course.

SOIL INFILTRATION RATE

Soil textures impact the rate that water infiltrates into the soil and becomes available to plants. For example, sandy soils have greater infiltration rates than silty or clay soils. Related to infiltration rate is the plant available water (PAW), which is the amount of water available for plant transpiration. PAW is less than the total volumetric soil moisture content that is reported by standard soil moisture sensors.

SOIL ROOT ZONE DEPTH

Shallow roots will be found on the golf green and tees, where the majority of roots are located in the top several inches of soil. Fairways and roughs will typically have deeper roots. Knowing the root zone depth allows you to form a clear estimate of the amount of water that needs to be available to the root system to avoid wilting.

EVAPOTRANSPIRATION

Knowing evapotranspiration rates, the rate at which water is lost through soil evaporation and plant transpiration, helps to determine water replacement needs. ET is higher on hot, windy days with low relative humidity. At the wilting point of plants, ET has depleted the available water in the soil. Potential ET can be calculated and should be used to help determine irrigation needs to refill soil reservoirs before plants reach the wilting point. Sources of potential ET data include on-site weather stations and automated weather data network maps based on climate data and published online by governmental agencies.

Identify Alternative Water Sources

Five major sources of irrigation water were identified in the EIFG report:

- Open water sources (lakes, irrigation ponds)
- On-site wells
- Freshwater sources (rivers, streams, creeks)
- Municipal drinking water supplies
- Reclaimed water sources

Be sure that you and other golf course employees know where your water comes from and are aware of local issues regarding water consumption. If using potable water sources, your highest priority should

be to change your irrigation source to conserve drinking water supplies. If using groundwater from on-site wells or freshwater sources, your highest priority should be to investigate the feasibility of using reclaimed water sources. Storage ponds that collect storm runoff water that might otherwise be lost are also an excellent alternative irrigation supply.

In many cases, golf courses will use more than one source of irrigation water to meet irrigation needs.

Because of increasing use restrictions, costs, and environmental concerns, irrigating with reclaimed water is becoming more common, especially in arid regions and large metropolitan areas. Reclaimed water (also called recycled water, wastewater, or effluent water) is defined as any water that has been treated after human use and is suitable for limited reuse, including irrigation. In some cases, using reclaimed water may also be part of a nutrient reduction strategy to meet Total Maximum Daily Load (TMDL) objectives in impaired watersheds. A step-by-step guide for using recycled waters on golf courses is published by the USGA in *Water Use on Golf Courses: A Collection of Resources for Sustainable Management of Golf Course Irrigation.*

Understanding the use of recycled water to meet the needs of turf includes an understanding of potential concerns. For example, recycled water may impact soil health. It typically is higher in salts and therefore increases the potential for salt injury to plants. Recycled water may also have higher amounts of other soluble compounds. However, especially when the recycled water source is close to a golf course, it can lower irrigation costs, offsetting the extra management necessary to monitor the water and soil nutrient content through routine testing.

Monitor Irrigation Water Quality

Water used for irrigating turf on golf courses must be suitable for plant growth. By monitoring irrigation water quality, you can protect turf from damage, as well as account for nutrients in water that can reduce supplemental nutritional needs. In particular, all non-potable water irrigation sources (including recycled water sources and detention ponds) should be regularly tested. In addition, wells along coasts used for irrigation might need to be tested for salt water intrusion.

Irrigation water quality tests identify the chemical characteristics of the water and can be used to address possible problems with soil salinity and plant health. This testing is also an important step in the total water quality program on your course as it will provide you will baseline data that can then be used to determine the impact (both positive and negative) of your operations. For more information on irrigation water quality specifically for turfgrass, see *Irrigation Water Quality Guidelines for Turfgrass Sites* and "Understanding Water Quality and Guidelines to Management."

Increase Irrigation System Efficiency

Irrigation systems should be designed to be efficient, distribute water uniformly, conserve and protect water resources, meet state and local code, and meet site requirements. Once designed, they must work properly to provide efficient irrigation. Note: Due to their expense, the ACSP does not mandate irrigation system upgrades for certification in Water Conservation. The program advocates that superintendents and their staff maximize the efficiency of the system that is in place, properly maintain equipment, and employ proper watering practices and agronomics.

Such a combination of mechanical and behavioral practices promotes judicious use of water resources and can result in overall turf health and improved playability. If the irrigation system is clearly in need of replacement, the course should demonstrate its plans to do so within a reasonable time frame.

A properly working irrigation system (pumps, valves, fittings, sprinklers, etc.) is critical for efficient irrigation. A schedule of inspections and a plan for record keeping should be completed. The publication *2014 Landscape Irrigation Best Management Practices* provides information on inspections and record keeping. To ensure that it is performing as intended, an irrigation system should be calibrated regularly by conducting periodic irrigation audits, such as catch-can tests. Conduct an annual irrigation audit to check actual water delivery and nozzle efficiency. While routine inspection and auditing tasks can be performed by you or your staff, a professional irrigation consultant is required for a detailed irrigation audit, which should be conducted with audit BMPs, such as those published by the Irrigation Association in Irrigation Audit Guidelines. Ideally, this professional audit should be conducted at least once every five years and, if possible, conducted by a Certified Golf Irrigation Auditor.

Routine Irrigation Maintenance and Inspection Activities Examples

- Regularly monitor the system to ensure that all heads are operating properly.
- Identify and repair all leaks.
- Check nozzle sizes as they relate to available pressure and resulting coverage.
- Check for nozzle wear.
- Check pump performance and other pump house systems.
- Relocate heads to improve water distribution, where necessary.
- Use half-circle sprinklers where applicable.
- Calibrate irrigation systems regularly.

Areas that can be identified to increase efficiency without replacing the entire irrigation system include using computer-controlled irrigation management, installing part-circle irrigation heads, utilizing weather stations, soaker hoses, etc. A well-designed, correctly installed, properly utilized automatic irrigation system provides the best means of conserving water. Water savings of 40 to 75 percent have been documented on golf courses that converted from manual to automatic systems.

Many lower cost opportunities are available to conserve water as well. For example, installing quick couplers can conserve significant amounts of water at a low cost. A New York BMP case study estimated that the installation of 40 quick couplers on one course saves an estimated 810,000 gallons of water annually. As a no-cost example, inspecting sprinkler head heights can improve efficiency, as efficiency can be reduced by as much as 20 percent when sprinkler heads are too low. In addition, too low or tilted sprinklers can cause problems with distribution uniformity, resulting in excessively dry or wet areas. Monitor your water usage to determine water savings and communicate with stakeholders to demonstrate your commitment to water conservation.

Conserve Irrigation Water

Proper watering practices and turf care will help maximize water absorption and minimize water loss due to evaporation and runoff. You may be able to alter water use habits so that water is used more efficiently (e.g. using ET rates to schedule irrigation and applying only as much water as is needed).

SET WATER PRIORITIES

When embarking on a water conservation program, especially in times of drought or when water usage has been restricted, setting priorities for irrigation identifies the highest priority areas (greens) and lowest priority areas (out-of-play areas). For example, in low-traffic sites where wear tolerance is not critical, irrigation can be delayed until signs of mild to moderate stress (wilting indicated by leaf roll/fold symptoms) occur, which has the added benefit of maximizing rooting and improving drought response. Most golf courses set priorities in the following order:

- Greens and collars
- Tees
- Approach areas
- Fairway landing zones
- Other fairway areas
- Roughs
- Out-of-play areas

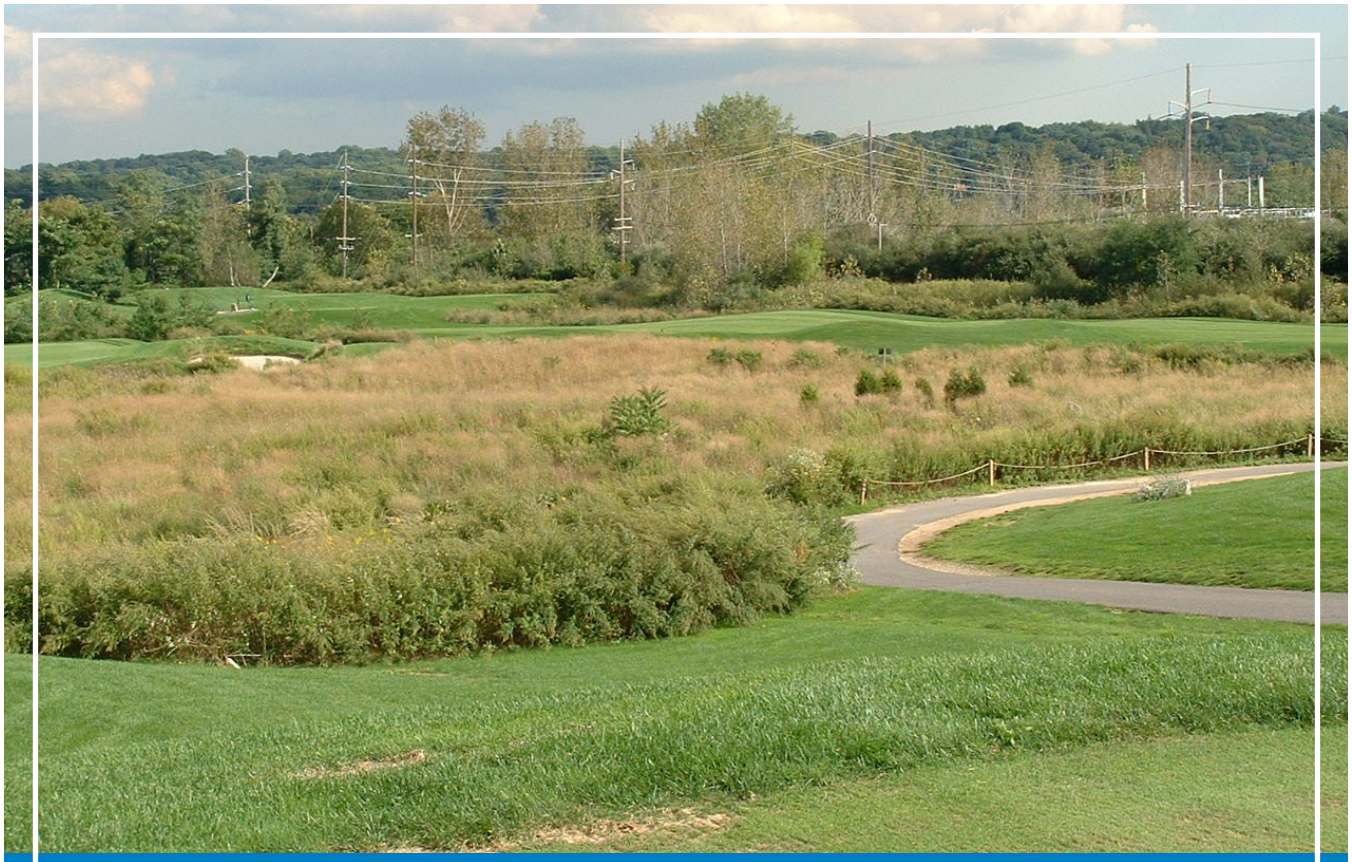
The current trend of greens, tees, and fairways representing the only highly maintained areas of the course saves water and has little effect on the game itself. For many courses, changing management practices to favor water conservation reestablishes the enjoyment of the original golf course design.

REDUCE IRRIGATED ACREAGE

Naturalization projects in out-of-play areas can substantially reduce the amount of irrigation needed on your course. Even small reductions in irrigated turf can add up to big savings over time. For example, tee banks, green banks, and densely shaded areas provide good opportunities for reducing the need for turf without impacting playability. In small areas such as these, mulching can eliminate the need for supplemental irrigation and can suppress weed growth. Irrigation can also be eliminated or reduced on the driving range. Several useful software tools can provide a quantity of turf acreage at the start of a turf reduction program, and periodically thereafter. Free computer applications can be used to quickly obtain approximate measurement of turf acreage.

PLANT DROUGHT AND STRESS TOLERANT TURF SPECIES AND CULTIVARS

The increased availability of improved turfgrass species and varieties provides an excellent opportunity to select the most well-adapted turf to site conditions. Well-adapted species require reduced amounts of inputs of supplemental fertilizer and pesticides and, if selected for drought tolerance, require less water to survive and maintain playability.



Naturalized areas are an effective way to reduce irrigated acreage and reduce water use. These areas will also reduce other inputs and result in costs savings.

Ongoing university turfgrass breeding programs work toward developing better-adapted cultivars. In the United States and Canada, the National Turfgrass Evaluation Program (NTEP) evaluates different species and cultivars. Therefore, NTEP trials should be reviewed for your area to assist in turf selection. Examples of university breeding program successes include the following:

- Several improved cultivars of buffalograss (Buchloe dactyloides), a native of the Great Plains, have been developed by turfgrasses breeders at the University of Nebraska-Lincoln. This grass can replace high water use grasses on fairways and roughs in a large geographic area of the Midwest, resulting in water savings of 50 percent or more.
- Improved cold-tolerant, seeded-type Bermuda grass (Cynodon dactylon) cultivars have been developed by breeders at Oklahoma State University, allowing this stress-tolerant, low water use grass to be established in the transition zone as a replacement for high water use cool-season grasses. Water savings of 30 to 50 percent or more can be realized.
- Turfgrass breeders at the University of Georgia have developed improved cultivars of seashore paspalum (Paspalum vaginatum). This extremely salt-tolerant grass can be irrigated with high-salt or brackish waters with little effect on turf quality. Cultivars are available for greens, tees, fairways, and roughs.

MEET PLANT NEEDS WITHOUT OVER-IRRIGATING

Irrigation should be scheduled only to meet the needs of turfgrass, or to water-in a fertilizer or chemical application as directed by the label. A number of important factors must be considered in scheduling irrigation to meet plant needs without over-irrigation, such as soil intake capacity, plant water requirements, root zone depth, and ET rates.

Monitoring soil moisture, estimating plant water needs, calculating ET rates, and making visual observations of turf can all help with scheduling irrigation frequency and rates. Irrigation should be scheduled when soils reach 50 percent of the plant

Tools for Determining Irrigation Needs

- Wireless moisture sensors and portable moisture meters for determining soil moisture conditions.
- Soil probe or spade to determine the depth of turf rooting.
- On-site weather stations.
- Potential ET data published online in automated weather data network maps.
- Rain gauges.
- Aerial photography using drones.
- Weather forecasts.

available water (PAW) point. The amount of water used should replenish the root zone to field capacity.

Calculating PAW in soils can have many variables so utilizing the tools identified below can also help determine when irrigation is required. Avoiding over-irrigation prevents excess water use that impedes your conservation efforts and could even lead to leaching and runoff.

Soil Moisture Meters

Using a soil moisture meter before irrigating will help you to evaluate existing soil moisture conditions and identify areas on your course that may not need as much water as they are currently getting. In addition, using handheld moisture meters can identify areas that need supplemental hand watering to meet water needs without requiring additional irrigation scheduling. For more information on soil moisture measurements, see the USGA article "Identify Soil Moisture Status More Accurately than Ever Before."

Soil Probes and Spades

To determine the depth of turf rooting (i.e. the depth to which 90 percent of the root system penetrates) use a soil probe or spade. Use this information in conjunction with infiltration rate and plant needs to determine irrigation needs to replace only as much soil moisture as required.

Weather Data Information

Having a weather station that includes ET rates can improve the efficiency of your watering program tremendously. Having daily access to ET rates can allow you to control how much water to replace. Rather than irrigate at 100 percent of ET, many golf courses are successfully replacing only 50 to 60 percent of their ET water loss. Replacing ET rates at a low level prevents excessive runoff and over-watering and better prepares turf for periods of drought. In many areas, governmental agencies publish ET-related information, such as on automated weather data network maps. Knowing where to get this information can assist in determining ET.

Weather stations can provide a wide range of information that can help you make irrigation decisions that lead to water savings without a negative impact to the course.

Weather data should also be used to determine if watering should occur at all. If you know how much natural precipitation has occurred, you will have a better idea of

how much water has been put into the soil. If rain is likely, automatic irrigation should be turned off.

Rain Gauges and Forecast Information

To complement available weather data, on-site rain gauges should be linked to the irrigation control system. Weather forecasts are also important for predicting significant amounts of rainfall from frontal or tropical storms expected in the area.

IRRIGATE EFFICIENTLY

Deep and Infrequent Irrigation

One strategy for scheduling irrigation that can conserve water on established turf is deep and infrequent irrigation, as compared to light and frequent schedules. Deep and infrequent irrigation has been shown to increase root production and the depth that roots penetrate. Frequent watering tends to promote shallow rooting and shoot growth similar to applying too much nitrogen. Be mindful, however, that deep, infrequent watering doesn't necessarily mean letting turf wilt before irrigating or irrigating below the root zone, which increases leaching potential.

The key is to monitor the existing root system and maintain adequate soil moisture for good growth.

Deficit Irrigation

Turf can be pre-conditioned with deficit irrigation for a period of 7 to 14 days prior to experiencing drought stress. Pre-conditioned turf has been shown to withstand periods of drought better and recover more quickly.

Hand watering can help conserve water and allow you to apply water to areas that are in need of moisture.

However, letting soils dry completely has a negative effect on plants. Research the deficit irrigation targets of the turf species on your course to plan for deficit irrigation.

Hand Watering

Hand watering conserves water and protects turf health by applying water only where and when it is absolutely necessary. However, hand watering increases labor costs. On putting greens, hot spots and dry mounds should be watered by hand if the majority of the green has adequate moisture. Hand watering fairways and approaches is more time intensive than greens but, if resources allow, should be considered as well.

Drip Irrigation

Using drip irrigation systems in landscaped beds can save a significant amount of water. Studies have shown that such systems save 30 to 50 percent of the water that traditional sprinkler systems use. Other benefits of these systems include improved growing conditions and discouraging weed growth because water is only applied to the intended vegetation.

Timing

Irrigate when there is little wind and avoid mid-day irrigation during peak evaporation periods.

REDUCE TURF STRESS

Avoid placing turf under unnecessary stress. A healthy, vigorous turf is more likely to survive a drought if other stress factors can be reduced.

Ways to Reduce Turf Stress to Conserve Water

Cart and foot traffic. Distribute traffic across the turf as uniformly as possible. When possible, eliminate traffic on important play areas by keeping carts on cart paths, banning cart use on certain days or weeks during the season, using a 90-degree rule, and carefully monitoring traffic.

Drainage. Good drainage is a prerequisite to good turf. Turf in poorly drained areas is usually shallow-rooted and weak.

Weeds, insects, diseases. Reduce competition and injury from weeds, insects, and diseases by monitoring turf areas and following an integrated pest management plan.

Trees. While trees provide many benefits on the course, trees can weaken turf by reducing air circulation, creating excessive shade, and competing with turf for available moisture and nutrients. Improve sunlight penetration and air circulation by thinning lower branches or removing trees when needed. Prune roots near tees and greens to reduce competition for moisture in these areas.

ALTER CULTURAL PROGRAMS

Good cultural practices are the cornerstone of a comprehensive water conservation program. Employing sound agronomics promotes an effective water cycle. When you maintain good turf cover and root depth, healthy soils, and ample drainage, water will be drawn down through the soil layers, absorbed by plants, and replenish groundwater supplies.

Conversely, poor plant cover, shallow rooted turf, inadequate drainage, or poor soil structure result in greater water loss to runoff and evaporation. Instead of being drawn down through the soil layers, much of the water applied (or resulting from precipitation) is drawn back toward the surface or runs off before it can be absorbed. Such conditions result in a vicious cycle of frequent watering that promotes weak, shallow rooted turf incapable of withstanding drought.

The following strategies will help you maximize the effectiveness of the water you use:

- **Aeration.** Core aerate turf areas at the appropriate times to relieve soil compaction, promote root growth, and improve water infiltration.
- **Other cultivation.** Spike or slice turf areas when weather permits throughout the season to maintain good water infiltration.
- **Wetting agents.** A wetting agent can be used during the spring, and at lighter rates during the summer, to assist in water infiltration through thatch and soil, improve soil water retention, and prevent dew formation.
- **Fertilization.** Use low to moderate rates of nitrogen fertilizer where possible. A lush, fast growing turf requires more water and is more susceptible to injury from drought, traffic, and other stresses.
- **Diseases and insects.** Avoid significant turf damage from diseases and insects by using proper monitoring and control programs.
- **Weeds.** Apply herbicides and pre-emergent herbicides for weed control only if large numbers of weeds are present (broadleaf) or can be anticipated (crabgrass). If weeds are present in certain areas and spraying must be done, spot-treat the infested areas rather than making a blanket application.
- **Cutting height.** Raise the cutting height as much as functionally possible to reduce mowing frequency on tees, fairways, and roughs.
- **Organic matter management.** If excessive thatch is a problem, then organic matter reduction measures (topdressing, aeration, spiking, slicing, vertical mowing) should be practiced on a regular basis to reduce the excessive accumulation. Wetting agents may help irrigation penetration.

- **Overseeding.** Though overseeding bermudagrass with a cool-season grass provides green color during cooler months, it requires more irrigation than dormant turf. Consider reducing overseeding from wall-to-wall to tees and greens only. Another beneficial practice for overseeding bermudagrass turf is to refrain from overseeding every third or fourth year. In addition to decreasing water use, this practice promotes stronger turf. On turf areas composed primarily of Poa annua, overseeding later in the growing season with a more drought tolerant grass species is often recommended.

Develop a Drought Management Plan

Planning for drought before one occurs will allow you to mitigate the effects of drought stress and reduce turf damage. A written drought management plan ensures that you will be prepared and ready to coordinate conservation measures among staff of various departments of the golf course (grounds, clubhouse, resort amenities, etc.). Having identified a variety of conservation measures in the plan will go a long way toward mitigating the effects of drought. For more information on developing a drought management plan, see the USGA article "Developing a Drought Emergency Plan" for a detailed step-by-step guide to developing your plan.

When drought conditions prevail, monitor your regulatory authority's drought status notifications to ensure compliance with any restrictions. The Global Drought Information System is another resource for large-scale drought information and links to regional drought monitoring systems.

Expand the Use of Drought Tolerant Plants and Mulch in Landscaped Areas

When considering choices for landscape trees, shrubs, and flowers, look for plants that tolerate low moisture conditions. Though annual flowers give a prominent burst of color throughout the growing season, use them sparingly, since they require nearly daily watering. Instead, select native perennials that can thrive with little supplemental irrigation. Native trees and shrubs also will be better adapted to your site, especially in areas with poor soils or drought conditions.

Incorporating mulches into landscape and garden beds will help conserve water and eliminate weeds. Mulches, such as shredded cedar or pine bark, cocoa mulch, crushed stone, and landscape fabric, reduce water demand by lowering surface temperatures, improving water infiltration, and reducing water lost to evaporation.

Self-Assessment Checklist

Judicious water use is key to a comprehensive environmental management program. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

General Knowledge

- Train employees to conserve water and make water conservation a priority in your management approach.
- Identify the water sources used for irrigation and drinking water.
- Know how to operate and manage the irrigation system correctly.

Irrigation Systems

- Irrigation system should be properly designed and correctly installed, and performance should be tested.
- Check irrigation system for proper water distribution in all irrigated areas at least once per year.
- Eliminate all non-target watering (e.g. sidewalks, ponds, habitat areas).
- Check all irrigation equipment regularly and maintain the system on a regular schedule.
- Identify and fix leaks in a timely manner.
- Regularly maintain the pump station so that it is working efficiently.
- Upgrade irrigation system or components of the system (e.g. valves, sprinkler heads, nozzles, computer software) to reduce inefficiency, malfunction, and water use.
- Install part-circle irrigation heads where possible to save water.

Irrigation Practices and Turf Management

- Incorporate evapotranspiration rates or weather data into daily irrigation decisions.
- Avoid running the irrigation system at peak evapotranspiration times.
- Hand water hot spots to target needed areas only, rather than running the entire irrigation system during the peak of the day.
- Work to maintain an effective water cycle to maximize water absorption and reduce runoff and evaporation, including maintaining soil cover, improving soil structure, adding or maintaining natural organic matter in the soil, and improving drainage to minimize runoff and maximize water penetration through soil layers.
- Reduce or eliminate irrigation on all unused or minimally used portions of the property.
- Monitor daily water use, tally monthly usage, and set targets for yearly improvement.
- Select turfgrasses on greens, tees, and fairways that are appropriate for local climate and growing conditions.
- Reduce turf stress in times of drought.

The purpose of a water quality management program is to ensure that course operations are not having a negative impact on surface and ground water on and around the property.

Chapter 6: Water Quality Management

CONTENTS

Overview

Ensuring clean water supplies and protecting the health and integrity of water bodies, such as oceans, rivers, streams, wetlands, lakes, and ponds, is an essential component of showing your commitment to environmental stewardship.

Water quality has long been a critical environmental issue for the golf course industry. Governmental agencies, environmental organizations, and the general public continue to raise concerns about the impacts of golf course chemical use on the water quality of surface water bodies and groundwater.

Research on nutrient fate, chemical leaching and runoff, and the impacts of chemical use on aquatic organisms has played a key role in helping the golf industry to address these concerns. Research results have translated into practical information to help golf courses monitor and minimize their impacts on water quality.

Still, many golf course superintendents find water quality management one of the most challenging aspects of their jobs. Managing water sources for golf, wildlife, aesthetics, irrigation, and overall water quality is not easy. Success depends on having a basic understanding of the factors that influence water quality and incorporating BMPs as part of an environmental management program.

Information in this chapter will help you to meet the following goals:

1. Improve your general knowledge regarding your local watershed and pollution prevention strategies.
2. Employ BMPs near all water bodies to reduce and/or eliminate the potential for chemical runoff, nutrient loading, and drift.
3. Monitor the health of all water bodies to detect possible movement of nutrient and chemical inputs into water sources, correct problems as needed, and consistently make improvements.

General Knowledge

Properly managed water resources provide good quality irrigation water, aesthetically pleasing ponds and streams, appropriate stormwater treatment, and no offsite surface water or groundwater pollution problems. In addition, good water quality provides habitat for a variety of plants and animals that can add beauty and enjoyment to your course. In contrast, poorly managed water sources can cause significant problems. For example, poor quality irrigation water may severely injure turf, while pond algal blooms can cause aesthetic and odor problems. Improper use of chemicals can damage aquatic organisms and degrade water quality.

Understanding your water resources, as well as local and regional influences affecting water quality, is the first step in developing a management plan that is right for your course. The next step is understanding the role of your water conservation and

protection efforts in protecting water resources. The last step is understanding the tiered approach to protecting water quality:

- Prevention. Prevent problems from occurring.
- Control. Have safeguards in place to control any problems.
- Detection. Develop a monitoring program to detect changes in environmental quality.

WATERSHEDS

As discussed in the "Environmental Planning" chapter, your watershed is the entire area of land that drains into a body of water, such as a river, lake, estuary, and eventually the ocean. Water drains from the highest elevations within the watershed to the lowest. Sometimes called a drainage basin, a river's regional watershed includes the many smaller local watersheds of the creeks, feeder streams, lakes, and wetlands that drain into it. Having already identified your watershed in your site assessment and when thinking about managing water quality, try to answer the following questions:

- How does water enter your property: rain, snowmelt, stream, wetland, springs?
- What neighboring upgradient sites drain onto your property?
- What is the quality of the water as it enters your property?
- What is the lowest point or points where water settles?
- Does it pick up any contaminants because of your golf course operations?
- Where does water go when it leaves the property?
- Does water quality improve, decline, or stay the same as it moves off your course?

The answers will help you evaluate your golf course's impact on water quality and to consider your local watershed when planning water quality management strategies.

Make water quality monitoring and protection a maintenance priority. Key maintenance staff – superintendent, assistant superintendent, crew foreman, irrigation technician, chemical spray technician – should be able to identify the local watershed in which the golf course is located and know where wastewater and runoff go after leaving the property. Key maintenance staff also need to be aware of water quality issues and potential impacts from golf operations.

WATER CONSERVATION

Excessive water withdrawals contribute to low water levels in streams, lakes, and ponds, which can decrease the ability of these water sources to provide quality water on a consistent basis. Low water levels, combined with increased temperatures in summer, also may alter habitats for aquatic organisms. Likewise, excessive withdrawals from groundwater contribute to aquifer depletion and poor water quality, such as saline or hard water. In extreme cases, excessive water withdrawals from an aquifer can cause soils to contract and

the land itself to sink. Therefore, the water conservation approaches discussed in the "Water Conservation" chapter should be implemented as part of your water quality management efforts.

TREATMENT TRAIN APPROACH

One way to think about your water quality management program is as a treatment train in which the individual BMPs are linked together as the cars of the train. In most cases, the more cars on the train – the more BMPs incorporated into the system – the better the performance of your treatment train. The first cars might include BMPs to minimize generation of runoff and pollutants and the final car might include filtration through a buffer or retention in a pond. This section outlines a variety of strategies and control measures that you may employ to prevent or address water quality problems.

PREVENTIVE MEASURES

The more you can prevent problems from occurring, the easier, less costly, and more effective your water quality protection program will be. Preventive controls include many of the concepts addressed throughout this guidebook that prevent soil erosion, runoff, and leaching. Preventing these three environmental processes also prevents contaminants from golf course operations – nutrients, pesticides, and other chemicals – from reaching surface water or groundwater. Incorporating IPM methods, managing operations properly, and maintaining healthy and dense turfgrass are the best first lines of defense in protecting water quality.

CONTROL MEASURES

Control measures are BMPs that protect water quality through removal, filtration, detention, or rerouting of potential contaminants before they enter surface water or groundwater. These controls can be structural (such as infiltration basins and secondary containment), vegetative practices (such as vegetated buffers), or constructed wetlands. Many courses use a combination of preventive practices, structural controls and vegetative practices to manage surface water and groundwater effectively.

Structural controls are often the costliest since they involve capital improvements. Two commonly used structural controls are detention basins and infiltration devices. Periodic inspection and maintenance of all structural controls are essential to ensure they function as designed. Detention basins and infiltration devices can achieve 60 to 100 percent removal efficiencies for sediment. Infiltration devices are capable of similar removal efficiencies for sediment but are subject to clogging if sediment inputs are excessive. Wet ponds and extended-detention ponds with shallow marshes have a moderate to high capability for removing both soluble and particulate pollutants via settling and biological uptake. Construction of such structural controls requires on-site consultation. Seek out expert advice to find out more about the appropriateness of such a control for your course. As with all structural controls, they should be inspected and maintained as necessary to continue to function properly.

DETECTION

Detection involves an environmental monitoring program that provides feedback to the superintendent about water quality conditions and movement of materials, such as sediments, nutrients, and other chemicals. Understanding the quality of water entering your property compared with the quality of water leaving the property is a key indicator of the effectiveness of your water quality management program.

Control Erosion

Erosion is the loss of soil due to water, wind, or gravity. Erosion is most commonly found along the banks of water bodies or along steep slopes. A number of problems are associated with erosion:

- Water quality impacts, such as increased sedimentation, nutrient enrichment, and decreased clarity of surface waters.
- Habitat degradation for fish and other aquatic organisms.
- Loss of topsoil.
- Increased potential for slides on steep slopes once erosion has started.

Once erosion starts, the problem tends to escalate. Banks or slopes become even less stable, thus causing more problems. To minimize erosion, control the amount of bare soil on your property wherever and whenever it may occur. For example, during turf establishment following construction or renovation activities, consider using hydro mulching to stabilize soils, in conjunction with erosion and sediment control measures. On steep slopes, sodding is preferred to seeding to avoid erosion. Shorelines are another critical area to maintain vegetative cover. Leave existing shoreline plants or quickly replant areas where vegetation has been disturbed. In already eroded areas, you may need to stabilize the area before you can revegetate it. Fiber logs and stone riprap can be an effective means of quickly stabilizing a shoreline, but stone is far less beneficial to wildlife and provides no supplemental filtering value. A longer-term solution is to recreate a natural stream flow or plan a riparian buffer that will permanently and effectively stabilize the shoreline.

Reduce Chemical Runoff, Leaching, and Drift Potential Near Water Bodies

The ways chemicals are applied can have a significant influence on how they impact water quality. The following practices are especially effective in decreasing the chances of chemicals coming into contact with water bodies:

- **No-Spray Zones.** Designating a zone around water features in which no chemicals are used eliminates runoff and drift from the immediate surrounding area. Ideally, a no-spray zone should be about 25-feet wide, but this width may need to vary depending upon slope, location, and relation to in-play areas. Pulling weeds by hand

has proven to be an effective strategy for many golf courses for minimizing weeds in no-spray zones. Spot treatment may be employed occasionally to control the spread of noxious weeds when applied in accordance with label instructions.

- **Limited-Spray Zones.** Designating an additional 25-foot zone around water features in which limited chemicals are used further reduces the probability of runoff and drift. A limited-spray zone frames the no-spray zone and, combined, provides a 50-foot zone of protection. (Actual width may need to vary depending upon slope, location, and relation to in-play areas.)

- **Spoon Feeding.** Applying small amounts of the turf's nutritional requirements in more frequent applications is an effective strategy for minimizing runoff and ensuring that the fertilizer applied is taken up by the turf.

- **Fertigation.** Applying fertilizers through the irrigation water offers two distinct advantages. First, fertigation tends to be more economical by reducing maintenance costs and reducing the amount of product that is applied. Secondly, fertigation offers better control of when, where, and how fertilizers are applied.

- **Slow-Release Fertilizers.** There are many different types of slow-release fertilizers that can be used in areas prone to leaching.

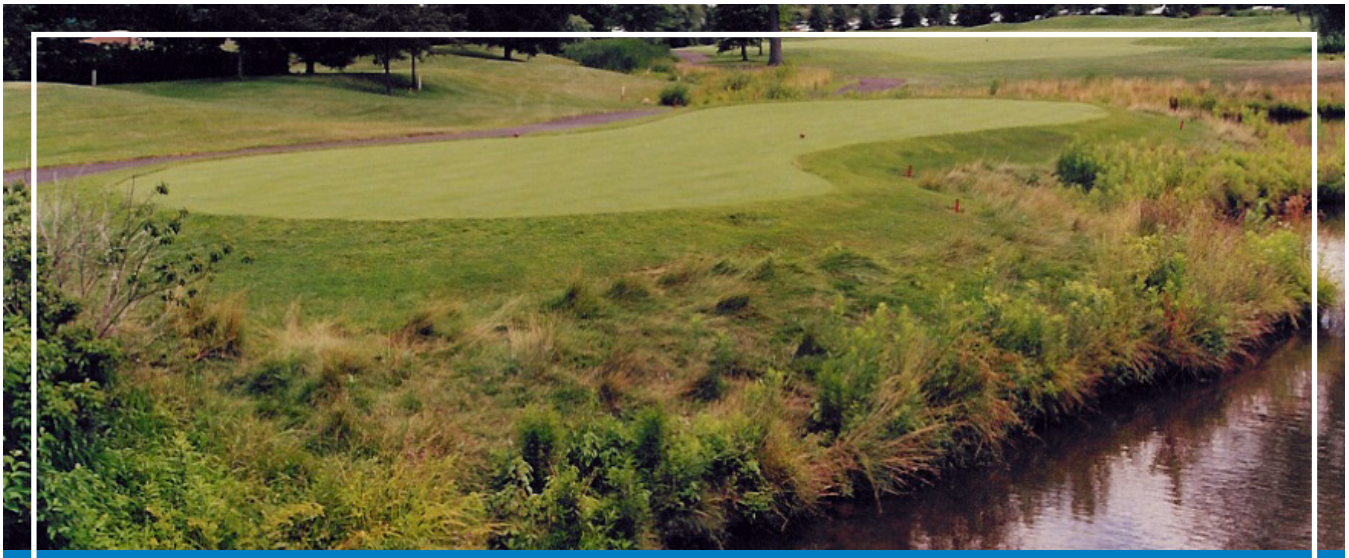
- **Chemical Application.** Always apply chemicals in accordance with the manufacturers' label requirements using equipment specifically designed for this use.

- **Chemical and Petroleum Storage.** Ensure primary and secondary containment is present and that storage facilities are not located in close proximity to water bodies.

Utilize Vegetated Buffers

A vegetated buffer is an area around the edge of a water body specifically designed to protect water quality. A buffer may be made up primarily of turfgrass, or include a combination of grasses, herbaceous (non-woody) plants, and shrubs. Vegetated buffers trap sediments, take up nutrients, reduce erosion, and slow down water as it moves from the land into a water body.

One type of effective vegetated buffer, often referred to as a vegetated filter strip, is turfgrass mown at a height of 3 inches, or as high as possible for the particular turfgrass species. In research trials, such filter strips, maintained at widths between 15 feet and 30 feet, reduced nutrient runoff from adjacent areas by 90 to 99 percent, respectively. Sediment removal rates have been found to be generally greater than 70 percent. In the field, the best height, width, and overall size of a vegetated buffer depends on several factors such as slope, type of vegetation, playability, and distance from intensively managed turf (e.g. greens and fairways). Many golf courses are able to



Vegetated buffers provide and effective way to reduce or eliminate nutrient rich runoff from entering surface water bodies.

maintain a full buffer all the way around a water body. For sites where this is not feasible, partial vegetated buffers can be combined with specialized management zones, utilizing the methods described above to manage the buffer areas.

Create Wetlands

Constructed wetlands are designed specifically for water treatment, efficiently removing pollutants. They feature poorly drained soils and wetland plants. These wetlands can be sited to treat wastewater (e.g. washwater) or stormwater before the water enters streams, natural wetlands, or other surface water and groundwater, as described in the USGA article "Managing Runoff with Constructed Wetlands." Once these areas are constructed, they are considered wetlands and are subject to wetland regulations.

Professional consultants need to be involved in the wetland creation process. Experts can assess the site-specific factors such as site selection, hydrologic analysis, water sources, soil and plant analysis, and permitting requirements that must be evaluated in order to have a successful project.

Reduce Thermal Pollution

When tree cover is removed along stream margins, the increased exposure to the sun causes water temperatures to rise. Cold-water fish, such as trout, and other aquatic organisms are adversely impacted by such changes in water temperature. When modifying or renovating a golf course, avoid clearing wooded streams. Leave large trees and shoreline plants where streams come into play. Vegetated stream banks will not only shade the water but have the added benefit of reducing erosion and filtering runoff.

Existing courses with exposed streams can add shoreline vegetation or take on a long-term riparian buffer project as described in the "Wildlife and Habitat Management" chapter.

Manage Aquatic Environments of Lakes and Ponds

A combination of sunlight, warm temperatures, and nutrients (typically nitrogen and phosphorus) promote plant growth (algae and larger aquatic plants called macrophytes) in ponds in a process called eutrophication. Many golf courses have problems when surface water drains directly into water bodies, adding increased levels of nutrients and stimulating excessive plant growth. Not only is the resulting murky-green water unattractive, but too much algae depletes the dissolved oxygen levels in the water, which adversely affects fish and other aquatic organisms.

To create a balanced pond ecology, it is essential to eliminate nutrient loading to golf course ponds. A careful review of maintenance practices is a good place to start. A common culprit of water quality problems is spring fertilization programs, since these nutrient applications coincide with warmer temperatures and increasing sunlight. A combination of the measures described in this chapter, such as vegetated buffers and no-spray zones, produces the best results for managing healthy ponds.

Additional ways to reduce the potential for eutrophication include the following:

- **Emergent and Floating Plants.** Emergent and floating plants, such as water lilies, can be installed to shade the water surface, thus reducing sunlight and water temperature. A single mature water lily can cover an area of 8 square feet or more, and small-leaved species can be used in small pools. Planting overhanging vegetation along pond margins can have the same effect. (Refer to the Appendix for aquatic plant lists.)

- **Aerators.** The amount of oxygen in the water can be increased by using oxygenating plants or by installing fountains, waterfalls, or cascades to aerate the water. This promotes healthy fish populations, which will feed on algae and insect larvae and help control mosquitoes.

- **Filters.** Pond filters rid the water of algae and debris, thus promoting a cleaner pond environment.

AQUATIC PLANT MANAGEMENT

Aquatic plants, including both algae and vascular plants, are part of aquatic ecosystems. They provide a number of ecological benefits, such as providing habitat for aquatic organisms, oxygenation, and shoreline stabilization. Littoral zones, the near-shore area where sunlight penetrates all the way to the sediment and allows aquatic plants to grow, provide valuable habitat for aquatic species, including insects, snails, and amphibians, which utilize this area for food and shelter, and for foraging by wading birds and fish. Some birds may also use the emergent vegetation for nesting. For more

information on the benefits of maintaining a healthy littoral zone, see the USGA article "Littorally Speaking."

Though aquatic plants can provide biologically rich habitat, shallow water bodies and nutrient-enriched water bodies can often promote excessive aquatic plant growth. Aquatic invasive species, such as Eurasian water milfoil, can be particularly troublesome. Some of these common aquatic species requiring management are described in the USGA article "Common and Troublesome Weeds of Golf Course Ponds." Managing aquatic plant populations should follow the same IPM principles laid out in the "Chemical Use Reduction" chapter. A number of management options should be considered before resorting to chemical control to deal with excessive aquatic plant growth, including:

- **Prevention.** These methods can focus on eliminating nutrient loading, avoiding the introduction of invasive species, and installing aerators to increase water movement and dissolved oxygen levels.
- **Cultural practices.** Cultural practices can use different means to alter the growth of aquatic plants, such as benthic barriers to prevent vascular plant growth, drawdown to dry out weeds or subject them to freezing temperatures, or dredging to remove existing rooted plants and nutrient-rich sediments.
- **Mechanical removal.** These methods remove plants either by hand-harvesting aquatic vegetation or using specialized mechanical equipment.
- **Storage of chemicals and fertilizers.** Ensure that any spill in a storage areas is contained and does not enter water bodies.

Although grass carp are a biological control sometimes used for aquatic plants, the introduction of this exotic species is not recommended, as it can become invasive and is not permitted in many areas.

Chemical control methods manage the problem but will not address the conditions that caused the excessive weed growth in the first place. If required, chemical control methods should be evaluated using the same criteria as with any other pesticide. You must follow the same regulatory requirements as those for pesticides used on turf. Chemicals should only be applied in accordance with label instructions.

More information on aquatic plant management can be found in the USGA article "Golf Course Water Features Need Management."

CONTROL NUISANCE WATERFOWL POPULATIONS

The deposits of fecal matter by resident and migrating waterfowl such as Canada geese can substantially impact water quality through nutrient enrichment and bacterial contamination. In addition, large populations of resident waterfowl can erode shorelines and thin the turf in surrounding areas, further increasing erosion potential. Like any other nuisance species, the first step in controlling waterfowl on the golf course is to examine the conditions that make the

course attractive to them. For example, short grass around the shoreline is attractive to geese, therefore instituting a no-mow buffer around water bodies (a recommended best practice for protecting water quality) acts as a barrier by impeding the ability of geese to detect predators. Additional methods for controlling nuisance waterfowl populations can be found in the article "The Canada goose: A wildlife success story?"

Monitor Water Quality

A water quality monitoring program is a valuable tool to assess the effectiveness of your BMPs. Based on sound, scientific principles, the results can help you to confirm and communicate that you are employing the correct management strategies. There are two primary monitoring approaches: visual (and olfactory) inspection and water quality sampling. Employing both will help you gather the information you need to adjust your management efforts if necessary.

VISUAL INSPECTION

Periodic visual (and olfactory) surveys of water quality require little or no equipment and take a minimal amount of time. They simply involve surveying the golf course water feature, looking at the water and surrounding land, and noting what you see, including the presence of invasive aquatic species. Despite its simplicity, it is an important aspect of environmental monitoring. By collecting information on a regular basis, you can develop a baseline of normal conditions and record changes over time.

When you visually monitor your water bodies, you should make sure to write down any abnormalities, as well as the date, time of day, previous and current weather conditions, previous chemical applications in the area, and any other changes that could be a possible cause of the abnormality. This simple chart can be carried with you in the field or posted in a central location to provide essential information about water quality conditions that you see.

WATER QUALITY SAMPLING PROGRAMS

Water quality sampling programs involve more effort than visual inspections and provide a wealth of information that can help you to assess the physical, chemical, and biological characteristics of water on your property and how well those properties support the health of aquatic environments. In addition, the results of your analyses will reflect upon the sustainability of your turf management activities and the success of your conservation efforts. Many guides to citizen science water monitoring are available online to provide guidance as you build your program. The following EPA publications are representative examples of detailed publications that can assist you in your efforts:

- *Volunteer Stream Monitoring: A Methods Manual*
- *Volunteer Estuary Monitoring: A Methods Manual*
- *Volunteer Lake Monitoring: A Methods Manual*

Visual (and Olfactory) Inspection

If the water is...	It could be...	You should...
Green or blue-green	Nutrients released into the water causing an algae bloom.	Check for possible fertilizer or manure run-off, sewage discharge or septic failure.
Orange-red	Acid drainage or the presence of synthetic dyes.	Check for industrial/chemical waste or for landfill seepage draining into the water.
Grey/Black	Sewage or livestock waste.	Check for sewage discharge or animal populations.
Light brown (muddy or cloudy)	Sediment deposition caused by erosion.	Look for disturbed ground left open to rainfall (e.g. construction).
Yellow-brown to dark brown	Acids released from decaying plants. Also common in streams draining from a marsh or swamp.	If not attributable to decaying leaves, search upstream for some foreign item in the water.
If you can smell...	**It could be...**	**You should...**
Rotten egg odor	A natural occurrence in swampy or marshy land or sewage pollution.	Look for sewage or septic inputs.
Musky odor	Untreated sewage, livestock waste, algae, or other conditions.	Check your watershed for sewage/septic input and animal populations.
Chlorine	Over-chlorination of sewage input water or swimming pool discharge.	Look for sewage input or a recently drained swimming pool.
Fishy odor	Excess algal growth or presence of dead fish.	Search for dead fish or look for cause of excess algae.

Visual (and Olfactory) Inspection (cont.)

If you notice...	It could be...	You should...
Fish kill	Naturally occurring, (accompanies annual spawning) or toxic dumping/ nutrient overloading.	Check upstream for discharges or seepage and dissolved oxygen levels. Depressed oxygen levels are the primary cause of fish kills.
Increase or decrease in wildlife sightings	Many reasons: habitat changes, water quality changes, natural population increases during breeding season, or decreases after migration.	Have any changes, such as construction or development, occurred since you last monitored? Note the time of year. Can this be correlated with breeding or migration?
Increase or decrease in water flow	Weather-related or possible obstruction or discharge into stream.	Note weather conditions such as temperature and recent rainfall. Check upstream for blockage and/or discharge source.
If surface or bottom has...	**It could be...**	**You should...**
Yellow coating (bottom)	Sulfur or natural color.	Check for industrial waste.
Multi-color sheen or reflection (surface)	Oil or a natural alga.	Check for petroleum smell. If present, look for road runoff or canisters of oil.
White cottony masses	"Sewage fungus."	Check for sewage or septic inputs.
White or cream-colored foam	A natural occurrence (cream-colored) or detergent or industrial waste.	If higher than 3 inches and white, check for industrial or residential discharge.

The extent of your monitoring program can vary from simple (limited number of sampling locations, limited number of parameters) to more complex (extensive sampling of different kinds of water features, greater number of parameters, inclusion of stream biodiversity surveys). Your monitoring efforts may expand over time and can include partners that provide time and expertise to your efforts.

Water Monitoring Plan

A water quality monitoring plan establishes the basics for your efforts, such as your monitoring objectives; where you plan to collect water samples; how often you plan to sample; how you plan to analyze the samples and what parameters you will assess; and how the information will be managed, analyzed, and used. *The Guide to Writing a Water Quality Monitoring Plan* provides not only guidance for creating your plan, but also a water quality plan template.

Monitoring Objectives

Identifying your monitoring objectives helps sets the stage for all of your efforts. Examples of objectives could include:

- Evaluate the impact of maintenance facility operations by sampling a nearby well to determine if contaminants are leaching into groundwater.
- Sample selected ponds on the course to assess aquatic habitat quality.
- Determine the impact of management activities by sampling water upstream and compare to downstream water quality.
- Identify trends in water quality data over time as BMPs are implemented on the course as a measure of increased sustainability.

Sampling Locations

Selecting appropriate sampling locations depends upon your monitoring objectives. For example, if you are assessing the impact of your management activities on the golf course, you will need to collect upstream water samples where water enters your course and downstream water samples where the water exits the course. Reviewing topographical maps of your course will help identify these locations. Once identified by GPS coordinates, the same locations should be sampled during each sampling event. Data from the same location provides a baseline for identifying any changes or trends in water quality over time.

Potential Water Quality Monitoring Partners

- Local or regional watershed or other water resources focus groups
- Non-profit environmental groups
- High school or university biology/ ecology professors
- Extension personnel
- Regulatory agency representatives (local to federal)
- Environmental consultants
- Other golf courses in your watershed

Sampling Frequency

When starting a water quality monitoring program, sampling should be conducted at least four times per year during the first year or two, once during each season. After establishing baseline data, sampling twice a year is typically sufficient, unless problems arise, such as an unintended chemical release or an acute environmental issue (e.g. algal bloom or fish kill).

Collecting Water Samples

To collect samples, you will need clean plastic containers that hold at least 100 ml. The containers and their lids should be rinsed several times with the water to be tested before proceeding. Samples should not be collected directly from the side of the water body to avoid sediment contamination; use a dipper or other type of extension to take the sample away from the shore if necessary. Collecting the water just below the surface (about 1 foot) is typically sufficient for most parameters. The U.S. Geological Survey publication National Field Manual for the Collection of Water-Quality Data provides information on proper sampling protocols.

Ensuring water quality samples are collected correctly will prevent contamination from other sources.

Water Quality Analysis

A number of methods can be used to analyze water, such as test kits, meters, commercial laboratories, and university laboratories. Each method has pros and cons that should be evaluated as part of your water monitoring plan development. For example, meters may be used in the field to measure water quality parameters such as temperature, dissolved oxygen (DO), pH, and conductivity/salinity. Although meters are easy to use, they are more expensive than test kits and require calibration and maintenance to ensure accuracy. Field test kits for the same parameters may be less expensive, but the results may be unacceptable to some data users, including regulatory agencies.

Your monitoring plan should also identify the sampling parameters – physical, chemical, and biological measurements – needed to meet your monitoring objectives. The following table identifies common parameters that can be evaluated and included in your monitoring program.

MACROINVERTEBRATE SURVEYS

Macroinvertebrates (bottom-dwelling aquatic invertebrates larger than 0.25 mm, such as insects, worms, and larvae) can also be a component of a water quality monitoring

Common Sampling Parameters for Water Quality Management

Parameter	Importance	Acceptable Range	Possible Effects When Outside the Acceptable Range
Physical Measurements			
Temperature	• Determines the suitability of a water body to support aquatic life. Some fish species and other aquatic life require specific temperatures (e.g. trout streams). • Affects the amount of DO.	Varies from region to region	• Because of the relationship of DO to water temperature, higher temperatures may indicate lower DO levels. • Affects chemical and biological processes.
Salinity	• Measures of the amount of dissolved salts in the water. • Related to conductivity.	Varies	• As salinity increases, it may become toxic to freshwater organisms.
Turbidity and Total Solids	• Turbidity is a measure of water clarity and an indirect indicator of sedimentation and nutrient enrichment.	Should not exceed background	• Excessive turbidity impacts aquatic habitats and can impair photosynthesis.
Chemical Measurements			
Dissolved Oxygen (DO)	• Essential for aquatic life. • Influenced by temperature, time of day, and the amount of organic matter in the water.	6.0 – 13.0 mg/L	• Below 4.0 mg/L can cause a fish kill. • Extremely low levels (~below 2 mg/L) can result in anaerobic decomposition and release noxious gases.
pH	• Measurement of how acidic or basic (alkaline) the water is. • Affects chemical and biological processes.	6.5 – 8.5	• pH values outside of acceptable range can affect metabolism in aquatic organisms. • Extreme pH values can damage gills, fins, etc. of fish and other aquatic organisms.
Alkalinity	• Measurement of the water's capacity to resist pH changes that would make the water more acidic; also known as buffering capacity.	Varies	• Alkalinity is important for fish and aquatic life because it protects or buffers against rapid pH changes.

Common Sampling Parameters for Water Quality Management (cont.)

Parameter	Importance	Acceptable Range	Possible Effects When Outside the Acceptable Range
Chemical Measurements (cont.)			
Conductivity	• Related to alkalinity. • Describes the ability of water to conduct an electrical current with the dissolved ions of mineral salts (e.g. calcium chloride, potassium chloride, sodium hydroxide) acting as the conductors. • Useful measure of general water quality.	Varies	• Significant changes may indicate a discharge or other source of pollution. • Outside the acceptable range can disrupt the natural physiology of aquatic life. • In irrigation ponds, increased levels can cause excess corrosion of equipment.
Nitrogen	• Nitrogen exists in a number of forms, including ammonium, nitrite, and nitrate. • Nitrification describes the process whereby ammonium (NH_4+) is oxidized by bacteria into nitrite (NO_2-) and eventually nitrate (NO_3-). Nitrate is the form found in freshwater aquatic ecosystems. • Essential for plant growth; necessary for metabolism and growth of aquatic organisms. • Nitrogen may be reported as total nitrogen (TN) or nitrate on water quality reports.	As a total nitrogen value, 0.3 to 2 mg/L. Natural levels of nitrate are usually less than 1 mg/L. Some species are sensitive to nitrate and have lower recommended concentrations (e.g. recommended level for salmon is 0.06 mg/L).	• Excessive amounts of nitrogen contribute to eutrophication, especially in coastal waters. • Too much nitrate can impair aquatic organisms. • For drinking water, greater than 10 mg/L nitrate is a public health hazard. • Water with low DO may slow the nitrification process. Nitrogen in the form of either nitrite and ammonium is far more toxic than nitrate to aquatic life.

Common Sampling Parameters for Water Quality Management (cont.)

Parameter	Importance	Acceptable Range	Possible Effects When Outside the Acceptable Range
Chemical Measurements (cont.)			
Phosphorus	• May be reported as total phosphorus or elemental phosphorus. • Essential for plant growth; necessary for metabolism and growth of aquatic organisms.	Goal is <0.02 mg/L. Most freshwater is between 0.01 and 0.05 mg/L.	• Excessive amounts of phosphorus contribute to eutrophication, especially in fresh waters.
Pesticides (and Insecticides)	• The active ingredient in a pesticide is the toxic component of pesticide formulations. • Consider testing for pesticides that are both mobile and toxic; pick three and test for these to serve as an indicator of the probability of movement for other pesticides as well. • Select an appropriate type of analysis (i.e. test kit, immunoassay, quantitative analysis) to meet data needs.	Should be below pesticide-specific toxicological screening levels.	• Pesticides can pose both acute and chronic toxicity dangers to aquatic organisms. • In drinking water, pesticide values should be below established standards.
Volatile Organic Compounds (VOCs)	• Presence may indicate a leak or spill from petroleum and/or chemical storage areas.	Varies	• VOCs can pose both acute and chronic dangers to aquatic organisms. • In drinking water, VOCs should be below established regulatory standards.

Common Sampling Parameters for Water Quality Management (cont.)

Parameter	Importance	Acceptable Range	Possible Effects When Outside the Acceptable Range
Biological Indicators			
Bacteria	• E. coli bacteria indicate fecal contamination from animal waste (e.g. geese) or humans (e.g. leaking septic systems).	<1 coliform/ 100ml	• Can cause illness in aquatic organisms and humans.
Chlorophyll A	• Main photosynthetic pigment in green algae. • Used to estimate the abundance of algae.	Varies	• Excessive values indicate eutrophication
Submerged Aquatic Vegetation (SAV)	• SAV are grasses that grow to the surface of – but do not emerge from – shallow coastal waters. • SAV is one of the best barometers of the water quality. • Monitoring can confirm the presence of SAV, identify the species (if possible), and locate beds too small to be seen from the air by the remote sensing methods typically used by environmental agencies.	Dense beds of SAV	• SAV beds filter polluted runoff and provide food and habitat for waterfowl and habitat for aquatic species. • Healthy, dense SAV beds are associated with clear water, and their presence helps improve water quality.
Macro-invertebrates	• Can serve as water quality indicators.	Can determine index values based on species composition and diversity analysis.	• Presence of species sensitive to water quality indicates healthy aquatic habitat; abundance of tolerant species and absence of sensitive species indicates degraded aquatic habitat.

program. Because they are affected by the physical, chemical, and biological conditions of streams, macroinvertebrates serve as good indicators of water quality. They can be found in various types of aquatic environments, from fast-flowing to very slow-moving streams. Most live part or most of their life cycle attached to submerged rocks, logs, and vegetation.

More information on sampling programs is available, such as New Mexico State University's *Stream Biomonitoring Using Benthic Macroinvertebrates*. Trained biologists are especially helpful for this monitoring activity. Consider partnering with universities or watershed association volunteer groups with experience in these kinds of surveys to gain the expertise needed to collect and analyze data.

DATA ANALYSIS AND MANAGEMENT

The parameters of how the data you collect will be stored, managed, and analyzed should be identified in the water quality monitoring plan. Water quality monitoring data must be carefully analyzed to reach proper conclusions and before taking appropriate action if warranted. Interpretation and use of the data depend to a large extent on the identified monitoring objectives, such as trends analyses and comparison to regulatory standards.

CORRECTIVE ACTION

It is vital to set up a management response if the water quality analyses indicate a problem. Outline specific, step-by-step actions, such as:

1. **Establish the cause of the problem.** For example, if a sample indicates high phosphorus levels, it may indicate erosion, low DO levels, or nutrient loading. High nitrogen levels may indicate nutrient loading. Was fertilizer inadvertently broadcast directly into a water feature? Was fertilizer applied before a rain storm?

2. **Take preventive actions.** Steps must be taken to reduce contaminant inputs. Examples of actions for nutrient loading issues include

    - Ensuring all staff know and adhere to no-spray zones near water bodies.
    - Establish or extend no-spray zones around the buffer areas in swales or around drainage that enters water features.
    - Use of fairway drain covers during chemical applications and initial irrigation or storms following the application to prevent "first flush" contamination.
    - Review your maintenance practices (e.g. timing of applications, wash pad design or maintenance, etc.) and identify opportunities to implement BMPs.

3. **Take curative actions.** If possible, reduce the current level of the contaminant. For example, if too much phosphorus is present, planting aquatic vegetation may help increase nutrient uptake and increase DO.

Self-Assessment Checklist

Your efforts to ensure good water quality will keep water supplies clean and protect the health and integrity of surface water and groundwater. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

General Knowledge

- Protecting water quality and conserving water is a management priority. All key maintenance staff should be trained regarding water quality and quantity concerns.
- All key maintenance staff (e.g. superintendent, assistant superintendent, crew foreman, irrigation technician, chemical spray technician) should be able to identify the specific watershed in which the property is located.
- All key maintenance staff should be able to identify where wastewater and runoff go after leaving the property.
- Incorporate a treatment train approach to managing stormwater and washwater.

Best Management Practices

- Eliminate/mitigate erosion to water bodies such as streams, lakes, and ponds.
- Employ more environmentally sensitive plant management techniques within 25 feet of all water bodies to minimize nutrient and chemical inputs.
- Eliminate potential chemical runoff and drift near all water bodies by designating no-spray zones, using spot treatments, or increasing thresholds for pest problems.
- Reduce the potential for nutrient loading to water bodies, such as streams, lakes, and ponds, by employing BMPs such as using slow-release fertilizers, spoon-feeding, and filtering drainage through vegetated or mechanical filters prior to entering water bodies.
- Utilize vegetated buffers around water bodies.
- Where shorelines are in play, raise the mowing height along the water's edge to slow and filter runoff.
- Reduce/eliminate the need for chemical algae control in ponds through proper aeration, nutrient reduction, bio-filters, vegetation management, or bio-controls.
- When aquatic weed management is required, first seek a physical solution (e.g. hand removal of plants) and then seek the least toxic method of chemical weed control. Address any underlying causes of the problem.

Water Quality Management: Monitoring

- Develop a water monitoring plan and establish your monitoring objectives, sampling locations, parameters to monitor, and monitoring frequency.

- Visually monitor water bodies for water quality problems, such as erosion, algae, aquatic weed growth, sheens, fish kills, and sediment buildup, as part of regular IPM scouting activities.
- Report water quality problems immediately to supervisors and, if required, to regulatory agencies for appropriate action.
- Keep records of monitoring activities, results, and control measures taken if needed.

Member and public awareness, education, and involvement build a broad base of support for environmental stewardship and sustainability on the golf course.

Chapter 7: Outreach and Education

CONTENTS

Overview

The purpose of Outreach and Education is to ensure ongoing support for stewardship initiatives, to strengthen local community connections, and to extend participation in environmental conservation activities.

When you invest in environmental improvement projects at your golf course, it's wise to also invest in outreach and education activities to help build support and ensure the long-term success of your efforts. Outreach and education efforts help you accomplish three primary goals:

1. Communicate your commitment to environmental stewardship and conservation.
2. Educate club members, staff, decision makers, and community members about your efforts and successes in improving environmental quality and sustainability.
3. Provide opportunities for people to be involved in environmental projects on the golf course.

This section provides information to help you focus your efforts, increase participation, build support, and generate positive publicity for your environmental stewardship efforts.

General Knowledge

Golf course managers across the globe have long expressed a desire for the general public, as well as their members, to understand what it really takes to manage a golf course. Faced with negative stereotypes about golf courses as polluters of the environment, superintendents also need to find ways to communicate their commitment to good stewardship and the positive impact golf courses can have on natural resource conservation. Implementing outreach and education projects can help you achieve these important goals.

STRATEGIC COMMUNICATION PRINCIPLES

Your outreach and education efforts should be based on basic strategic communication principles. By communicating strategically, you can share your successes with and educate club owners, staff, club members, and the general public effectively using messages that are credible, clear, concise, connect with people, and communicate value. By taking time to consider your goals, stakeholders, and different communication methods, you can build consistency in your communications that can be used in a variety of outreach and education scenarios.

While ideally you will have the time to craft a written communication plan for your outreach and education efforts, even an informal consideration of the main steps in developing a communication strategy will help direct your efforts. The following are the general steps in creating an effective communication strategy:

- Define goals and objectives.
- Determine the target audience(s).

- Develop key messages for each audience.
- Create a schedule and budget.
- Measure results.

The goals and objectives of your communication efforts can be varied. For example, your goals in communicating with club owners may include garnering financial support for your efforts, while your goals in communicating with the general public may include educating them on the environmental benefits of a sustainable managed golf course.

Identifying the goals and objectives for your communication with each target audience will help to develop key messages for each audience. Messages are specific, clear, persuasive, and reflect audience values; reinforce club mission and values; and include specific calls to action to encourage activation. Messages should be consistent in the frequency of their delivery and branding, and attractive and accessible in varied formats for maximum exposure. A schedule and budget can be based on existing avenues for communication (website, emails, newsletters, etc.) and any additional needs, based on the available budget. Last, consider how best to measure the results of your efforts so that you can evaluate the effectiveness of your efforts.

A Resource Advisory Group is a good first step in creating a successful communication strategy comprised of a variety of outreach and education efforts. Resource Advisory Groups, as discussed in the "Environmental Planning" chapter, can be made up of fellow employees, golfers, and even people outside the golf course who can provide technical expertise. The primary role of resource people is to aid the superintendent in communicating a commitment to environmental stewardship and implementing conservation activities.

Facing Concerns

Reaching out to public golfers, members, guests, and the local community is not always easy. Superintendents from private clubs are often concerned about keeping a low profile, while public course managers often feel their golfers are too transient to

The Benefits of Reaching Out

Communicating with your target audiences (club owners, club members, the public, etc.) about your environmental efforts can help you:

- Gain recognition and support for your management efforts.
- Increase golfer understanding of wildlife and environmental quality on the golf course.
- Let the public know that environmentally managed golf courses can be valuable community resources, whether or not the public ever steps on the course.

care about what's happening beyond the greens. Both may be reluctant to invite more oversight or input from golfers or the public. Most of all, taking that first step – picking up the phone and reaching out – is often the hardest obstacle to overcome.

All of these concerns have been successfully dealt with by golf course managers. Outreach and education can take many forms, and you can choose projects that are best suited to your course. By taking one step at a time, you can build support and effectively communicate your environmental management strategies.

Working Proactively with Neighbors

Working with neighboring homeowners may be essential to the success of your stewardship efforts, particularly if your course is part of a residential development. Many courses report that homeowners sometimes tamper with sensitive habitats, cut back natural buffers between their homes and the golf course to improve the view, or add trees or shrubs that are inconsistent with the ecological region of the property. Other courses struggle with homeowner complaints when a course attempts to naturalize areas that border homes.

Seven Steps to Minimize Homeowner Impacts on Natural Areas in a Planned Unit Development

1. Appoint a project management team or Design Review Committee made up of a planning or development engineer, landscape coordinator, community manager, golf course manager, design review manager, or other qualified personnel.
2. Mail a formal policy letter outlining the guidelines for habitat maintenance or removal to residents and property managers. Ask several managers to sign the policy letter. Re-mail the letter each year.
3. Establish an approved vendor list for landscape maintenance.
4. Develop a recommended landscape plant list for trees, shrubs, and perennial flowers that are native to your site. Distribute the list to homeowners.
5. Promote a unified effort by informing all staff of your habitat maintenance policy.
6. Encourage residents to call for an appointment and make a drawing of their plan for habitat maintenance or removal before the committee meets with them.
7. Use the club or community newsletter to communicate the policy to residents.

To address concerns effectively or avoid problems from the outset, it is critical to inform neighbors of landscape changes that may affect them and develop strategies for dealing with problems. By working together in a positive way, property managers and community association members or neighboring homeowners can find common goals and work to achieve them. Flexibility on both sides is often key.

If a homeowner association exists, introduce yourself and communicate your commitment to environmental stewardship. Let people know about management practices that protect water quality, minimize chemical use, and provide wildlife habitat. Make yourself available as a community resource.

Several golf courses have had success in appointing a Design Review Committee to assist homeowners with planning appropriate backyard landscape changes. Such a committee can set policy regarding the removal of any golf course buffer or sensitive habitat that would have an adverse impact on the environment or wildlife. This committee may also discuss homeowner issues and review proposed projects.

Golf courses bordered by property owners who have not formed an association may find it wise to communicate with individual landowners directly. This is especially important if changes in golf course maintenance will alter views or manicured aesthetics. A straightforward letter sent before naturalizing along property boundaries will be far more effective than a letter sent after homeowner complaints arrive.

Identifying Support

The first logical step is to designate at least one staff person or Resource Advisory Group member to take primary responsibility for communicating your environmental goals, objectives, and projects to club members, staff, decision makers, and community members. This person may be the superintendent, manager, pro, or someone in a respected position who can comfortably communicate with a variety of people.

Start by contacting golfers at your course. Inform them of your involvement in conservation projects and invite their participation. A newsletter article or announcement on the bulletin board requesting help from individuals to assist with projects, such as wildlife surveys, nest box construction, or monitoring, may result in more positive responses than you may think.

Prepare a list of organizations, agencies, and people from the community who might be interested in helping with conservation projects on the course. This list could include a local schoolteacher, scout leader, or garden or bird club member. For larger projects, consider college interns, local natural resource agency personnel, Cooperative Extension agents, or members of your town conservation committee or other local board. Some people may be interested in helping with specific projects, while others may be willing to get involved in all aspects of project implementation and communication.

Remember, achieving public input doesn't mean you have to have an open house for your community or base decisions on what your neighbors want. Think of "the public" as members of the local community who can help you with publicity, habitat enhancement, water monitoring, native plant selection, or other environmental projects.

Increasingly, social media and news media can strengthen connections with stakeholders and help to disseminate messages that resonate with your stakeholders.

Education

There are many ways to let people know about your commitment to conservation. Education and outreach projects can inform people about your efforts or teach people how they can support environmental practices. Try one or more of these ideas. All have been successfully implemented on a number of golf courses.

CREATE A DISPLAY

Creating a display in your clubhouse can help to educate members about wildlife species, natural areas, water conservation, and IPM. The purpose of a display is to promote the positive efforts you have undertaken to maintain a high degree of environmental quality at your course. The following information will help you set up in your clubhouse or pro-shop an attractive display that draws people's interest and encourages their support.

Step 1: Choose the best style and format for your clubhouse or pro-shop.

Before deciding what you want to include in your display, determine how information would be best presented. The display could be formal or informal; you may want to design it in such a way that you can periodically change information or simply create a permanent display. Determine what style and format will best suit your needs.

Step 2: Determine how you want to present information.

There are many ways to present information about your environmental efforts. The display could be instructional, interactive, or simply a collection of artwork or photographs of the wildlife and natural features on your course. An instructional display might describe the Audubon Cooperative Sanctuary Program, explain the needs of wildlife, or tell how the golf course is maintained. For a more interactive presentation, invite participation in creating a wildlife inventory or present questions to test golfers' knowledge about the natural history of the course.

Step 3: Present information to encourage interest.

While there are many things you might want your display to say, remember that a picture speaks a thousand words. Choose a combination of pictures and text for the best results.

We suspect that there are people at your course who would enjoy volunteering their time or expertise to help you create a display. Someone with knowledge of birds

or wildlife may be interested in writing wildlife descriptions. Other members may be talented artists. Let people know of your plans and invite the help, talent, and suggestions of interested members.

Display Features

The following features could be incorporated into your display to create interest and inform people about your golf course sanctuary:

- Audubon Cooperative Sanctuary Program information and certificates.
- Photographs or artwork.
- Information about wildlife and habitats on the course.
- Information about conservation projects.
- Wildlife inventory.
- List of Resource Advisory Group members.

Displays boards in the Clubhouse are a great way to provide members with information about your participation in the ACSP.

- Upcoming events and activities.
- List of what golfers can do to support environmental stewardship on the course.
- Map.

WRITE NEWSLETTER ARTICLES

Newsletter articles at your golf course are a natural. Start by letting people know that you have joined the ACSP and provide background information about the program drawn from our brochures, informational literature, or website. Promoting your stewardship efforts doesn't only include writing about wildlife or habitat management. Think about the various aspects of the ACSP and choose from this variety of topics for articles. Best Management Practices, water quality testing, dealing with problem wildlife, and water conservation measures are just a few topics to address. Feel free to use information from ACSP fact sheets or newsletters for your own newsletter.

MOUNT SIGNS

Posting signs is a simple way to educate the public about different projects you are doing. They also can be used to protect areas of special concern or to create a display garden. The primary objective of any sign is to communicate your message concisely to all who will see it.

DEVELOP AN EDUCATIONAL BROCHURE

An educational brochure is an excellent way to inform people who use your site about your general environmental efforts or specific

Sample Statements for Educational Signs

- Natural Area.
- This area is being (has been) naturalized to improve wildlife habitat and environmental quality.
- Environmentally Sensitive Area. Please keep out.
- Shoreline Naturalization.
- Vegetative "buffers" provide important sources of food and cover for wildlife and improve the environmental quality of ponds.
- (Course Name) is a proud member of the Audubon Cooperative Sanctuary Program.
- Critical Nesting Habitat. Please keep out.
- (Course Name) is committed to environmental quality.
- Wildflower Meadow: Once meadow flowers are established, we hope you'll enjoy the beauty and variety of native flowers and grasses in this area.

conservation projects. A brochure doesn't have to be elaborate, with fancy text, color, or graphics. If you have the budget, though, you can certainly choose to go that route. A simple layout that is easy to read can be just as effective. It can even be produced on a home or office computer with little expense.

Step 1: Determine whom the brochure is geared for.

Before producing a brochure, determine the kinds of people who are likely to read it. If they have specific needs or concerns, you can address them right in the brochure.

Step 2: Figure out how the brochure will be distributed.

You also need to decide how to distribute the brochure. Is there a central location where it can be displayed? Do you want to mail the brochure to everyone who regularly uses your course? Keep in mind that without a good method for distribution, your brochure will have few readers. In addition, consider how many copies you are likely to use. If you are having the brochure professionally printed, the price per copy generally decreases as the number of copies increases.

Step 3: Include basic information.

The brochure layout can follow a fairly standard format. Usually a three-fold brochure will be large enough to communicate your message. Your brochure should include the following components:

- **What.** Write a paragraph that describes your commitment to stewardship and your involvement in the ACSP. List the environmental aspects of the program that you will focus on. Use larger headlines to communicate key words or phrases, such as "Committed to Stewardship," "Environmental Projects," or "What golfers can do."
- **Why.** Clearly and concisely state the benefits of good stewardship for golfers and your course. You may want to bullet this information to make each benefit stand out.
- **How.** You may want to include a section about how you will implement the ACSP or particular projects. Tell how golfers can help.
- **Who.** Describe who is involved. If you have formed a Resource Advisory Group, list each member's name.
- **For More Information.** Tell people whom they should contact for questions or to get involved. Make sure your contact information and phone number are included. The best rule to follow in creating any educational brochure is to keep it simple. This allows the reader to understand the message. Another helpful hint is to gather other educational brochures you've received and look at them carefully. Ask yourself these questions: "Why am I attracted to this brochure?" or "Why is this brochure hard to read and confusing?" Learning from others' successes and mistakes will help you design a great educational piece.

WRITE A PRESS RELEASE

A press release is a useful vehicle for announcing your environmental plans or projects. Because it is designed to attract media and public attention, it must spark interest and conform to the style of layout and writing used by the media.

Though some news sources may publish your press release exactly as you wrote it, most will rewrite the information to fit the style of their publications. They'll use the basic information you've provided, including quotes, but build a story around it. Therefore, one of your primary goals is to spark interest in your subject. Secondly, you must be concise, while giving enough detail to explain your project.

Your press release must include the following information:

- Use letterhead stationery or type your organization's name and address at the top of the page.
- Include a contact name and telephone number and email address.
- Type the words "PRESS RELEASE" and indicate when the information can be released, i.e. "FOR IMMEDIATE RELEASE" or "March 5, 2019."
- Include a short title to introduce the subject of the release.
- Begin your first paragraph with the city and state.

- Explain who, what, why, when, and where in the first paragraph. If the newspaper were to print only this paragraph, it should say enough to tell the basic details of your story.
- Use quotes in the second and third paragraphs to spark interest and embellish the story.
- Keep the press release to one to two pages of double-spaced copy.
- Check your spelling, dates, and contact information carefully. There should be no mistakes in your release.
- End with the following notation: ####

COMMUNICATE THROUGH SOCIAL MEDIA

With the abundance of social media platforms, opportunities abound to communicate with target audiences. The easiest way to add social media to your educational strategy is to tap into the audiences already developed by your facility. Does your course have a Twitter or Instagram account? Facebook page? YouTube channel? If so, providing content to the appropriate person in charge of posting to these platforms or gaining access to these platforms yourself is the easiest approach to start using social media for your environmental stewardship activities.

Use eye-catching photos and concise text to increase interest in your efforts. The content of your social media content should be in keeping with the goals and objectives you've already identified and utilize the key messages in your communication efforts. If your facility does not already have a social media policy, take the time to develop a formal or informal social media policy to help guide your efforts.

Outreach and Involvement

Providing opportunities for people to be involved in environmental projects on the golf course can help to ensure an understanding of your stewardship activities. It also helps the golf course maintenance crew share the work of conservation activities, such as nest box monitoring, inventorying wildlife, or developing a display, which are often viewed as "non-essential" projects. Spreading the work and enjoyment among many people builds a broader base of support for conservation activities and BMPs.

INVITE PARTICIPATION

Inviting participation in ACSP activities can begin when you form a Resource Advisory Group. This gives staff, patrons, decision makers, and community members an opportunity to become involved in planning and implementing stewardship projects right from the start. Some golf course superintendents designate all activities related to obtaining certification in the ACSP to someone from this group, such as the assistant superintendent. Others retain overall control and designate specific environmental components (e.g. wildlife habitat management, water conservation, water quality management) to various members of the ACSP team or staff.

Review the following sample to get ideas for writing a press release for your course.

SAMPLE PRESS RELEASE

Orion Golf Course
21 Fairway Drive
Toronto, Ontario L9Y 1T1
Telephone 617-212-7654

PRESS RELEASE

FOR IMMEDIATE RELEASE, 3/5/19

Contact: Mary Becker, 617-212-7654 ext. 12

Orion Golf Course Going Wild

TORONTO, ONTARIO – The Orion Golf Course will be going wild this spring. Employees of the eighteen-hole golf public facility plan to naturalize five acres of the manicured out-of-play areas with wildflowers and native grasses to diversify the landscape and increase wildlife habitat on the course.

"We couldn't be more excited about the project," stated Horticulturist Mary Becker. "We've seen so much growth and development in this area over the last four years and we want to do our part to give something back to the natural landscape." Indeed, Orion employees hope the meadow, which is designed to complement existing woods on the property, becomes a refuge for butterflies and songbirds.

"We're aiming for a beautiful site that is attractive to both people and wildlife," Becker added. She envisions golfers and the public taking a stroll around the meadow, or enjoying the view of colorful flowers from the clubhouse windows.

The idea to create a meadow came about when Becker read about similar naturalization projects taking place at other golf course properties both in Canada and the U.S. Rather than maintain expansive turf throughout out-of-play areas, Becker rallied fellow employees to go wild and transform the site. A group of interested employees has been planning the meadow for the past few months and ground breaking is scheduled for April 10, 2020

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Creating a Social Media Strategy

Every organization with a social media presence (or that wants a social media presence) needs a social media policy. If your club does not already have one or if one needs to be adapted to your efforts, review these steps to develop a policy that governs your social media work.

1. Plan your strategy (goals, target audiences). Think about which social media platforms (Facebook, Twitter, Instagram, etc.) make sense for you to use in your communication efforts. If your facility already has a social media policy, make sure your efforts follow existing guidelines.

2. Assign social media roles and responsibilities. Who will be responsible for developing content and posting information to social media platforms?

3. Determine what content you should post. Go back to basics: What are your communication goals and which activities will help you make progress toward those goals? Identify goals for posting frequency.

4. Include a plan for monitoring/evaluating your activities. Who will be responsible for monitoring your social media presence? What metrics (such as likes and retweets) will be gathered, and how often? Is the time spent obtaining metrics worth the information you are able to gather?

5. Establish rules of thumb for who and how you respond to comments. Decide who has authority to respond to or delete comments. Balance the desire to quickly reply to someone and engage in a conversation to the need to reply thoughtfully.

6. Establish a flexible policy for handling negative comments. For instance, create strategies and responses for turning complaints into opportunities; avoiding the spread of misinformation; defining inappropriate behavior or postings, and responding or eliminating such posts. Also decide when it's best to simply ignore the comments.

7. Describe your expectations for comments, and rules on privacy and permissions. Determine what is allowed and when it is allowed (for example, no profanity or flames). Remember to explicitly state that you are not responsible for third-party posts.

As we have stressed elsewhere in this guidebook, inviting participation from people outside the golf course builds positive community relations, while providing technical expertise or volunteer assistance with specific projects. There are many stewardship activities that can include an outreach component. By

Bird box projects are a great way to get children involved in environmental benefit projects on the golf course.

simply inviting patrons or their children or community members to participate, you will spread goodwill and communicate good stewardship.

CHOOSE OUTREACH PROJECTS

It goes without saying that every golf course is different, but this is especially true when it comes to choosing outreach activities that are best suited to each course. What works for one golf course may not be appropriate for another. Some courses may have greater flexibility in inviting community participation, while others may be bound by labor union contracts or club regulations that prohibit certain types of activities. Hence, the ACSP does not stipulate specific outreach projects that must be done to achieve certification. Instead, we recommend that courses choose at least two outreach projects to meet certification requirements.

Listed in this section are a variety of outreach activities that have been successful on a number of golf courses that participate in the ACSP. Your Resource Advisory Group can help determine which activities will be most appropriate for your course.

- **Request help with nest boxes.** As a good starter project for Wildlife and Habitat Management, nest boxes may also serve as a catalyst for ACSP involvement. Here are a few suggestions:
    - Invite golfers to "adopt-a-box" by donating money for one or more boxes and agreeing to check and maintain them throughout the spring and summer.
    - Make a few extra birdhouses every year. Donate the boxes to golfers, schools, or the local cemetery association to stimulate interest in your stewardship activities.
    - Invite a local scout troop or Eagle Scout to make and monitor your nest boxes.
    - Sponsor a workshop for members' children or resort guests to make nest boxes for the golf course. Extra boxes can be given away.
    - Place a few nest boxes within view of your property border. These boxes will subtly communicate a message that the course is concerned about local birds and wildlife.
- **Create a garden.** If you choose to create a garden for butterflies,

hummingbirds, or songbirds, invite gardeners at your course to help with planting. A local school class, scout troop, or after school program may also like to help. You can expand garden activities to include a brief lesson about connections between plants and wildlife. Invite a local newspaper to visit on planting day to garner positive publicity.

- **Inventory Wildlife.** A great way to get people involved in inventorying wildlife is to provide wildlife inventory cards to golfers as they pick up their scorecards. You can even encourage people to fill out these cards by creating a raffle. Each filled out card can serve as one raffle ticket. Alternately, you can simply post a wildlife inventory list in the pro-shop or in locker rooms. Provide books on natural habitat, building nest boxes, butterflies, bird identification, or environmental issues as a service to your golfers. These can be checked out at the club or offered in a lounge area.

- **Create a nature guide.** Create a simple hole-by-hole environmental guide for golfers. At each stop, you can point out interesting natural features or environmental projects. This can include native plants, nest boxes, unique trees, habitat areas, common wildlife, IPM practices, and water conservation measures.

- **Host nature walks.** Ask golfers who are knowledgeable about birds to host an early morning walk to look for birds and other wildlife species on the course. People who attend can add their sightings to the club's wildlife inventory. Providing refreshments is a nice way to conclude the walk.

- **Lead a golf course tour.** Very basic golf course tours have a great impact on public perception. A successful outing demonstrates goodwill and will spread by word of mouth. Consider hosting an outing once per year for members or regular golfers, or extend the invitation to specific golfing groups (e.g., seniors, women), grade school children, young adults, biology clubs, scout groups, college students, local golf course superintendents, or even local media. Your tour should demonstrate various aspects of your stewardship efforts.

- **Use tournaments to showcase environmental aspects of the course.** If you are hosting a tournament, use the opportunity to educate people about the environmental quality of your course. For example, highlight your ACSP involvement through the media or put up a simple display to show some of the environmental projects you've undertaken. Create a media fact sheet that highlights stewardship accomplishments and key natural features of the course.

- **Teach good stewardship to golfers.** If your course offers golf lessons or has a junior golf program, include lessons on how golfers can support good environmental stewardship while

they play. Repairing ball marks and divots are just the beginning of what golfers can do. Discuss how sustainable practices may alter the aesthetics of the course as more natural areas are created. Encourage people to view natural areas as integral to the nature of the game and to respect wildlife and natural habitats on the property.

- **Offer a workshop.** A wonderful way to develop communication skills is to begin talking to small community groups. You might speak with a local school class, garden club, homeowner association, or superintendent association. Choose a topic you're comfortable with, such as tree and shrub care, integrated pest management, environmental quality on your golf course, or your involvement with the ACSP.

- **Encourage neighborly stewardship.** Write a letter to course neighbors to encourage participation in environmental stewardship activities in their own backyards. This may tie in well with nest box giveaways, providing garden or lawn care tips, or a seasonal golf course tour. When the golf course serves as a catalyst for such activities, it spreads the word regarding environmental stewardship and extends environmental quality improvements beyond the course itself.

- **Host kids projects.** Get kids involved by making bird feeders or houses for the course or their own backyards, hosting a fishing derby, or leading a school tour. You can also get kids involved with planting gardens, creating nature guides, or tracking wildlife on the course in the winter. Getting kids

Getting children out on the course is a great way to teach them that golf courses can be environmentally sustainable.

involved in environmental activities pulls parents into the golf course for non-golf activities and helps people begin to see the property not just as a golf course, but as a community asset.

- **Sponsor a school.** Sponsor a local school in the Audubon Cooperative Sanctuary Program for Schools. This is a sure way to let the community know you care about the environment. You might also offer one field trip to your course as part of your involvement with the school. To receive a school program brochure, write or call Audubon International.

AUDUBON INTERNATIONAL CONSERVATION INITIATIVES

Audubon International leads a number of Conservation Initiatives designed to promote golf's positive environmental contributions. These programs can also provide wonderful Outreach opportunities with your golf club members, public golfers, and your local community. These initiatives include BioBlitz, a free species-counting competition designed to showcase the environmental value of the natural habitats found on golf courses, Monarchs in the Rough, a program that partners with golf courses to restore pollinator habitat in out-of-play areas, and The Raptor Relocation Network that connects Audubon International certified golf courses with airport wildlife managers who are trapping and relocating raptors at airports for safety reasons, including bird strikes. For information about current Conservation Initiatives, visit our website, or call our office.

Self-Assessment Checklist

Outreach and education efforts will help ensure support for stewardship initiatives, strengthen local community connections, and extend participation in environmental conservation activities. Review the Self-Assessment Checklist to check your knowledge and assess your current management practices.

GENERAL KNOWLEDGE

- Form a Resource Advisory Group to help plan and implement environmental projects and educational efforts on the golf course.
- Identify at least one staff member or Resource Advisory Group member who will take primary responsibility for communicating environmental goals, objectives, and projects to patrons, staff, decision makers, and community members.
- Contact at least one member of the local community or one community organization (not affiliated with the golf course) to participate in project planning or implementation. This person may provide advice, assist with projects or monitoring, or provide technical support.

EDUCATION

- Develop written materials to be made available to patrons that describe your involvement in the ACSP or highlight different stewardship projects taking place on the course (e.g. brochures, regular newsletter articles, locker room signs, signs that highlight key habitats or projects, educational posters, letters to members, yardage books, e-mail newsletter, scorecards).
- Create a display that describes your involvement in the ACSP and highlights stewardship projects taking place on the course.
- Communicate with neighboring property owners/homeowner association or key community contacts to explain your involvement in the ACSP and various stewardship projects (e.g. letters to neighbors, press releases, presentations at workshops, seminars, or committee meetings).

OUTREACH AND INVOLVEMENT

- Invite employees, patrons, and community members to be involved in your Resource Advisory Group.
- Invite employees, patrons, and community members to help with stewardship projects. Provide at least two of the following activities to encourage participation:
    - Mount or monitor nest boxes with golfer/community assistance.
    - Help with wildlife gardens or ecological restoration projects.
    - Inventory wildlife species.
    - Maintain or use a nature trail.

- Provide a hole-by-hole guide to environmental stewardship.
- Host wildlife walks on or around the golf course.
- Host tours of the course for patrons and staff to showcase stewardship projects.
- Host tours of the course for community groups to showcase stewardship projects.
- Host tournaments to support environmental stewardship projects.
- Host workshops on stewardship projects or environmental issues.
- Encourage patrons, staff, decision makers, and community members to join the ACSP for Backyards.
- Sponsor a local school's involvement in the ACSP for Schools.
- Other: (You may have personalized projects that also meet this objective.)

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Appendix

Bird Inventory Checklist

Common Birds of North America

Though not a complete listing, this bird inventory checklist should help you get started on inventorying the birds you see.

Date _____ Location _____ Weather _____

Notes _____

Loons & Grebes
- ☐ Red-throated Loon
- ☐ Arctic Loon
- ☐ Pacific Loon
- ☐ Common Loon
- ☐ Yellow-billed Loon
- ☐ Least Grebe
- ☐ Pied-billed Grebe
- ☐ Horned Grebe
- ☐ Red-necked Grebe
- ☐ Eared Grebe
- ☐ Western Grebe
- ☐ Clark's Grebe

Ducklike Birds
- ☐ American White Pelican
- ☐ Brown Pelican
- ☐ Great Cormorant
- ☐ Double-crested Cormorant
- ☐ Neotropic Cormorant
- ☐ Pelagic Cormorant
- ☐ Red-faced Cormorant
- ☐ Anhinga
- ☐ Brown Noddy
- ☐ Black Noddy
- ☐ Black Skimmer
- ☐ Dovekie
- ☐ Common Murre
- ☐ Thick-billed Murre
- ☐ Razorbill
- ☐ Black Guillemot
- ☐ Pigeon Guillemot
- ☐ Marbled Murrelet
- ☐ Kittlitz's Murrelet
- ☐ Xantus's Murrelet
- ☐ Craveri's Murrelet
- ☐ Ancient Murrelet
- ☐ Cassin's Auklet
- ☐ Parakeet Auklet
- ☐ Least Auklet
- ☐ Whiskered Auklet
- ☐ Crested Auklet
- ☐ Rhinoceros Auklet
- ☐ Tufted Puffin
- ☐ Atlantic Puffin
- ☐ Horned Puffin

Waterfowl
- ☐ Fulvous Whistling-Duck
- ☐ Black-bellied Whistling-Duck
- ☐ Tundra Swan
- ☐ Trumpeter Swan
- ☐ Mute Swan
- ☐ Greater White-fronted Goose
- ☐ Snow Goose
- ☐ Ross's Goose
- ☐ Brant
- ☐ Canada Goose
- ☐ Muscovy Duck
- ☐ Wood Duck
- ☐ Green-winged Teal
- ☐ American Black Duck
- ☐ Mottled Duck
- ☐ Mallard
- ☐ Northern Pintail
- ☐ Blue-winged Teal
- ☐ Cinnamon Teal
- ☐ Northern Shoveler
- ☐ Gadwall
- ☐ Eurasian Wigeon
- ☐ American Wigeon
- ☐ Canvasback
- ☐ Redhead
- ☐ Ring-necked Duck
- ☐ Tufted Duck
- ☐ Greater Scaup
- ☐ Lesser Scaup
- ☐ Common Eider
- ☐ King Eider
- ☐ Spectacled Eider
- ☐ Harlequin Duck
- ☐ Oldsquaw
- ☐ Black Scoter
- ☐ Surf Scoter
- ☐ White-winged Scoter
- ☐ Common Goldeneye
- ☐ Barrow's Goldeneye
- ☐ Bufflehead
- ☐ Hooded Merganser
- ☐ Common Merganser
- ☐ Red-breasted Merganser
- ☐ Ruddy Duck
- ☐ Masked Duck

Seabirds
- ☐ Wandering Albatross
- ☐ Waved Albatross
- ☐ Short-tailed Albatross
- ☐ Black-footed Albatross
- ☐ Laysan Albatross
- ☐ Black-browed Albatross
- ☐ Northern Fulmar
- ☐ Black-capped Petrel
- ☐ Bulwer's Petrel
- ☐ Cory's Shearwater
- ☐ Pink-footed Shearwater
- ☐ Flesh-footed Shearwater
- ☐ Greater Shearwater
- ☐ Buller's Shearwater
- ☐ Sooty Shearwater
- ☐ Short-tailed Shearwater
- ☐ Manx Shearwater
- ☐ Black-vented Shearwater
- ☐ Audubon's Shearwater
- ☐ Wilson's Storm-Petrel
- ☐ Fork-tailed Storm-Petrel
- ☐ Leach's Storm-Petrel
- ☐ Ashy Storm-Petrel
- ☐ Band-rumped Storm-Petrel
- ☐ Black Storm-Petrel
- ☐ Least Storm-Petrel
- ☐ White-tailed Tropicbird
- ☐ Red-billed Tropicbird
- ☐ Masked Booby
- ☐ Blue-footed Booby
- ☐ Brown Booby
- ☐ Red-footed Booby
- ☐ Northern Gannet
- ☐ Magnificent Frigatebird
- ☐ Pomarine Jaeger
- ☐ Parasitic Jaeger
- ☐ Long-tailed Jaeger
- ☐ Great Skua
- ☐ South Polar Skua
- ☐ Black-legged Kittiwake
- ☐ Red-legged Kittiwake
- ☐ Gulls & Terns
- ☐ Laughing Gull
- ☐ Franklin's Gull
- ☐ Little Gull
- ☐ Black-headed Gull
- ☐ Bonaparte's Gull
- ☐ Heermann's Gull
- ☐ Mew Gull
- ☐ Ring-billed Gull
- ☐ California Gull
- ☐ Herring Gull
- ☐ Yellow-legged Gull
- ☐ Thayer's Gull
- ☐ Iceland Gull
- ☐ Lesser Black-backed Gull
- ☐ Slaty-backed Gull
- ☐ Yellow-footed Gull
- ☐ Western Gull
- ☐ Glaucous-winged Gull
- ☐ Glaucous Gull
- ☐ Great Black-backed Gull
- ☐ Ross's Gull
- ☐ Sabine's Gull
- ☐ Ivory Gull
- ☐ Gull-billed Tern
- ☐ Caspian Tern
- ☐ Royal Tern
- ☐ Elegant Tern
- ☐ Sandwich Tern
- ☐ Roseate Tern
- ☐ Common Tern
- ☐ Arctic Tern

- ☐ Forster's Tern
- ☐ Least Tern
- ☐ Aleutian Tern
- ☐ Bridled Tern
- ☐ Sooty Tern
- ☐ White-winged Tern
- ☐ Black Tern

Long-legged Wading Birds
- ☐ American Bittern
- ☐ Least Bittern
- ☐ Great Blue Heron
- ☐ Great Egret
- ☐ Little Egret
- ☐ Snowy Egret
- ☐ Little Blue Heron
- ☐ Tricolored Heron
- ☐ Reddish Egret
- ☐ Cattle Egret
- ☐ Green Heron
- ☐ Black-crowned Night-Heron
- ☐ Yellow-crowned Night-Heron
- ☐ White Ibis
- ☐ Scarlet Ibis
- ☐ Glossy Ibis
- ☐ White-faced Ibis
- ☐ Roseate Spoonbill
- ☐ Wood Stork
- ☐ Sandhill Crane
- ☐ Whooping Crane

Smaller Wading Birds
- ☐ Yellow Rail
- ☐ Black Rail
- ☐ Clapper Rail
- ☐ King Rail
- ☐ Virginia Rail
- ☐ Sora
- ☐ Purple Gallinule
- ☐ Common Moorhen
- ☐ American Coot
- ☐ Limpkin
- ☐ Black-bellied Plover
- ☐ American Golden-Plover
- ☐ Pacific Golden-Plover
- ☐ Mongolian Plover
- ☐ Snowy Plover
- ☐ Wilson's Plover
- ☐ Semipalmated Plover
- ☐ Piping Plover
- ☐ Killdeer
- ☐ Mountain Plover
- ☐ American Oystercatcher
- ☐ Black Oystercatcher
- ☐ Black-necked Stilt
- ☐ American Avocet
- ☐ Northern Jacana
- ☐ Greater Yellowlegs
- ☐ Lesser Yellowlegs
- ☐ Wood Sandpiper
- ☐ Solitary Sandpiper
- ☐ Willet
- ☐ Common Sandpiper
- ☐ Spotted Sandpiper
- ☐ Upland Sandpiper
- ☐ Long-billed Curlew
- ☐ Hudsonian Godwit
- ☐ Bar-tailed Godwit
- ☐ Marbled Godwit
- ☐ Ruddy Turnstone
- ☐ Black Turnstone
- ☐ Surfbird
- ☐ Red Knot
- ☐ Sanderling
- ☐ Semipalmated Sandpiper
- ☐ Western Sandpiper
- ☐ Red-necked Stint
- ☐ Least Sandpiper
- ☐ White-rumped Sandpiper
- ☐ Baird's Sandpiper
- ☐ Pectoral Sandpiper
- ☐ Sharp-tailed Sandpiper
- ☐ Purple Sandpiper
- ☐ Rock Sandpiper
- ☐ Dunlin
- ☐ Curlew Sandpiper
- ☐ Stilt Sandpiper
- ☐ Buff-breasted Sandpiper
- ☐ Ruff
- ☐ Short-billed Dowitcher
- ☐ Long-billed Dowitcher
- ☐ Common Snipe
- ☐ American Woodcock
- ☐ Wilson's Phalarope
- ☐ Red-necked Phalarope
- ☐ Red Phalarope

Fowl-like Birds
- ☐ Plain Chachalaca
- ☐ Gray Partridge
- ☐ Chukar
- ☐ Ring-necked Pheasant
- ☐ Spruce Grouse
- ☐ Willow Ptarmigan
- ☐ Rock Ptarmigan
- ☐ White-tailed Ptarmigan
- ☐ Ruffed Grouse
- ☐ Sage Grouse
- ☐ Greater Prairie-chicken
- ☐ Lesser Prairie-chicken
- ☐ Sharp-tailed Grouse
- ☐ Wild Turkey
- ☐ Northern Bobwhite
- ☐ Scaled Quail
- ☐ Gambel's Quail
- ☐ California Quail
- ☐ Mountain Quail

Birds of Prey
- ☐ Black Vulture
- ☐ Turkey Vulture
- ☐ California Condor
- ☐ Osprey
- ☐ Hook-billed Kite
- ☐ Swallow-tailed Kite
- ☐ White-tailed Kite
- ☐ Snail Kite
- ☐ Mississippi Kite
- ☐ Bald Eagle
- ☐ Northern Harrier
- ☐ Sharp-shinned Hawk
- ☐ Cooper's Hawk
- ☐ Northern Goshawk
- ☐ Common Black-Hawk
- ☐ Harris's Hawk
- ☐ Red-shouldered Hawk
- ☐ Broad-winged Hawk
- ☐ Short-tailed Hawk
- ☐ Swainson's Hawk
- ☐ White-tailed Hawk
- ☐ Zone-tailed Hawk
- ☐ Red-tailed Hawk
- ☐ Ferruginous Hawk
- ☐ Rough-legged Hawk
- ☐ Golden Eagle
- ☐ Crested Caracara
- ☐ American Kestrel
- ☐ Merlin
- ☐ Peregrine Falcon
- ☐ Gyrfalcon
- ☐ Prairie Falcon
- ☐ Barn Owl
- ☐ Ashy-faced Owl
- ☐ Oriental Scops-Owl
- ☐ Flammulated Owl
- ☐ Eastern Screech-Owl
- ☐ Western Screech-Owl
- ☐ Balsas Screech-Owl
- ☐ Pacific Screech-Owl
- ☐ Whiskered Screech-Owl
- ☐ Vermiculated Screech-Owl
- ☐ Tropical Screech-Owl
- ☐ Bearded Screech-Owl
- ☐ Bare-shanked Screech-Owl
- ☐ Puerto Rican Screech-Owl
- ☐ Bare-legged Owl
- ☐ Crested Owl
- ☐ Spectacled Owl
- ☐ Great Horned Owl
- ☐ Snowy Owl
- ☐ Northern Hawk Owl
- ☐ Northern Pygmy-Owl
- ☐ Andean Pygmy-Owl
- ☐ Least Pygmy-Owl
- ☐ Ferruginous Pygmy-Owl
- ☐ Cuban Pygmy-Owl
- ☐ Elf Owl
- ☐ Burrowing Owl
- ☐ Mottled Owl
- ☐ Black-and-white Owl
- ☐ Spotted Owl
- ☐ Barred Owl
- ☐ Fulvous Owl
- ☐ Great Gray Owl
- ☐ Long-eared Owl
- ☐ Stygian Owl
- ☐ Striped Owl
- ☐ Short-eared Owl
- ☐ Jamaican Owl
- ☐ Boreal Owl
- ☐ Northern Saw-whet Owl
- ☐ Unspotted Saw-whet Owl

Parrots
- ☐ Budgerigar
- ☐ Monk Parakeet

Pigeons & Doves
- ☐ Rock Dove
- ☐ White-crowned Pigeon
- ☐ Red-billed Pigeon
- ☐ Band-tailed Pigeon
- ☐ Eurasian Collared-Dove
- ☐ Spotted Dove
- ☐ White-winged Dove
- ☐ Mourning Dove
- ☐ Inca Dove
- ☐ Common Ground-Dove
- ☐ Ruddy Ground-Dove
- ☐ White-tipped Dove

Cuckoos
- ☐ Common Cuckoo
- ☐ Black-billed Cuckoo
- ☐ Yellow-billed Cuckoo
- ☐ Mangrove Cuckoo
- ☐ Lesser Roadrunner
- ☐ Greater Roadrunner
- ☐ Greater Ani
- ☐ Smooth-billed Ani
- ☐ Groove-billed Ani

Goatsuckers
- ☐ Lesser Nighthawk
- ☐ Common Nighthawk
- ☐ Pauraque
- ☐ Common Poorwill
- ☐ Chuck-will's-widow
- ☐ Buff-collared Nightjar
- ☐ Whip-poor-will

Hummingbirds
- ☐ Broad-billed Hummingbird
- ☐ White-eared Hummingbird
- ☐ Buff-bellied Hummingbird
- ☐ Violet-crowned Hummingbird
- ☐ Blue-throated Hummingbird
- ☐ Magnificent Hummingbird
- ☐ Plain-capped Starthroat
- ☐ Lucifer Hummingbird
- ☐ Ruby-throated Hummingbird
- ☐ Black-chinned Hummingbird
- ☐ Anna's Hummingbird
- ☐ Costa's Hummingbird
- ☐ Calliope Hummingbird
- ☐ Broad-tailed Hummingbird
- ☐ Rufous Hummingbird
- ☐ Allen's Hummingbird

Kingfishers
- ☐ Ringed Kingfisher
- ☐ Belted Kingfisher
- ☐ Green Kingfisher

Woodpeckers
- ☐ Lewis's Woodpecker
- ☐ Red-headed Woodpecker
- ☐ Acorn Woodpecker
- ☐ Gila Woodpecker
- ☐ Golden-fronted Woodpecker
- ☐ Red-bellied Woodpecker
- ☐ Yellow-bellied Sapsucker
- ☐ Red-naped Sapsucker
- ☐ Red-breasted Sapsucker
- ☐ Williamson's Sapsucker
- ☐ Ladder-backed Woodpecker
- ☐ Nuttall's Woodpecker
- ☐ Downy Woodpecker
- ☐ Hairy Woodpecker
- ☐ Strickland's Woodpecker
- ☐ Red-cockaded Woodpecker
- ☐ White-headed Woodpecker
- ☐ Three-toed Woodpecker
- ☐ Black-backed Woodpecker
- ☐ Northern Flicker
- ☐ Gilded Flicker
- ☐ Pileated Woodpecker

Swifts
- ☐ Black Swift
- ☐ White-fronted Swift
- ☐ Chimney Swift
- ☐ Vaux's Swift

Flycatchers
- ☐ Northern Beardless-Tyrannulet
- ☐ Olive-sided Flycatcher
- ☐ Western Wood-Pewee
- ☐ Eastern Wood-Pewee
- ☐ Yellow-bellied Flycatcher
- ☐ Acadian Flycatcher
- ☐ Alder Flycatcher
- ☐ Willow Flycatcher
- ☐ Least Flycatcher
- ☐ Hammond's Flycatcher
- ☐ Dusky Flycatcher
- ☐ Gray Flycatcher
- ☐ Pacific-slope Flycatcher
- ☐ Cordilleran Flycatcher
- ☐ Buff-breasted Flycatcher
- ☐ Black Phoebe
- ☐ Eastern Phoebe
- ☐ Say's Phoebe
- ☐ Vermilion Flycatcher
- ☐ Dusky-capped Flycatcher
- ☐ Ash-throated Flycatcher
- ☐ Great Crested Flycatcher
- ☐ Brown-crested Flycatcher
- ☐ Tropical Kingbird
- ☐ Couch's Kingbird
- ☐ Cassin's Kingbird
- ☐ Thick-billed Kingbird
- ☐ Western Kingbird
- ☐ Eastern Kingbird
- ☐ Gray Kingbird
- ☐ Scissor-tailed Flycatcher
- ☐ Fork-tailed Flycatcher

Larks
- ☐ Sky Lark
- ☐ Horned Lark

Swallows
- ☐ Purple Martin
- ☐ Tree Swallow
- ☐ Violet-green Swallow
- ☐ Northern Rough-winged Swallow
- ☐ Bank Swallow
- ☐ Cliff Swallow
- ☐ Cave Swallow
- ☐ Barn Swallow

Jays, Crows, & Ravens
- ☐ Gray Jay
- ☐ Steller's Jay
- ☐ Blue Jay
- ☐ Green Jay
- ☐ Brown Jay
- ☐ Florida Scrub-Jay
- ☐ Island Scrub-Jay
- ☐ Western Scrub-Jay
- ☐ Mexican Jay
- ☐ Pinyon Jay
- ☐ Clark's Nutcracker
- ☐ Black-billed Magpie
- ☐ Yellow-billed Magpie
- ☐ American Crow
- ☐ Northwestern Crow
- ☐ Fish Crow
- ☐ Chihuahuan Raven
- ☐ Common Raven

Chickadees, Titmice, & Nuthatches
- ☐ Rose-throated Becard
- ☐ Black-capped Chickadee
- ☐ Carolina Chickadee
- ☐ Mexican Chickadee
- ☐ Mountain Chickadee
- ☐ Boreal Chickadee
- ☐ Chestnut-backed Chickadee
- ☐ Tufted Titmouse
- ☐ Verdin
- ☐ Bushtit
- ☐ Red-breasted Nuthatch
- ☐ White-breasted Nuthatch
- ☐ Pygmy Nuthatch
- ☐ Brown-headed Nuthatch

Creepers, Bulbuls, and Wrens
- ☐ Brown Creeper
- ☐ Red-vented Bulbul
- ☐ Red-whiskered Bulbul
- ☐ Cactus Wren
- ☐ Rock Wren
- ☐ Canyon Wren
- ☐ Carolina Wren
- ☐ Bewick's Wren
- ☐ House Wren
- ☐ Winter Wren
- ☐ Sedge Wren
- ☐ Marsh Wren

Wrentit, Dippers, & Pipits
- ☐ Wrentit
- ☐ American Dipper
- ☐ Northern Wheatear
- ☐ Yellow Wagtail
- ☐ Gray Wagtail
- ☐ Black-backed Wagtail
- ☐ Red-throated Pipit
- ☐ American Pipit
- ☐ Sprague's Pipit

Kinglets and Gnatcatchers
- ☐ Golden-crowned Kinglet
- ☐ Ruby-crowned Kinglet
- ☐ Blue-gray Gnatcatcher
- ☐ California Gnatcatcher
- ☐ Black-tailed Gnatcatcher
- ☐ Black-capped Gnatcatcher

Mimic Thrushes
- ☐ Gray Catbird
- ☐ Northern Mockingbird
- ☐ Sage Thrasher
- ☐ Brown Thrasher
- ☐ Long-billed Thrasher
- ☐ Bendire's Thrasher
- ☐ Curve-billed Thrasher
- ☐ California Thrasher
- ☐ Crissal Thrasher
- ☐ Le Conte's Thrasher

Thrushes
- ☐ Eastern Bluebird
- ☐ Western Bluebird
- ☐ Mountain Bluebird
- ☐ Bluethroat
- ☐ Townsend's Solitaire
- ☐ Veery
- ☐ Gray-cheeked Thrush
- ☐ Bicknell's Thrush

- ☐ Swainson's Thrush
- ☐ Hermit Thrush
- ☐ Wood Thrush
- ☐ Clay-colored Robin
- ☐ Rufous-backed Robin
- ☐ American Robin
- ☐ Varied Thrush
- ☐ Aztec Thrush
- ☐ Northern Wheatear

Shrikes and Starlings
- ☐ Brown Shrike
- ☐ Northern Shrike
- ☐ Loggerhead Shrike
- ☐ European Starling
- ☐ Crested Myna

Waxwings
- ☐ Bohemian Waxwing
- ☐ Cedar Waxwing
- ☐ Phainopepla

Vireos
- ☐ White-eyed Vireo
- ☐ Bell's Vireo
- ☐ Black-capped Vireo
- ☐ Gray Vireo
- ☐ Solitary Vireo
- ☐ Yellow-throated Vireo
- ☐ Hutton's Vireo
- ☐ Warbling Vireo
- ☐ Philadelphia Vireo
- ☐ Red-eyed Vireo
- ☐ Yellow-green Vireo
- ☐ Black-whiskered Vireo

Warblers
- ☐ Arctic Warbler
- ☐ Blue-winged Warbler
- ☐ Golden-winged Warbler
- ☐ Tennessee Warbler
- ☐ Orange-crowned Warbler
- ☐ Nashville Warbler
- ☐ Virginia's Warbler
- ☐ Colima Warbler
- ☐ Lucy's Warbler
- ☐ Northern Parula
- ☐ Tropical Parula
- ☐ Yellow Warbler
- ☐ Chestnut-sided Warbler
- ☐ Magnolia Warbler
- ☐ Cape May Warbler
- ☐ Black-throated Blue Warbler
- ☐ Yellow-rumped Warbler
- ☐ Black-throated Gray Warbler
- ☐ Townsend's Warbler
- ☐ Hermit Warbler
- ☐ Black-throated Green Warbler
- ☐ Blackburnian Warbler
- ☐ Yellow-throated Warbler
- ☐ Grace's Warbler
- ☐ Pine Warbler
- ☐ Prairie Warbler
- ☐ Palm Warbler
- ☐ Bay-breasted Warbler
- ☐ Blackpoll Warbler
- ☐ Cerulean Warbler
- ☐ Black-and-white Warbler
- ☐ American Redstart
- ☐ Prothonotary Warbler
- ☐ Worm-eating Warbler
- ☐ Swainson's Warbler
- ☐ Ovenbird
- ☐ Northern Waterthrush
- ☐ Louisiana Waterthrush
- ☐ Kentucky Warbler
- ☐ Connecticut Warbler
- ☐ Mourning Warbler
- ☐ MacGillivray's Warbler
- ☐ Common Yellowthroat
- ☐ Hooded Warbler
- ☐ Wilson's Warbler
- ☐ Canada Warbler
- ☐ Red-faced Warbler
- ☐ Painted Redstart
- ☐ Yellow-breasted Chat
- ☐ White-winged Warbler
- ☐ Bachman's Warbler

Blackbirds & Orioles
- ☐ Bobolink
- ☐ Red-winged Blackbird
- ☐ Tricolored Blackbird
- ☐ Eastern Meadowlark
- ☐ Yellow-headed Blackbird
- ☐ Rusty Blackbird
- ☐ Brewer's Blackbird
- ☐ Great-tailed Grackle
- ☐ Boat-tailed Grackle
- ☐ Common Grackle
- ☐ Shiny Cowbird
- ☐ Bronzed Cowbird
- ☐ Brown-headed Cowbird

Tanagers
- ☐ Hepatic Tanager
- ☐ Summer Tanager
- ☐ Scarlet Tanager
- ☐ Western Tanager

Weaver Finches
- ☐ House Sparrow
- ☐ Eurasian Tree Sparrow

Finches, Sparrows, & Juncos
- ☐ Brambling
- ☐ Gray-crowned Rosy-Finch
- ☐ Black Rosy-Finch
- ☐ Brown-capped Rosy-Finch
- ☐ Pine Grosbeak
- ☐ Common Rosefinch
- ☐ Purple Finch
- ☐ Cassin's Finch
- ☐ House Finch
- ☐ Red Crossbill
- ☐ White-winged Crossbill
- ☐ Common Redpoll
- ☐ Hoary Redpoll
- ☐ Pine Siskin
- ☐ Black-capped Siskin
- ☐ Black-headed Siskin
- ☐ Yellow-bellied Siskin
- ☐ Red Siskin
- ☐ Antillean Siskin
- ☐ Lesser Goldfinch
- ☐ Lawrence's Goldfinch
- ☐ American Goldfinch
- ☐ European Goldfinch
- ☐ Eurasian Siskin
- ☐ Yellow-fronted Canary
- ☐ Common Canary
- ☐ Eurasian Bullfinch
- ☐ Hooded Grosbeak
- ☐ Evening Grosbeak
- ☐ Northern Cardinal
- ☐ Pyrrhuloxia
- ☐ Rose-breasted Grosbeak
- ☐ Black-headed Grosbeak
- ☐ Blue Grosbeak
- ☐ Indigo Bunting
- ☐ Varied Bunting
- ☐ Painted Bunting
- ☐ Dickcissel
- ☐ Green-tailed Towhee
- ☐ Collared Towhee
- ☐ Spotted Towhee
- ☐ Eastern Towhee
- ☐ California Towhee
- ☐ Canyon Towhee
- ☐ Abert's Towhee
- ☐ Bachman's Sparrow
- ☐ Botteri's Sparrow
- ☐ Cassin's Sparrow
- ☐ Rufous-winged Sparrow
- ☐ Rufous-crowned Sparrow
- ☐ Oaxaca Sparrow
- ☐ Rusty Sparrow
- ☐ Striped Sparrow
- ☐ Zapata Sparrow
- ☐ American Tree Sparrow
- ☐ Chipping Sparrow
- ☐ Clay-colored Sparrow
- ☐ Brewer's Sparrow
- ☐ Field Sparrow
- ☐ Worthen's Sparrow
- ☐ Black-chinned Sparrow
- ☐ Vesper Sparrow
- ☐ Lark Sparrow
- ☐ Black-throated Sparrow
- ☐ Sage Sparrow
- ☐ Five-striped Sparrow
- ☐ Lark Bunting
- ☐ Savannah Sparrow
- ☐ Baird's Sparrow
- ☐ Grasshopper Sparrow
- ☐ Henslow's Sparrow
- ☐ Le Conte's Sparrow
- ☐ Saltmarsh Sharp-tailed Sparrow
- ☐ Nelson's Sharp-tailed Sparrow
- ☐ Seaside Sparrow
- ☐ Fox Sparrow
- ☐ Song Sparrow
- ☐ Lincoln's Sparrow
- ☐ Swamp Sparrow
- ☐ White-throated Sparrow
- ☐ Golden-crowned Sparrow
- ☐ White-crowned Sparrow
- ☐ Harris's Sparrow
- ☐ Dark-eyed Junco
- ☐ Yellow-eyed Junco
- ☐ McCown's Longspur
- ☐ Lapland Longspur
- ☐ Smith's Longspur
- ☐ Chestnut-collared Longspur
- ☐ Rustic Bunting
- ☐ Snow Bunting
- ☐ McKay's Bunting

Nest Box Survey and Monitoring Record

Nestbox Survey

Box Type 1
- S Small (1 1/2" hole)
- M Medium (3–4" hole)
- L Large (6–8" hole)
- C Colonial boxes with multiple rooms

Habitat 2
- H Hedge row or tree row
- M Mowed lawn
- OF Open field or pasture (not mowed)
- WA In standing water
- WE Edge of woods
- WO Woods

Distance 3
- A < 10 feet
- B 10 feet–50 feet
- C 50 feet–100 feet
- D 100 feet–500 feet
- E > 500 feet

Common Bird Species 4
- TS Tree Swallow
- BB Bluebird
- HW House Wren
- CH Chickadee
- PM Purple Martin
- WD Wood Duck
- K Kestrel
- U Unknown
- O Other

Causes of Nest Failure 5
- W Weather
- PR Predation
- BF Blow Flies
- PE Pesticides
- HS House Sparrows
- AB Nest Abandonment
- V Vandalism
- U Unknown
- O Other

Name _____

Business Name (if applicable) _____

Address _____

City _____ State _____ Zip _____ County _____

Country _____ E-mail _____

Phone _____ Fax _____

What year is this survey being filled out for? _____ What is the total number of nest boxes on your property? _____

Use the guide to the left when filling in the nestbox chart data. For more than one nest in the same box use a separate row.

Box #	Box Type 1	Habitat Type 2	Distance to Trees 3	Distance to Water 3	Bird Species 4	Number of Eggs	Number Fledged	Cause of Failure 5	Comments

Use the guide to the left when filling in the nestbox chart data. For more than one nest in the same box use a separate row.

Box Type **1**
- S Small (1 1/2" hole)
- M Medium (3–4" hole)
- L Large (6–8" hole)
- C Colonial boxes with multiple rooms

Habitat **2**
- H Hedge row or tree row
- M Mowed lawn
- OF Open field or pasture (not mowed)
- WA In standing water
- WE Edge of woods
- WO Woods

Distance **3**
- A < 10 feet
- B 10 feet–50 feet
- C 50 feet–100 feet
- D 100 feet–500 feet
- E > 500 feet

Common Bird Species **4**
- TS Tree Swallow
- BB Bluebird
- HW House Wren
- CH Chickadee
- PM Purple Martin
- WD Wood Duck
- K Kestrel
- U Unknown
- O Other

Causes of Nest Failure **5**
- W Weather
- PR Predation
- BF Blow Flies
- PE Pesticides
- HS House Sparrows
- AB Nest Abandonment
- V Vandalism
- U Unknown
- O Other

Box #	Box Type 1	Habitat Type 2	Distance to Trees 3	Distance to Water 3	Bird Species 4	Number of Eggs	Number Fledged	Cause of Failure 5	Comments

Bat Box Instructions

Bat Conservation International holds a copyright to standard bat house plans. You may join this organization and receive its publication on this topic: ***The Bat House Builder's Handbook***, by Merlin D. Tuttle, and Donna L. Hensley. It is also available from University of Texas Press, P.O. Box 7819, Austin TX 78713-7819, ISBN 0-9638248-0-5. Also follow these guidelines for the best results:

The Bat Box

- **Size**—Larger houses seem to be far more likely to be occupied than small ones. Large houses may measure approximately 25"–36" tall by 10"–24" wide by 11" deep.
- **Wood Type**—Pine, cypress, cedar, and exterior plywood are all fine. Interestingly, old wood seems to attract bats sooner—within the first season after mounting. However, boxes constructed of new wood placed in suitable conditions will work too.
- **Paint and Stain**—Dark stain, black paint, or tar paper increases the absorption of solar heat and helps to keep boxes warm—a condition northern bats prefer. In fact, temperature is a key factor in bat house use. In northern parts of North America (above 40° latitude), bats prefer temperatures in the 80° to 90° range. However, in southern areas (below 30° latitude), just the opposite seems to be true. White or unstained bat houses help to prevent overheating in the South.
- **Guano**—Placing bat guano in or around the bat house doesn't appear to have a significant impact on whether bats take up residence. It may help to attract bats sooner, but proper house size and location are far more important in attracting bats.

Bat House Placement

- **Solar Radiation**—Bat house exposure to sun is one of the most significant criteria for attracting bats. In Northern areas, make sure your box gets at least four hours of sun per day. In the South, your box should get less than four hours.
- **Mounting**—Mount your box a minimum of 15' to 30' above the ground. Where solar exposure is important, mount your box on a pole for the best success. The side of a building or on a tree will also work, but be sure to look for hanging branches or other obstacles that block sunlight. In general, try to place bat houses in remote areas of the golf course and in places that do not receive high pesticide applications.
- **Water Source**—If at all possible, place your bat house close to a water source. Bats show a strong preference for habitat that is in close proximity to water. Boxes placed within 1/2 mile or less of a stream or river are most successful. Large lakes of three or more acres also attract bats.

Wildlife Garden Plant List

HB= *Hummingbird* BF= *Butterfly* SB= *Songbird*

Perennials		
Asters	*Aster* spp.	BF
Beebalm	*Monarda didyma*	HB, BF
Black-eyed Susan	*Rudbeckia* spp.	BF, SB
Blazing star	*Liatris* spp.	HB, BF
Bleeding heart	*Dicentra* spp.	HB
Butterfly weed	*Asclepias tuberosa*	BF
Cardinal flower	*Lobelia cardinalis*	HB, BF
Catnip	*Nepeta cataria*	HB
Columbine	*Aquilegia canadensis*	HB, BF
Coneflower	*Echinacea* spp.	BF, SB
Coral bells	*Heuchera sanguinea*	HB
Coreopsis	*Coreopsis* spp.	BF
Delphinium	*Delphineum* spp.	HB
Foxglove	*Digitalis* spp.	HB
Hosta	*Hosta* spp.	HB
Milkweed	*Asclepias* spp.	BF, SB
Paintbrush	*Castilleja* spp.	HB
Penstemon	*Penstemon* spp.	HB, BF
Sage	*Salvia* spp.	HB
Yucca	*Yucca* spp.	HB
Annual Flowers		
Calendula	*Calendula officinalis*	BF, SB
Cosmos	*Cosmos* spp.	BF, SB
Flowering tobacco	*Nicotiana alata*	HB
Fushia	*Fushia* spp	HB
Impatiens	*Impatiens* spp.	HB, BF
Nasturtium	*Tropaeolum majus*	HB
Scarlet runner bean	*Phaseolus coccineus*	HB
Snapdragon	*Antirrhinum majus*	HB, BF
Spider flower	*Cleome spinosa*	HB
Sunflower	*Helianthus annuus*	SB, BF
Zinnia	*Zinnia elegans*	HB, BF, SB
Vines *Ask for trumpet vines by the Latin name to be sure you get the right vine! Other varieties can be invasive.*		
Grape	*Vitis* spp.	SB
Trumpet creeper	*Campsis radicans*	HB
Trumpet honeysuckle	*Lonicera sempervirens*	HB
Shrubs		
Bayberry	*Myrica* spp.	SB
Blueberry	*Vaccinium* spp.	SB, BF
Butterfly bush	*Buddleia davidii*	BF, HB
Current	*Ribes* spp.	SB
Dogwood	*Cornus* spp.	SB
Hibiscus	*Hibiscus* spp.	HB, SB
Rhododendron	*Rhododendron* spp.	HB, BF
Scarlet bush	*Hamelia erecta*	HB
Serviceberry	*Amelanchier* spp.	SB
Viburnum	*Viburnum* spp.	SB
Winterberry	*Ilex* spp.	SB

Aquatic and Shoreline Plants for Ponds, Lakes, and Streams

Border Shrubs

These plants prefer periodic flooding, and should be planted on pond banks above normal water edge. Height ranges from 5 to 20 feet.

Alder, Speckled (*Alnus rugosa*)—This attractive shrub provides food for 15 species of songbirds, including goldfinches and pine siskins.

Bayberry, Northern (*Myrica pennsylvanica*)—Provides both cover for nesting sites and food for many songbirds.

Buttonbush, Common (*Cephalanthus occidentalis*)—This food source for waterfowl also bears attractive flowers used by ruby-throated hummingbirds.

Chokeberry, Red (*Aronia arbutifolia*)—Berries are eaten by 12 species of songbirds; provides fall color interest as well.

Dogwood, Silky (*Cornus amomum*)—Cover, nesting sites, and food source for birds; adds fall color interest.

Servicebery, Shadblow (*Amelanchier canadensis*)—Berry food source for 36 species of songbirds.

Willow, Pussy (*Salix discolor*)—Grouse eat buds, American goldfinches use for nesting, mammals and songbirds eat the showy fruits.

Winterberry, Common (*Ilex verticulata*)—Berries provide a winter food source for birds.

Emergent Plants

Grow best in shallow water and prefer wet conditions. Plant in 6 to 12 inches of water. Height ranges from 2 to 4 feet.

Arrow arrum (*Petrandra virginica*)—This clump plant does not spread. Wood ducks and other waterfowl eat the seeds.

Arrowheads, Duck Potato (*Sagittaria* sp.)—Underground tuber is eaten by waterfowl including wood ducks, trumpeter and whistling swans, sandhill cranes, and king rail.

Bulrushes (*Scirpus* sp.)—Many species of water birds and songbirds eat the seeds, while muskrats and geese eat stems and rhizomes. Birds also nest in the upright stems. This plant is also valuable for controlling shore erosion.

Iris, Yellow Water Iris, Blue Flag (*Iris* sp.)—Yellow or blue flowers of ornamental interest, but limited in wildlife value. Roots eaten by muskrats.

Pickerelweed (*Pontederia cordata*)—Slow spreading with colorful bright blue flowers; seeds eaten by wood and black ducks.

Rice Cutgrass (*Leersia oryzoides*)—Seeds and roots provide food source for waterfowl and songbirds.

Sedge species (*Carex* sp.)—Excellent for wildlife cover and food. Many species nest in the clumps of grass.

Sweet Flag (*Acorus calamus*)—This attractive clump plant does not spread; limited wildlife value.

Turf IPM Field Infestation Report

Hole _____ Scout _____ Date _____

Site (turf species)	Mowing Height	Soil Moisture	Weeds Species No. or %	Diseases Species No. or %	Remarks	Nematodes Species No. or %
Green						
Tee						
Fairway						
Rough						
Notes:			1. Goosegrass 2. Crabgrass 3. Broadleaves 4. Nutsedge, Yellow 5. Nutsedge, Purple 6. *Poa annua* 7. Other	1. Dollar spot 2. Leaf spot 3. *Pythium* blight 4. *Pythium* root rot 5. Fairy ring 6. Brown patch *(R. solani)* 7. Rhizoctonia leaf and sheath blight *(R. zeae)* 8. Algae/moss 9. Other		1. Sting 2. Lance 3. Stubby-root 4. Root-knot 5. Cyst 6. Ring 7. Spiral 8. Sheath 9. Other

Turf IPM Field History Report Form

Hole _____ Scout _____ Date _____

Site	Turf Species	Mowing Schedule	Soil Analysis			Soil Drainage	Fertilization (N/1000 sq ft)				Irrigation Schedule
			pH	P	K		Spring	Summer	Fall	Winter	
Green											
Tee											
Fairway											
Rough											
Driving range											
Nursery green											
Practice green											

Comments on specific topics such as shade, overseeding blend, nitrogen carrier, topdressing mix, weather, irrigation salinity levels, etc.

2012 SCOUTING FORM

Golf Course: Ladies' Golf Club of Toronto

Date: 25-Jun-2012 Soil Temp at 8 cm: 17.3c °C Soil Temp Location: #! Green Time of day (soil temp recorded): 6 am ☑ pm ☐

Previous 24 hr data: Precipitation: 0 mm Air Temp: High 20.1 °C Low 15 °C Humidity: Low ☐ Med ☑ High ☐

Location	Pest or Condition	# of Pests seen (#/unit area or % of area)	Possible Contributing Factors	Action Taken (cultural, chemical or other)	Results	
					Date	Effect of action taken
All Fairways	Knotweed	15% blight	Heat stress to Poa Annua turfs, knotweeds invade areas. Conducive weather.	Chemical	26-Jun-2012	Good control of knotweed.
Rough(s)	Broadleaf weeds, primarily clover.	>4/0.1m2	Height of cut, history of weed competition.	Chemical	27-Jun-2012	Good control of broadleaf weeds.
All Fairways	Dollar spot	10% blight	Conducive weather, history of disease.	Chemical	28-Jun-2012	Good control of dollar spot.
All Greens	Dollar spot	5% blight	Conducive weather, history of disease.	Chemical	29-Jun-2012	Good control of dollar spot.
Mulch areas	Broadleaf weeds	>4/0.1m2	Thinning of mulch, dry compacted soil conditions.	Chemical	29-Jun-2012	Good control of broadleaf weeds.

I attest that the above information is accurate and truthful. I also acknowledge that I, and the golf course owner/operator are responsible to be aware of the requirements of IPM Accreditation as defined by the IPM Council of Canada and that failure to meet the requirements can result in loss of the golf course's IPM Accreditation status.

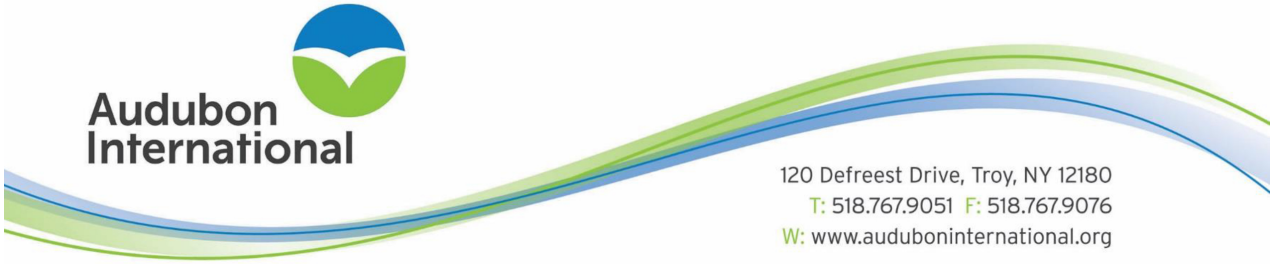
Scout's Name: Graeme Shennan

IPM Agent: Graeme Shennan IPM certification number: 2235 Signature: _____

IPM Accreditation Program

Feb 27, 2012

Water Quality Monitoring Guidance



Technical Bulletin #1

Water Quality Monitoring

A water quality monitoring program is a valuable tool to assess the effectiveness of your Best Management Practices. **This type of monitoring is different than the testing you'd conduct on the source of your irrigation water to inform your agronomic management decisions.** Based on sound scientific principles, water quality monitoring results can help you to confirm and communicate that you are employing the correct management strategies. Water quality monitoring in an important part of the Audubon Cooperative Sanctuary Program (ACSP). There are two primary approaches to monitoring, visual (and olfactory) inspection and water quality sampling. Employing both will help you obtain information needed to make adjustments in your management efforts if necessary.

The following provides a brief overview of each of the primary methods:

Visual (and olfactory):

Periodic visual (and olfactory) surveys of water quality requires little or no equipment and takes a minimal amount of time. It simply involves surveying your property's water features by looking at the water and surrounding land and noting what you see and smell, including the presence of invasive aquatic species. Despite its simplicity, this is an important aspect of environmental monitoring. By collecting information on a regular basis, you can develop a baseline of normal conditions and record changes over time.

When you visually monitor your water bodies, make sure to write down any abnormalities noted, as well as the date, time of day, previous and current weather conditions, previous chemical applications in the area, and any other changes that could be a possible cause of the abnormality.

Water Quality Sampling Programs:

Water quality sampling programs involve more effort than visual inspections and provide a wealth of information you can use to assess the physical, chemical, and biological characteristics of water on your property and how well those characteristics support the health of aquatic environments. In addition, the results of your analyses will reflect the sustainability of your turf management activities and the success of your conservation efforts.

The extent of your monitoring program can vary from simple (limited number of sampling locations, limited number of parameters) to more complex (extensive sampling of different kinds of water features, greater number of parameters, stream biodiversity surveys, etc.).

To assess the impact of your management activities, you'll need to collect upstream water samples where water enters your course and downstream water samples where the water exits the course. Reviewing topographical maps of your course will help you identify these locations. You can then identify them by GPS coordinates and use the same locations during each sampling event. Data from the same location(s) provides a valuable baseline for identifying any changes or trends in water quality over time. In some instances, your irrigation water source can be used as your upstream sample.

When starting a water quality monitoring program, sampling should be conducted at least four times per year during the first year or two, once during each season. After establishing baseline data, sampling twice a year is typically sufficient, unless problems arise, such as an unintended chemical release or an acute environmental issue (e.g. algal bloom, fish kill, etc.).

A number of methods can be used to analyze water such as do-it-yourself test kits, meters, commercial laboratories, and university laboratories. Each method has pros and cons that should be evaluated as part of your water monitoring program development. For example, meters may be used in the field to measure water quality parameters such as temperature, dissolved oxygen (DO), pH, and conductivity/salinity. Although meters are easy to use, they are more expensive than test kits and require calibration and maintenance to ensure accuracy. Field test kits for the same parameters may be less expensive, but the results may be unacceptable to some data users, including regulatory agencies.

For the ACSP, water quality testing should include the following:

- Physical Characteristics: dissolved oxygen, pH, temperature and specific conductivity
- Nutrients: Total nitrogen (the sum of kjeldahl nitrogen and nitrate-nitrite) and total phosphorus

For complete information regarding water quality monitoring, please see Chapter 5 of Audubon International's A Guide to Environmental Stewardship on the Golf Course document.

Should you have any questions regarding your water quality monitoring program, please feel free to call our office at (518) 767-9051.

Useful Resources

Wildlife Identification

- *Peterson, Audubon, Golden, National Geographic* all have field guides for birds, mammals, fish, amphibians & reptiles, and more.
- Peterson, A Field Guide to Birds—eastern and western editions available, great for identification. Check out the Peterson Guide to Bird Songs too.
- Peterson First Guide to Birds—beginner guide
- The National Audubon Society Field Guide to North American Birds—eastern or western edition, good for background information
- National Geographic Society Field Guide to the Birds of North America
- Golden Field Guides—simple beginner guides
- The Sibley Guide to Birds—although geared for experienced birders, this guide provides even the novice with a great deal of information
- Kaufman Focus Guides: Birds of North America—beginner guide using digitized photographs to highlight important field marks
- Stokes Nature Guides and Guides to Bird Behavior—goes beyond basic information to include ecology, behavior, habitat, and life cycle.
- The Birder's Handbook—comprehensive reference for in-depth information on birds
- North American Birdfeeder Handbook—valuable resource for backyard birders
- The Field Guide to Wildlife Habitats, by Janine Benyus—both eastern and western editions available

Web-Based Resources

Amphibian Conservation

- Partners in Amphibian and Reptile Conservation (PARC): https://parcplace.org/
- IUCN's FrogLog: https://www.iucn-amphibians.org/resources/froglog/
- USGS-Frogwatch USA: https://my.usgs.gov/gcmp/site/list/938543
- Canadian Wildlife Federation - Amphibians and Reptiles: https://cwf-fcf.org/en/resources/encyclopedias/fauna/amphibians-and-reptiles/

Bat Conservation

- Bat Conservation International: https://www.batcon.org/
- Bat Conservation and Management: https://batmanagement.com/

Bird Conservation and Nest Boxes

- The Cornell Lab - Bird Cams: https://www.allaboutbirds.org/cams/
- Cornell Lab of Ornithology: https://www.birds.cornell.edu/home/
- Partners in Flight: https://partnersinflight.org/
- US Fish & Wildlife Service-Migratory Birds: https://www.fws.gov/birds/index.php
- Birds of North America: https://www.birds-of-north-america.net/

General

- Audubon International: https://audubonintenational.org/
- United States Fish and Wildlife Service: http://www.fws.gov

Native Plant Landscaping

- EPA-Landscaping with Native Plants: https://www.epa.gov/watersense/what-plant
- National Wildlife Federation Native Plant Finder: https://www.nwf.org/NativePlantFinder/

Water Conservation and Wetlands

- EPA's How's My Waterway: https://www.epa.gov/waterdata/hows-my-waterway
- Society for Ecological Restoration (SER): https://www.ser.org/
- U.S. Water News: https://www.uswaternews.com/
- Water Resources of the United States: https://www.usgs.gov/mission-areas/water-resources
- EPA's Wetlands Protection and Restoration: https://www.usgs.gov/mission-areas/water-resources

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