Rio Grande Chapter
GCSAA
Golf Course Superintendents Association of America

Best Management Practices

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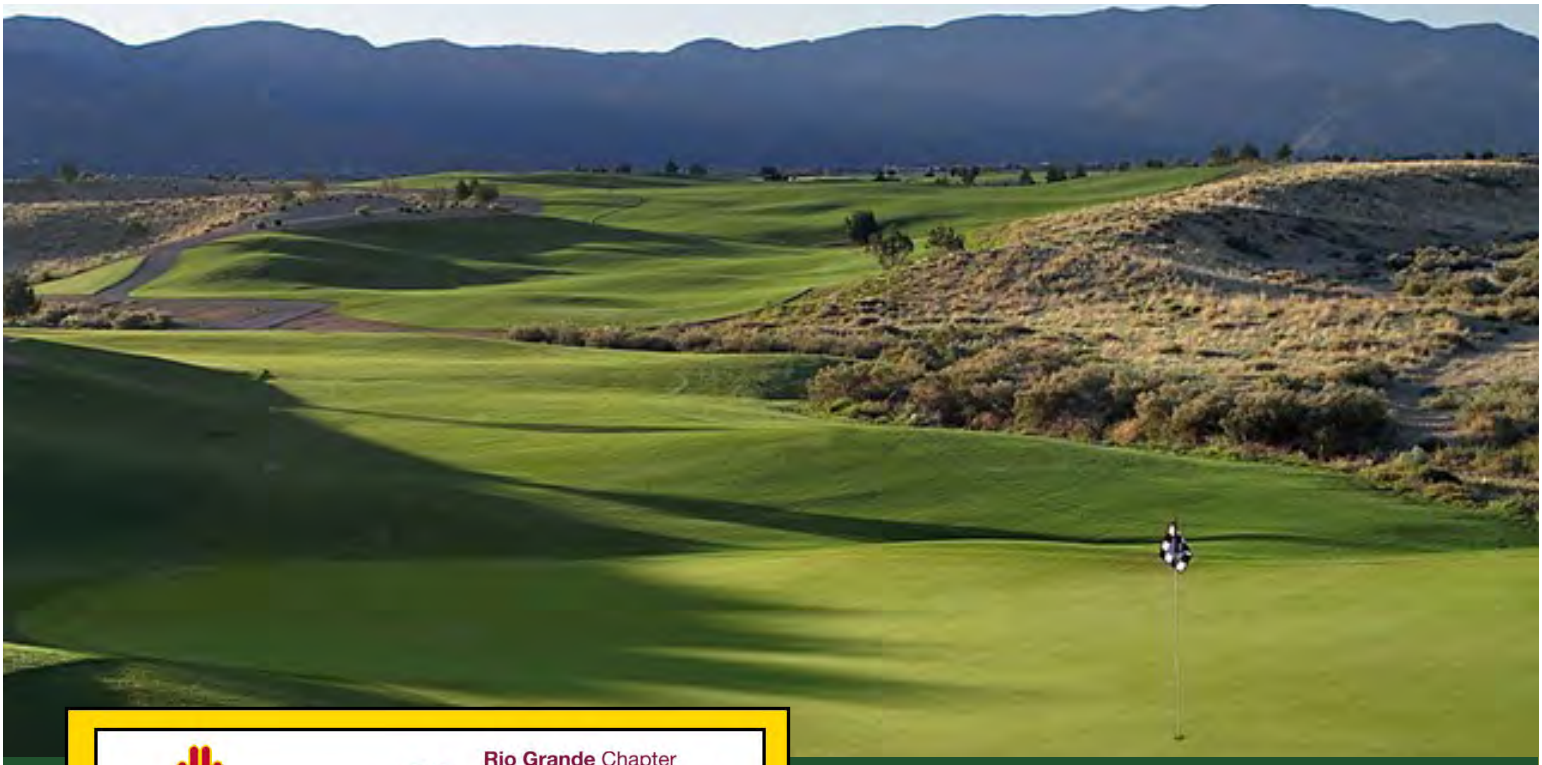

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Best Management Practices

Acknowledgments

BMP Best Management Practices

GCSAA Golf Course Superintendents Association of America

USGA®

In partnership with the PGA TOUR

EIFG

Funded through the Environmental Institute for Golf

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Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Introduction

BMP Best Management Practices

The Rio Grande Golf Course Superintendents Association is the professional association for the men and women of New Mexico who manage and maintain the game's most valuable resource — the golf course. Today, the RGGCSA and its members are recognized by the New Mexico golf industry as one of the key contributors in elevating the game and business to its current state. The association provides education, information and representation to more than 100 members from all parts of New Mexico and the El Paso region. The RGGCSA is an affiliated chapter of the Golf Course Superintendents Association of America whose mission is to serve its members, advance their profession and enhance the enjoyment, growth and vitality of the game of golf.

In 2018, the RGGCSA initiated the process of creating and providing to its members a comprehensive golf-facility written ***Best Management Practices*** plan focused on important environmental areas like nutrient management, water management and drought contingency, land and wildlife conservation, and integrated pest management (IPM). Our efforts continued through 2019 and utilized the BMP Planning Guide and Template provided by the GCSAA as a resource for the development of golf course best management practices (BMP) programs at the state level. This template was created thanks to the technical expertise and funding resource of the Environmental Institute for Golf The Environmental Institute for Golf (EIFG) and the United States Golf Association The United States Golf Association (USGA). The GCSAA established a goal that by the end of 2020, every state in the US will publish state created BMP plans and has been directly involved with the RGGCSA program by providing technical expertise and funding.

The need for state-level BMP programs and, ultimately, golf facility-written BMP plans is greater than ever. Golf courses, many of which are located in urban environments under the watchful eye of concerned citizens, face heightened scrutiny from the public, media and environmental activist special-interest groups regarding the use of inputs (that is, water, pesticides, etc.) and commonly held misconceptions about golf course management. BMP programs help superintendents manage golf facilities in an efficient manner while providing quality playing surfaces and protecting the environment. They also enable the golf course facility to operate where regulatory pressures exist, and they offer the industry a significant platform for advocacy, education, recognition, and demonstration of professional land management. These guidelines are not meant to become rules, ordinances or laws, but are rather informational materials to assist developing policies for resource conservation.

Not all golf courses in New Mexico can retrofit their facilities to meet all of the BMP recommended by the program. The intent, therefore, should be to establish a performance baseline for each course, and then measure future performance or progress against that individual baseline. Golf courses, for the most part, are self-sustaining businesses paid for by user groups. To burden a golf course facility economically is not the intent of these BMP; it is quite the opposite. Carefully adopted BMP can potentially improve the financial sustainability of the golf course, as well as the environmental sustainability. This is why industry and government interests must cooperatively and intelligently select which BMP will achieve the greatest benefit for everyone. BMPs should be flexible and provide leeway to the golf course superintendent to implement practices that will facilitate reaching the end goal – sustainable golf course management.

Throughout the process of creating this project, the association requested feedback and input from many individuals and organizations within the state that are directly involved with specific issues addressed in the program. The RGGCSA is very appreciative for all of the great input and contributions that we received from many. Each of these contributions are recognized on the pages with the included information.

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Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 1

Planning, Design and Construction

The construction phase of any industry's infrastructure poses the greatest risk of ecosystem alteration. With proper planning and design, golf facilities can be constructed and maintained with minimal impact to existing wildlife and their habitat.

Furthermore, facilities should be designed and constructed to maximize energy efficiency.

Regulatory Issues

Local and state regulations may be in place in your location. Early engagement among developers, designers, local community groups, and permitting agencies is essential to designing and constructing a golf facility that minimizes environmental impact and meets the approval process.

Planning

Principles

Proper planning will minimize expenses resulting from unforeseen construction requirements. Good planning provides opportunities to maximize/integrate environmentally favorable characteristics into the property. This often requires the involvement of golf course architects, golf course superintendents, civil engineers, soil scientists, agronomists, irrigation designers, ecologists, etc.

New Mexico Environment Department

The New Mexico Environment Department (NMED) is the environmental agency for the State of New Mexico. We have over 550 employees throughout our main offices in Santa Fe and 22 district offices state-wide.

OUR RESPONSIBILITIES ARE TO:

INFORM citizens and businesses on environmental protection and health and safety requirements.

MONITOR air and water quality and assess land to assure state and federal standards are met.

ISSUE PERMITS to facilities and businesses to ensure operations meet established environmental and health standards.

INSPECT work sites and industrial facilities to ensure they meet environmental laws and protect public and employee health and safety.

ASSIST facilities with compliance requirements of environmental laws and regulations through outreach and technical assistance.

PLANNING

Best Management Practices

- Assemble a qualified team
  - Golf course architect
  - Golf course superintendent
  - Clubhouse architect
  - Irrigation engineer
  - Environmental engineer
  - Energy analyst
  - Economic consultant
  - Civil engineer
  - Soil scientist
  - Geologist
  - Golf course builder
  - Legal team
- Determine objectives
- Complete a feasibility study
- Are needs feasible given existing resources?
  - Financial
  - Environmental
  - Water
  - Energy
  - Labor
  - Materials
  - Governmental regulatory requirements/ restrictions
- Select an appropriate site that is capable of achieving the needs of stakeholders.
- Identify strengths and weakness of the selected site.
- Identify any rare, protected, endangered, or threatened plant or animal species on the site.

New Mexico Environment Department

WE ARE COMMITTED TO:

- **Providing** clear articulation of our goals, standards, and expectations in a professional manner so that employees and the public may make informed decisions and be actively involved in setting priorities.
- **Promoting** environmental awareness through the practice of open and direct communication and sound decision-making by carrying out the mandates and initiatives of the department in a fair and consistent manner.

ORGANIZATIONAL STRUCTURE:

The department is organized into the Secretary's and General Counsel's offices, Divisions, Bureaus, Programs, field offices, boards, **councils**, and commissions.

District Map

Contact Sheet Organizational Charts

Our Mission:

To protect and restore the environment, and to foster a healthy and prosperous New Mexico for present and future generations.

DEPARTMENT HISTORY

The New Mexico Environment Department was created by the 40th state Legislature in 1991 under the "Department of Environment Act" (Chapter 25). As a regulatory agency, NMED enforces various state regulations and federal laws relating to protection of the environment, resources, and public health and safety.

Design

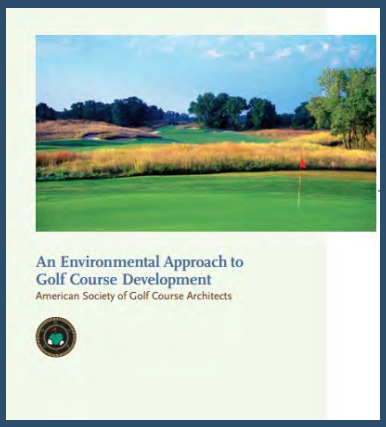
Principles

Proper design will meet the needs of the stakeholders, protect the locations environmental resources, and be economically sustainable.

Best Management Practices

- Retain a qualified golf course superintendent/ project manager at the beginning of the design and construction process to integrate sustainable maintenance practices in the development, maintenance, and operation of the course.
- Design the course to minimize the need to alter or remove existing native landscapes. The routing should identify the areas that provide opportunities for restoration.
- Design the course to retain as much natural vegetation as possible. Where appropriate, consider enhancing existing vegetation through the supplemental planting of native vegetation/materials next to long fairways, out-of-play areas, and along water sources supporting fish and other water-dependent species.
- Design out-of-play areas to retain or restore existing native vegetation where possible. Nuisance, invasive, and exotic plants should be removed and replaced with native species that are adapted to that particular site.
- Greens
    - Select a location that has adequate sunlight to meet plant specific needs and provides sufficient drainage.
    - Choose a green size and sufficient number of hole locations that is large enough to accommodate traffic and play damage, but not so large that it is not sustainable with your resources.
    - Select an appropriate root-zone material as designated by the USGA.
    - Consider the number of bunkers as it relates to resources available for daily maintenance.
    - Greens should be irrigated separately from surrounding turf.
    - Select a turf species/variety that meets the needs of the stakeholders while adhering to the principle of “right plant, right place.”
- Plant only certified turfgrass.
- Decide whether bunkers will contain drainage.
- Consider bunker entry and exit points. Consider wear patterns and create adequate space for ingress/egress points on greens, tees, fairways, and bunkers.
- Select the proper color, size, and shape of bunker sand that meets your needs.
- Define play and non-play maintenance boundaries.

An Environmental Approach to Golf Course Development



American Society of Golf Course Architects

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Construction

Principles

Construction should be completed with care to minimize environmental impact and financial ramifications caused by poor construction techniques.

Best Management Practices

- Conduct a pre-construction conference with stakeholders.
- Construction should be scheduled to maximize turfgrass establishment and site drainage.
- Use environmentally sound construction techniques.
- Use soil stabilization techniques to minimize soil erosion and maximize sediment containment.
- Maintain a construction progress report and communicate the report to the proper permitting agencies.
- Use only qualified contractors who are experienced in the special requirements of golf course construction.
- Schedule construction and turf establishment to allow for the most efficient progress of the work, while optimizing environmental conservation and resource management.
- Temporary construction compounds should be built in a way that minimizes environmental impacts.

Golf Course Builders Association of America

The **GCBAA** is a nonprofit trade association of the world's foremost golf course builders and leading suppliers to the golf course construction industry. It was founded in the early 1970s, and its members represent all segments of the golf course construction industry.

It is the only organization in the world organized by and for golf course builders, and the only organization that represents the interests of the golf course construction industry.

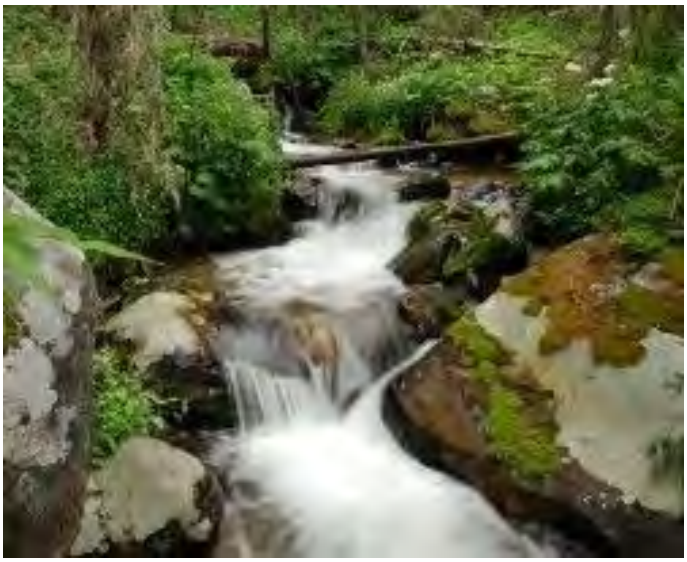
The Association also endeavors to provide comprehensive programs and services to construction contractors and specialists in regard to the changing regulations and technology of golf course construction.

CLICK

New Mexico Environment Department

Water Resources & Management

As all New Mexicans know, water in our state is a very precious – and at times elusive – resource. Even with New Mexico's wonderful diversity of ecosystems , the mostly desert landscape receives an average of 10 inches of precipitation annually…



Surface water (rivers, lakes and streams) in New Mexico originates as rain or melting snow, but over 95% of that water evaporates or is transpired by plants.Most of New Mexico's fresh water is stored as groundwater in aquifers or confining layers below the land surface, where it occupies small open spaces between sand or gravel and small fractures in rock.

Water Topics Spotlight:

NMED is responsible for overseeing water infrastructure systems and water quality issues throughout the state.

*NOTE: The state's water resources in regards to **water quantity**, appropriation, and distribution of surface and ground waters are administered by the Office of the State Engineer.*

NMED has many programs that focus on protecting the quality of our waters and assuring safe and effective infrastructure for delivering clean water to our communities. We coordinate much of our work with federal agencies, other state agencies, local governments, and citizen groups.

Water Quality Programs and Regulatory Information:

- DRINKING WATER
- GROUND WATER
- SURFACE WATER
- WASTEWATER
- WATER & WASTEWATER INFRASTRUCTURE
- CLEANUPS & MONITORING FOR WATER RESOURCE PROTECTION

Grow-In

Principles

Turfgrass establishment is a unique phase in turfgrass growth, which can require greater quantities of water and nutrients than established turfgrasses. To this end, the establishment phase should be considered carefully to minimize environmental risk.

GOLF COURSE CONSTRUCTION: GROW-IN PHILOSOPHIES

GOLF COURSE CONSTRUCTION: GROW-IN PHILOSOPHIES

by TERRY BUCHEN, CGCS
Superintendent, Double Eagle Club, Galena, Ohio

ONE OF THE MOST specialized and least understood challenges ever faced by a golf course superintendent is overseeing the construction and subsequent grow-in of a new golf course. In this unique area of turfgrass management, there is a lot of art to go along with the science.

The Double Eagle Club in Galena, Ohio (north of Columbus), was designed by Jay Morrish and Tom Weiskopf. It was constructed by the Wadsworth Golf Construction Company of Plainfield, Illinois, using cool-season grasses. Double Eagle was grown-in during 1991 and opened for play in 1992. In the following article I would like to share some of the trials and tribulations of being an owner's representative and golf course superintendent at the Double Eagle Club, as well as discuss points experienced from the grow-in of 10 other golf courses.

Overview

It is safe to say that:

1. After the initial seeding and when the sprinklers are turned on for the first watering, the most critical time during grow-in is the *first three weeks!*

2. Growing-in newly planted turf will require *up to 10 times* more fertilization (for a limited period of time) than an existing golf course practicing routine maintenance.

3. Preventative fungicide applications should be applied at higher rates, with shorter intervals between applications, as recommended by the pesticide label.

4. The common goal of the owner, architect, contractor, and superintendent always is to grow-in the turf with minimal soil erosion as fast as agronomically possible. The grow-in budget usually is the determining factor.

Fairways

Penncross creeping bentgrass was planted at 2 pounds pure live seed (PLS) per 1,000 square feet with a Brillion Turf-Maker Seeder. The soil physical analysis indicated a silt loam composition for the 6- to 8-inch depth of topsoil. Soil nutrient tests revealed deficiencies in N-P-K, a soil pH range of 6 to 7, and acceptable minor nutrient levels. Atrazine levels were checked, even though the property had not be farmed in eight years, and minimal amounts were detected. After experimenting with high rates of N-P-K during prior grow-ins, we decided to go with Scott's Pro-Turf fertilizer, a homogeneous product that is safe for young turf.

Grassing of the practice area early allowed the membership to hit balls while waiting for the course to open for initial play.

by TERRY BUCHEN, CGCS
Superintendent, Double Eagle Club

ONE OF THE MOST specialized and least understood challenges ever faced by a golf course superintendent is overseeing the construction and subsequent grow-in of a new golf course. In this unique area of turfgrass management, there is a lot of art to go along with the science.

CLICK FOR FULL STORY

Best Management Practices

- The area to be established should be properly prepared and cleared of pests (weeds, pathogens, etc.).
- Ensure erosion and sediment control devices are in place and properly maintained.
- Sprigs should be “knifed-in” and rolled to hasten root establishment.
- Sod should be topdressed to fill in the gaps between sod pieces. This hastens establishment and provides a smoother surface.
- Use appropriate seeding methods for your conditions. When using sod, nutrient applications should be delayed until sod has sufficiently rooted.
- When using sprigs, application rates for nitrogen, phosphorous, and potassium should correspond to percent ground cover (i.e., increasing rate as ground coverage increases.)
- Slow-release nitrogen or light, frequent soluble-nitrogen sources should be used during grow-in.
- Nutrients should be applied — in either foliar or granular formulations — to the turf surface. Incorporating nutrients into the root zone does not result in more rapid establishment and increases environmental risk.
- Mow as soon as the sod has knitted-down, when sprigs have rooted at the second to third internode, and seedlings have reached a height of one-third greater than intended height-of-cut. This will hasten establishment.

Erosion and Sediment Control

Principles

Soil carried by wind and water erosion transports contaminants with it. Contaminants can dislodge, especially on entering water bodies, where they can cause pollution.

Erosion and sediment control is a critical component of construction and grow-in of a golf course.

Best Management Practices

- Develop a working knowledge of erosion and sediment control management. Each state has its own specifications including types of acceptable structures, materials, and design features.
- Develop and implement strategies to effectively control sediment, minimize the loss of topsoil, protect water resources, and reduce disruption to wildlife, plant species, and designed environmental resource areas.
- Hydro-seeding or hydro-mulching offer soil stabilization.

National Pollutant Discharge Elimination System Manual

Storm Water Management Guidelines for Construction and Industrial Activities
Revision 2
August 2012

This August 2012 edition of the Storm Water Management Guidelines for Construction and Industrial Activities is to be used as guidance for construction projects and industrial sites. The project designer should attempt to meet all criteria presented in this manual, however, this manual should not be considered a standard that must be met regardless of impacts. Designers must exercise good judgment on individual projects and frequently must be innovative in their approach to storm water management. The manual is designed to be used in all parts of the state of New Mexico, both in urban and rural areas.

CLICK FOR FULL MANUAL

Wetlands

Principles

Most states consider wetlands as “waters of the state,” a designation that carries significant legal ramifications. Furthermore, permitting requirements for wetlands can have multiple overlapping jurisdictions of federal, state, and local agencies. At the federal level alone, the U.S. Army Corps of Engineers (USACOE), EPA, U.S Fish and Wildlife Service (FWS), National Oceanic and Atmospheric Administration (NOAA), and maritime agencies may all be involved.

Wetlands act both as filters for pollutant removal and as nurseries for many species of birds, insects, fish, and other aquatic organisms. The biological activity of plants, fish, animals, insects, and especially bacteria and fungi in a healthy, diverse wetland is the recycling factory of our ecosystem.

When incorporated into a golf course design, wetlands should be maintained as preserves and separated from managed turf areas with native vegetation or structural buffers. Constructed or disturbed wetlands may need to be permitted to be an integral part of the stormwater management system.

Best Management Practices

- Ensure that proper permitting has been obtained before working on any wetlands.
- Ensure that wetlands have been properly delineated before working in and around any wetlands.

Drainage

Principles

Adequate drainage is necessary for growing healthy grass.

A high-quality BMP plan for drainage addresses the containment of runoff, adequate buffer zones, and filtration techniques in the design and construction process to achieve acceptable water quality.

Drainage of the golf course features is only as good as the system's integrity. Damaged, improperly installed, or poorly maintained drainage systems will result in inferior performance that negatively impacts play and increases risks to water quality.

Best Management Practices

- When constructing drainage systems, pay close attention to engineering details such as subsoil preparation, the placement of gravel, slopes, and backfilling.
- Internal golf course drains should not drain directly into an open waterbody, but should discharge through pretreatment zones and/or vegetative buffers to help remove nutrients and sediments.
- Drainage should discharge through proper drainage and stormwater management devices, for example, vegetative buffers, swales, etc.
- The drainage system should be routinely inspected to ensure proper function.

Drainage: Through the Green The fundamentals of successful golf course drainage.

Jim Skorulski and Patrick O'Brien

Extensive drainage improvements may need to be done in phases, so proper planning is essential.

The best greenkeeper in the world cannot maintain perfect turf unless their course is well drained," declared Wendell Miller, a drainage engineer, in his advertisement in the National Greenkeeper in 1924. Miller's statement is even more relevant today, as many golfers have higher-than-ever expectations of course conditioning. Poorly drained areas are challenging to maintain at a high level of conditioning on a consistent basis. Unfortunately, it is easy to underestimate the negative effects of poor drainage until playing conditions deteriorate or regular maintenance is disrupted. Poor drainage directly impacts golf courses in many ways. Excessively wet areas usually require additional maintenance inputs and can further reduce revenue due to course closures, cart restrictions, and poor playing conditions. In short, poorly drained golf courses struggle to provide good conditions on a consistent basis and are more reliant on favorable weather conditions to remain successful. Providing firm, consistent playing surfaces requires good drainage.

CLICK HERE FOR FULL ARTICLE

Surface Water:

Stormwater, Ponds, Lakes

Principles

Stormwater is the conveying force behind nonpoint source pollution.

Controlling stormwater on a golf course is more than preventing the flooding of facilities and play areas. In addition to controlling the amount and rate of water leaving the course, stormwater control also involves storing irrigation water, controlling erosion and sediment, enhancing wildlife habitat, removing waterborne pollutants, and addressing aesthetic and playability concerns. Keep in mind that not all stormwater on a golf course originates there; some may be from adjoining lands, including residential or commercial developments.

New Mexico's surface waters consist of rivers, streams, lakes and reservoirs, and wetlands.

These waters not only provide great natural beauty, they supply the water necessary for drinking, recreation, industry, agriculture, and aquatic life as well. Our major watershed, the Rio Grande, encompasses much of New Mexico and connects us to the headwaters in Colorado and passing through Texas to its mouth in Mexico.

The basic authority for water quality management in New Mexico is provided through the State Water Quality Act which establishes the Water Quality Control Commission (WQCC). The WQCC is the state water pollution control agency for purposes of the Federal Clean Water Act.

NMED is responsible for implementing the Federal Clean Water Act in New Mexico and ensuring surface waters meet their designated beneficial uses and New Mexico state water quality standards.

Best Management Practices

- Stormwater treatment is best accomplished by a "treatment train" approach, in which water is conveyed from one treatment to another by conveyances that themselves contribute to the treatment.
- Eliminate or minimize as much directly connected impervious area (DCIA) as possible.
- Use vegetated swales to slow and infiltrate water and trap pollutants in the soil, where they can be naturally destroyed by soil organisms.
- Use depressed landscape islands in parking lots to catch, filter, and infiltrate water, instead of letting it run off. When hard rains occur, an elevated stormwater drain inlet allows the island to hold the treatment volume and settle out sediments, while allowing the overflow to drain away.
- Maximize the use of pervious pavements, such as brick or concrete pavers separated by sand and planted with grass. Special high-permeability concrete is available for cart paths or parking lots.
- Disconnect runoff from gutters and roof drains from impervious areas, so that it flows onto permeable areas that allow the water to infiltrate near the point of generation.

Our programs and activities include:

New Mexico Environment Department

[Monitoring and Assessment of all Surface Waters]

NEMD is responsible for the continual collection, integration, and assessment of water quality data for all lakes and streams in the State of New Mexico. Data analysis is used to determine if state water quality standards are being met. Our programs involve:

- Conducting stream and lake surveys & analyzing data
- Listing impaired streams not meeting water quality standards
- Developing water quality improvement plans through Total Maximum Daily Loads (TMDLs) Supporting, reviewing, and suggesting amendments to the New Mexico Water Quality Standards

[Overseeing Discharges to Surface Water]

NMED monitors and inspects all point source discharges in the state to assure compliance and compatibility with applicable state and federal laws. Our activities include:

- Assisting the EPA in implementing its Nationa Pollutant Discharge Elimination System (NPDES) permitting program
- Conducting and maintaining a comprehensive monitoring program for the regulated community of industrial and municipal effluent dischargers
- Reviewing federal NPDES permits for municipal wastewater treatment plants, electrical generating stations, fish hatcheries, mines, etc
- Managing Water and Wastewater Operators at all public water and wastewater utilities in New Mexico through the [Operator Certification Program] Managing stormwater from urban areas which is considered a regulated point discharge under the federal Clean Water Act

[Protecting New Mexico Watersheds]

NMED is responsible for organizing all federal [Clean Water Act] (CWA) [§319(h)] related activities in watersheds with TMDLs or with assessed data. Organized efforts include outreach, facilitation, administration and oversight of CWA §319(h) projects. Our programs involve:

- Working cooperatively to implement best management practices (BMPs) for reducing nonpoint source (NPS) pollutants.
- Developing work plans to include watershed association development, riparian area restoration, spill response, and treatment of abandoned mines.

Coordinating the state's CWA [§401 certification] of [§404 dredge-and-fill permits] issued by the [US Army Corps of Engineers] and implementing portions of the New Mexico Mining Act pertaining to water quality.

For more information go to: NMED Surface Water Quality Bureau

Maintenance Facilities

Principles

The maintenance facilities must incorporate BMP to minimize the potential for contamination of soil and water resources. The pesticide mixing and storage facility, the equipment wash pad, and the fuel center are focal points.

Best Management Practices

- Design and build pesticide storage structures to keep pesticides secure and isolated from the surrounding environment.
- Store pesticides in a roofed concrete or metal structure with a lockable door.
- Construct floors of seamless metal or concrete sealed with a chemical-resistant paint.
- Ensure that flow from floor drains does not discharge directly to the ground and that drains are not connected to the sanitary sewer line or septic system.
- Equip the floor with a continuous curb to retain spilled materials.
- Do not store pesticides near burning materials or hot work (welding, grinding), or in shop areas.
- Provide storage for personal protective equipment (PPE) where it is easily accessible in the event of an emergency, but do not store in the pesticide storage area.
- Provide adequate space and shelving to segregate herbicides, insecticides, and fungicides.
- Use shelving made of plastic or reinforced metal. Keep metal shelving painted.
- Provide appropriate exhaust ventilation and an emergency wash area.
- Always place dry materials above liquids, never liquids above dry materials.
- Never place liquids above eye level.
- Locate operations well away from groundwater wells and areas where runoff may carry spilled pesticides into surface waterbodies.
- Do not build new facilities on potentially contaminated sites.
- An open building must have a roof with a substantial overhang (minimum 30° from vertical, 45° recommended) on all sides.
- In constructing a concrete mixing and loading pad, it is critical that the concrete have a water-to-cement ratio no higher than 0.45:1 by weight.
- The sump should be small and easily accessible for cleaning.
- Ensure that workers always use all personal protection equipment as required by the pesticide label and are provided appropriate training.
- Assess the level of training and supervision required by staff.
- Any material that collects on the pad must be applied as a pesticide according to the label or disposed of as a (potentially hazardous) waste according to state laws and regulations.

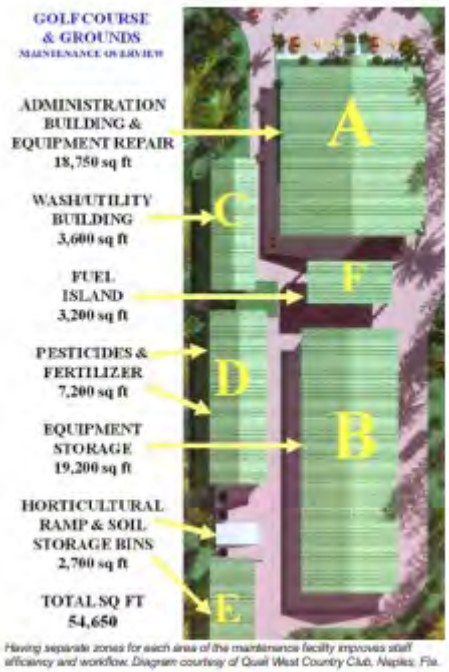
MAINTENANCE FACILITIES (cont.)
Best Management Practices

- Clean up spills immediately!
- Always store nitrogen-based fertilizers separately from solvents, fuels, and pesticides, since many fertilizers are oxidants and can accelerate a fire. Ideally, fertilizer should be stored in a concrete building with a metal or other type of flame-resistant roof.
- Always store fertilizers in an area that is protected from rainfall. The storage of dry bulk materials on a concrete or asphalt pad may be acceptable if the pad is adequately protected from rainfall and from water flowing across the pad.
- Sweep up any spilled fertilizer immediately.
- Do not wash equipment unnecessarily.
- Clean equipment over an impervious area, and keep it swept clean.
- Brush or blow equipment with compressed air before, or instead of, washing.
- Use spring shutoff nozzles.
- Use a closed-loop recycling system for wash water.
- Recycle system filters and sludge should be treated and disposed appropriately.
- Each piece of equipment should have an assigned parking area. This allows oil or other fluid leaks to be easily spotted and attributed to a specific machine so that it can be repaired.
- Use solvent-recycling machines or water-based cleaning machines to cut down on the use of flammable and/or toxic solvents.
- Use a service to remove the old solvents and dispose of them properly.
- Design pesticide storage to keep pesticides secure and isolated from the environment.

What Makes a Good Maintenance Facility?

They range in shape, size, age, and condition, but effective maintenance facilities share several key attributes.

By Todd Lowe



Having separate zones for each area of the maintenance facility improves staff efficiency and workflow. Diagram courtesy of Quail West Country Club, Naples, Fla.

Golf courses vary in size and quality, and so do the facilities that maintain them. In my years with the USGA, I have visited many inadequate and outdated maintenance facilities. However, I also visit many newer facilities with spacious courtyards, ample equipment storage areas, safe and efficient equipment repair areas, state-of-the-art chemical handling areas, separate fertilizer storage, and covered storage bins for bulk materials like soil, sand, gravel, etc. The staffs at these facilities generally take greater pride in their work and maintain cleaner, safer, maintenance facilities. It stands to reason that with improved facilities come more professionalism, increased worker safety, higher staff morale, and greater overall efficiency.

There is no "one-size-fits-all" model for golf course maintenance facilities, as they differ in size, available area, layout, and location. However, successful modern facilities share many common attributes that can be incorporated into your maintenance facility. This article lists several features that should be considered when building or redesigning your next maintenance facility.

Click here for full article

External Certification Programs

Principles

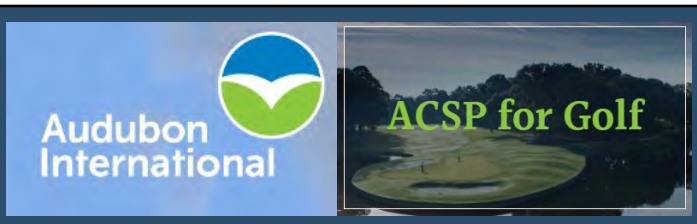
Golf-centric environmental management programs or environmental management systems can help golf courses protect the environment and preserve the natural heritage of the game.

These programs help people enhance the natural areas and wildlife habitats that golf courses provide, improve efficiency, and minimize potentially harmful impacts of golf course operations.

Golf courses can gain valuable recognition for their environmental education and certification efforts.

Best Management Practices

- Obtain and review materials to ascertain whether the facility should seek certification.
- Work with staff to establish facility goals that lead to certification.
- Establish goals to educate members about the certification program.



About the Audubon Cooperative Sanctuary Program for Golf

The Audubon Cooperative Sanctuary Program for Golf is an award winning education and certification program that helps golf courses protect our environment and preserve the natural heritage of the game of golf. By helping people enhance the valuable natural areas and wildlife habitats that golf courses provide, improve efficiency, and minimize potentially harmful impacts of golf course operations, the program serves an important environmental role worldwide.

Audubon International has developed Standard Environmental Management Practices that are generally applicable to all golf courses. These standards form the basis for ACSP for Golf certification guidelines.

Get Involved and Get Results

Getting involved is easy. Membership is open to golf courses in the United States and internationally, including private clubs, public and municipal courses, PGA sites, 9-hole facilities, resort courses, and golf residential communities. After joining the program, your next step is to take stock of environmental resources and potential liabilities, and then develop an environmental plan that fits your unique setting, goals, staff, budget, and time.

Audubon International provides a Site Assessment and Environmental Planning Form to provide guidance, as well as educational information to help you with:

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

CLICK FOR MORE INFORMATION

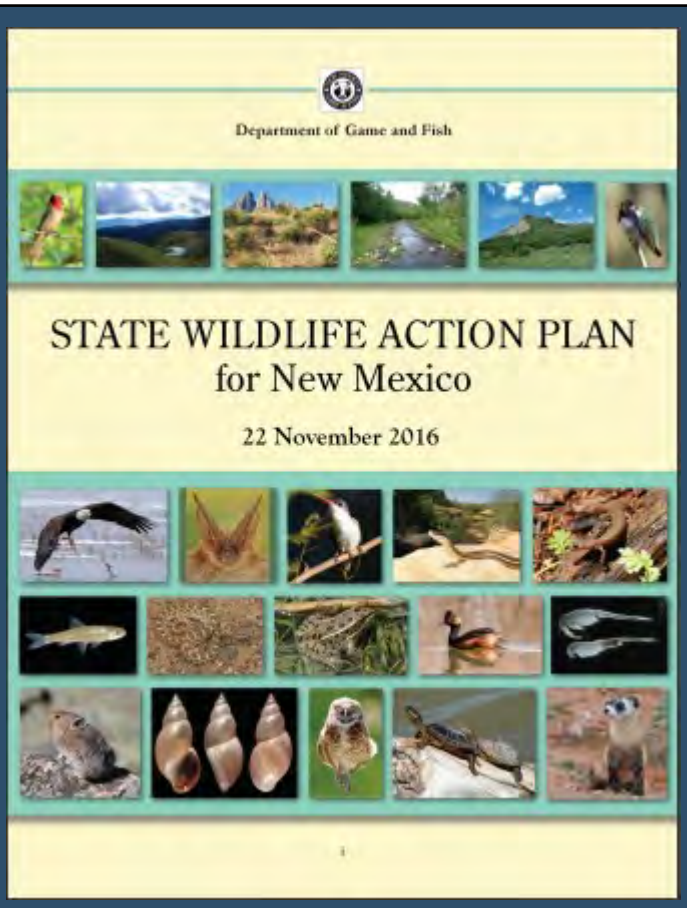
Wildlife Considerations

Principles

Golf courses occupy large land areas, generally in urban areas, providing critical links between urban and rural/natural environments.

Maintaining wildlife habitat on golf courses better maintains biological diversity, which is especially important in the urban environment.

Most golfers enjoy observing non-threatening wildlife as they play the game.



Executive Summary

New Mexico is one of the most biologically diverse states in the nation, home to over 6,000 species of animals that occupy habitats from hot deserts to alpine tundra. Maintaining the viability of every species is difficult and some have declined and are now listed as Threatened or Endangered under the Endangered Species Act.

The State Wildlife Grants (SWG) and Tribal Wildlife Grants Programs were initiated by Congress as proactive and collaborative means to keep common species common. The New Mexico Department of Game and Fish (Department) began participating in SWG in 2002, when work began on the Department's Comprehensive Wildlife Conservation Strategy (CWCS). The CWCS was approved by the US Fish and Wildlife Service (USFWS) in 2006. The CWCS and this revised State Wildlife Action Plan (SWAP) address eight required elements and fulfill SWG legislative requirements.

CLICK HERE FOR NEW MEXICO STATE WILDLIFE ACTION PLAN - 2019

WILDLIFE CONSIDERATIONS

Best Management Practices

- Identify the different types of habitat specific to the site.
- Identify the habitat requirements (food, water, cover, space) for identified wildlife species.
- Identify species on the site that are considered threatened or endangered by the federal or state government, including species the state deems “of special concern.”
- Preserve critical habitat.
- Identify and preserve regional wildlife and migration corridors.
- Design and locate cart paths to minimize environmental impacts. Construct the paths of permeable materials, if possible.
- Avoid or minimize crossings of wildlife corridors. Design unavoidable crossings to accommodate wildlife movement.
- Remove nuisance and exotic/invasive plants and replace them with native species that are adapted to a particular site.
- Maintain clearance between the ground and the lowest portion of a fence or wall to allow wildlife to pass, except in areas where feral animals need to be excluded.
- Retain dead tree snags for nesting and feeding sites, provided they pose no danger to people or property.
- Construct and place birdhouses, bat houses, and nesting sites in out-of-play areas.
- Plant butterfly gardens around the clubhouse and out-of-play areas.
- Retain riparian buffers along waterways to protect water quality and provide food, nesting sites, and cover for wildlife.
- Minimize stream or river crossings to protect water quality and preserve stream banks.
- Retain riparian buffers along waterways to protect water quality, provide food, nesting sites, and cover for wildlife.




NEW MEXICO GAME & FISH

Conserving New Mexico’s Wildlife for Future Generations

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Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 2

Irrigation

The supplemental use of water for course play and non-play areas is essential to supporting healthy turfgrass and landscape plant health. It is also necessary to sustaining optimal course playability, aesthetics, marketability, and club membership participation.

The purpose of this section is to identify best management practices related to water use that conserve and protect water resources. It is important to keep in mind that, while new technology makes many tasks easier or less labor-intensive, the principles discussed in this section are important to understand and apply to protect water quality and quantity and surrounding natural resources.

Additionally, irrigation BMP may provide an economic, regulatory compliance, and environmental stewardship advantage to those who consider them part of their irrigation management plan. BMP are not intended to increase labor or place an undue burden on the owner/superintendent. If applied appropriately, BMP can help stabilize labor cost, extend equipment life, and limit repair and overall personal and public liability.

The monetary investment in non-structural, BMP costs little to nothing to implement in a daily course water-use plan. Other advantages to using BMP include: reduced administrative management stress, improved employee communication and direction, and effective facilities training procedures.

Several benefits of adopting BMP are:

- **Conserving the water supply**
- **Protecting existing water quality**
- **Maintaining optimal ball roll and playing conditions**
- **Saving water and electricity**
- **Increasing pump and equipment life longevity**
- **Demonstrating responsible environmental stewardship**
- **Retaining knowledgeable and effective employees**

NMWCA

New Mexico Water Conservation Alliance

New Mexico Water Conservation Alliance (NMWCA) is a 501(c)(3) non-profit organization whose goal is to promote water conservation education, innovation and ideas throughout the State of New Mexico. The alliance is composed of individuals from industry, commercial, water providers and municipalities.

Water Management Approaches

Conservation and Efficiency

Conservation and efficiency considers the strategic use of appropriate course and irrigation design, plant selection, computerized and data-integrated scheduling, and alternative water quality/supply options that maximize plant health benefits and reduce the potential for negative impacts on natural resources.

Resource Protection

Resource protection is an integrated approach that includes irrigation practices as part of the course design, pesticide and nutrient practices, and regulatory compliance measures and structural measures as they concern environmental stewardship and policy.

Regulatory Considerations

Principles

Golf course owners are responsible for contacting federal, state, and local water use authorities at the pre- and post-construction phase to determine annual or specific water consumption (water rights), permitting guidelines, and other requirements allowed by regulators.

Superintendents have a responsibility to adhere to water-quality standard rules regarding groundwater and surface water flows resulting from the removal of water for irrigation use.

Best Management Practices

- Design and/or maintain a system to meet site's peak water requirements under normal conditions and also be flexible enough to adapt to various water demands and local restrictions.
- Develop an annual water budget for the golf course.
- Look for ways to increase efficiency and reduce energy use associated with irrigation systems and practices.
- Demonstrate good stewardship practices by supplementing watering only for the establishment of new planting and new sod, hand watering of critical hot spots, and watering-in of chemicals and fertilizers (if permissible).
- Protect aquatic life and impairment of water systems by adhering to state and local water withdrawal allocations (gallons/day).
- Design an irrigation system that delivers water with maximum efficiency.

New Mexico's water resources in regards to ***water quantity****, appropriation, and distribution of surface and ground waters are administered by the*

New Mexico Office of the State Engineer / Interstate Stream Commission

Water Rights Rules, Regulations & Guidelines

Water Rights Applications/Forms

Irrigation Water Suitability

Principles

Golf course designers and managers should endeavor to identify and use alternative supply sources to conserve freshwater drinking supplies, promote plant health, and protect the environment.

The routine use of potable water supply is not a preferred practice; therefore, municipal drinking water should be considered only when there is no alternative.

Studies of water supplies are recommended for irrigation systems, as are studies of waterbodies or flows on, near, and under the property. These maybe helpful to properly design a course's stormwater systems, water features, and to protect water resources.

When necessary, sodic water system treatment options should be included in the budget to address water quality and equipment maintenance.

Best Management Practices

- Use alternative water supplies/sources that are appropriate and sufficiently available to supplement water needs.
- Use salt-tolerant varieties of turf and plants to mitigate saline conditions resulting from an alternative water supply or source, if necessary.
- Amend sodic water systems appropriately (with gypsum or an appropriate ion) to minimize sodium buildup in soil.
- Flush with freshwater or use amending materials regularly to move salts out of the root zone and/or pump brackish water to keep salts moving out of the root zone.
- Monitor sodium and bicarbonate buildup in the soil using salinity sensors.
- Routinely monitor shallow groundwater table of freshwater for saltwater intrusion or contamination of heavy metals and nutrients.
- Reclaimed, effluent, and other non-potable water supply mains must have a thorough cross-connection and backflow prevention device in place and operating correctly.
- Post signage in accordance with local utility and state requirements when reclaimed water is in use.
- Account for the nutrients in effluent (reuse/reclaimed) water when making fertilizer calculations.
- Monitor reclaimed water tests regularly for dissolved salt content.
- Where practical, use reverse-osmosis filtration systems to reduce chlorides (salts) from saline groundwater.
- Monitor the quantity of water withdrawn to avoid aquatic life impairment.
- *Identify appropriate water supply sources that meet seasonal and bulk water allocations for grow-in and routine maintenance needs.*

Water Conservation and Efficient Use Planning

Principles

Document actual watering practices, especially to show savings in water use over averages. Communication should be maintained with water managers, golf course members, and the public to explain what you are doing and why.

Potable water supplies in many areas of the United States are limited, and demand continues to grow. Our challenge is to find solutions to maintain the quality of golf while using less water.

BMP and educational programs are necessary to change the public's mind-set toward the inevitable changes in water-related issues.

Some courses are being designed using a "target golf" concept that minimizes the acreage of irrigated turf. Existing golf courses can make an effort to convert out-of-play areas turf to naturally adapted native plants, grasses, or ground covers to reduce water use and augment the site's aesthetic appeal.

Best Management Practices

- Selecting drought-tolerant varieties of turfgrasses can help maintain an attractive and high-quality playing surface, while minimizing water use.
- Non-play areas may be planted with drought-resistant native or other well-adapted, noninvasive plants that provide an attractive and low-maintenance landscape.
- Native plant species are important in providing wildlife with habitat and food sources. After establishment, site-appropriate plants normally require little to no irrigation.
- The system should be operated to provide only the water that is actually needed by the plants, or to meet occasional special needs such as salt removal.
- If properly designed, rain and runoff captured in water hazards and stormwater ponds may provide supplemental water under normal conditions, though backup sources may be needed during severe drought.
- During a drought, closely monitor soil moisture levels. Whenever practicable, irrigate at times when the least amount of evaporative loss will occur.
- Control invasive plants or plants that use excessive water.

NM STATE **BE BOLD.** Shape the Future.
New Mexico State University

Efficient Irrigation for Water Conservation

The Rio Grande Basin Initiative is a joint Texas A&M University and New Mexico State University effort to improve water conservation through research and education of irrigation efficiency. It is funded by the Congress through the U.S. Department of Agriculture's Cooperative State Research, Extension and Education Service. The project is administered in Texas through the Texas Water Research Institute, and in New Mexico through the College of Agricultural, Consumer and Environmental Sciences' Water Task Force.

Click Here For Full Publication

Irrigation System Design

Principles

A well designed irrigation system should operate at peak efficiency to reduce energy, labor and natural resources.

Irrigation systems should be properly designed and installed to improve water use efficiency.

An efficient irrigation system maximizes water use, reduces operational cost, conserves supply and protects water resources.

Best Management Practices

- Design should account for optimal distribution efficiency and effective root-zone moisture coverage. Target 80% or better Distribution Uniformity (DU).
- Design should allow the putting surface and slopes and surrounds to be watered independently.
- The design package should include a general irrigation schedule with recommendations and instructions on modifying the schedule for local climatic soil and growing conditions. It should include the base ET rate for the particular location.
- The application rate must not exceed the infiltration rate, ability of the soil to absorb and retain the water applied during any one application. Conduct saturated hydraulic conductivity tests periodically.
- The design operating pressure must not be greater than the available source pressure.
- The design operating pressure must account for peak-use times and supply line pressures at final buildout for the entire system.
- The system should be flexible enough to meet a site's peak water requirements and allow for operating modifications to meet seasonal irrigation changes or local restrictions.
- Turf and landscape areas should be zoned separately. Specific use areas zoned separately; greens, tees, primary roughs, secondary roughs, fairways, native, trees, shrubs, etc.
- Design should account for the need to leach out salt buildup from poor-quality water sources by providing access to freshwater.
- Only qualified specialists should install the irrigation system.
- Construction must be consistent with the design.
- The designer must approve any design changes before construction.
- Construction and materials must meet existing standards and criteria.
- Prior to construction, all underground cables, pipes, and other obstacles must be identified and their locations flagged.
- Permanent irrigation sprinklers and other distribution devices should be spaced according to the manufacturer's recommendations.
- Space should be based on average wind conditions during irrigation.
- For variable wind directions, triangular spacing is more uniform than square spacing.
- Distribution devices and pipe sizes should be designed for optimal uniform coverage.
- The first and last distribution device should have no more than a 10% difference in flow rate. This usually corresponds to about a 20% difference in pressure.
- Distribution equipment (such as sprinklers, rotors, and micro-irrigation devices) in a given zone must have the same precipitation rate.
- Heads for turf areas should be spaced for head-to-head coverage.
- Water supply systems (for example, wells, and pipelines) should be designed for varying control devices, rain shutoff devices, and backflow prevention.
- Water conveyance systems should be designed with thrust blocks and air-release valves.
- Flow velocity must be 5 feet per second or less.
- Pipelines should be designed to provide the system with the appropriate pressure required for maximum irrigation uniformity.
- Pressure-regulating or compensating equipment must be used where the system pressure exceeds the manufacturer's recommendations.

Irrigation System Design (Cont.)
Best Management Practices

- Equipment with check valves must be used in low areas to prevent low head drainage.
- Isolation valves should be installed in a manner that allows critical areas to remain functional.
- Manual quick-coupler valves should be installed near greens, tees, and bunkers so these can be hand-watered during severe droughts.
- Install part-circle heads along lakes, ponds, and wetlands margins.
- Use part-circle or adjustable heads to avoid overspray of impervious areas such as roadways and sidewalks.
- Update multi-row sprinklers with single head control to conserve water and to enhance efficiency.
- Incorporate multiple nozzle configurations to add flexibility and enhance efficiency/distribution.
- Ensure heads are set at level ground and not on slopes.

USGA Course Care
Research You Should Know

A New Method For Irrigating Tees

Click here for video

NM STATE

Bernd Leinauer, NMSU Extension turf specialist, right, attaches two subsurface drip irrigation lines as Matteo Serena, NMSU research assistant professor, assists. They directed the installation of one of the first golf course tee box subsurface drip irrigation systems at The Club at Las Campanas in Santa Fe. They will compare two commercial drip systems to a traditional sprinkler system for water efficiency and turf quality.
(NMSU photo by Jane Moorman)

NMSU Extension turf specialist helps New Mexico golf courses save water

Drought conditions and water shortages are having an impact on all sectors of society, including recreational landscape areas. In arid and semi-arid environments across the Southwest, the golf industry is trying to find ways to conserve water while maintaining playability and course quality.

For the past five years, The Club at Las Campanas, a luxury golf community in Santa Fe, has been working on implementing water conservation strategies for its two 18-hole courses, designed by golf pro Jack Nicklaus.

Recently, club management turned to New Mexico State University's Cooperative Extension Service turf specialist Bernd Leinauer in Las Cruces for suggestions on how to resolve a lingering issue.

Click here for full article

Irrigation Pumping System

Principles

Pump stations should be sized to provide adequate flow and pressure. They should be equipped with control systems that protect distribution piping, provide for emergency shutdown necessitated by line breaks, and allow maximum system scheduling flexibility.

Variable frequency drive (VFD) pumping systems should be considered if dramatically variable flow rates are required, if electrical transients (such spikes and surges) are infrequent, and if the superintendent has access to qualified technical support.

Design pumping systems for energy conservation.

Best Management Practices

- The design operating pressure must not be greater than the available source pressure.
- The design operating pressure must account for peak-use times and supply-line pressures at final buildout for the entire system.
- Maintain the air-relief and vacuum-breaker valves by using hydraulic-pressure-sustaining values.
- Install VFD systems to lengthen the life of older pipes and fittings until the golf course can afford a new irrigation system.
- An irrigation system should also have high- and low-pressure sensors that shut down the system in case of breaks and malfunctions.
- Pumps should be sized to provide adequate flow and pressure.
- Pumps should be equipped with control systems to protect distribution piping.
- System checks and routine maintenance on pumps, valves, programs, fittings, and sprinklers should follow the manufacturer's recommendations.
- Monitor pumping station power consumption.
- Monthly bills should be monitored over time to detect a possible increase in power usage.
- Compare the power used with the amount of water pumped. Requiring more power to pump the same amount of water may indicate a problem with the pump motor(s), control valves, or distribution system.
- Quarterly checks of amperage by qualified pump personnel may more accurately indicate increased power usage and thus potential problems.


research

Golf course energy use
Part 2: Pump stations

GCM
GCSAA

Golf Course Energy Use

Part 2: Pump Stations

Click here for full article


research

Irrigation System Program and Scheduling

Principles

Irrigation scheduling must take plant water requirements and soil intake capacity into account to prevent excess water use that could lead to leaching and runoff.

Plant water needs are determined by evapotranspiration (ET) rates, recent rainfall, recent temperature extremes and soil moisture.

Irrigation should not occur on a calendar-based schedule, but should be based on ET rates and soil moisture replacement.

An irrigation system should be operated based only on the moisture needs of the turfgrass, or to water-in a fertilizer or chemical application as directed by the label.

Responsible irrigation management conserves water, reduces nutrient and pesticide movement.

Time-clock-controlled irrigation systems preceded computer-controlled systems, and many are still in use today. Electric/mechanical time clocks cannot automatically adjust for changing ET rates. Frequent adjustment is necessary to compensate for the needs of individual turfgrass areas.

Best Management Practices

- The reliability of older clock-control station timing depends on the calibration of the timing devices; this should be done periodically, but at least seasonally.
- An irrigation system should have rain sensors to shut off the system after 0.25 to 0.5 inch of rain is received. Computerized systems allow a superintendent to call in and cancel the program if it is determined that the course has received adequate rainfall.
- Install control devices to allow for maximum system scheduling flexibility.
- Generally, granular fertilizer applications should receive 0.25 inch of irrigation to move the particles off the leaves while minimizing runoff.
- Irrigation quantities should not exceed the available moisture storage in the root zone.
- Irrigation rates should not exceed the maximum ability of the soil to absorb and hold the water applied at any one time.
- Irrigation schedule should coincide with other cultural practices (for example, the application of nutrients, herbicides, or other chemicals).
- Account for nutrients in effluent supply when making fertilizer calculations.
- Irrigation should occur in the early morning hours before air temperatures rise and relative humidity drops.
- Base plant water needs should be determined by ET rates, recent rainfall, recent temperature extremes, and soil moisture.
- Use mowing, verticutting, aeration, nutrition, and other cultural practices to control water loss and to encourage conservation and efficiency.
- Visually monitor for localized dry conditions or hot spots to identify poor irrigation efficiency or a failed system device.
- Use predictive models to estimate soil moisture and the best time to irrigate.
- Avoid use of a global setting; make adjustments to watering times per head.
- Base water times on actual site conditions for each head and zone.
- Adjust irrigation run times based on current local meteorological data.
- Use computed daily ET rate to adjust run times to meet the turf's moisture needs.
- Manually adjust automated ET data to reflect wet and dry areas on the course.
- Use soil moisture sensors to assist in scheduling or to create on-demand irrigation schedules.

- Use multiple soil moisture sensors to reflect soil moisture levels.
- Install soil moisture sensors in the root zone for each irrigation zone to enhance scheduled timer-based run times.
- Place soil moisture sensors in a representative location within the irrigation zone. Install a soil moisture sensor in the driest irrigation zone of the irrigation system.
- Wired soil moisture systems should be installed to prevent damage from aerification.
- Periodically perform catch-can uniformity tests.
- Reducing dry spots and soil compaction improves water infiltration, which in turn reduces water use and runoff in other areas.
- Install emergency shutdown devices to address line breaks.

Los Robles Greens in California expects to use 25 percent less water as a result of its turf reduction program

GOLF COURSE ARCHITECTURE

THE GLOBAL JOURNAL OF GOLF DESIGN AND DEVELOPMENT

How better irrigation management can save water

Of all golf's environmental challenges, its use of water is without doubt the most important and urgent. That might seem odd for a game that grew up in a country as wet as Scotland, but the spread of golf around the world has put courses in many areas where water is precious, some where it is even in desperately short supply. And, as the hotter the climate, the more water is typically needed to keep the golf course alive, there is an inevitable clash.

Golf de Vidauban in France, profiled later in this issue, is a classic example of a course that almost ceased to exist because of water issues, and the truth is that there are likely to be many more in years to come.

Click here for full article

Turf Drought Response

Principles

The presence of visual symptoms of moisture stress is a simple way to determine when irrigation is needed.

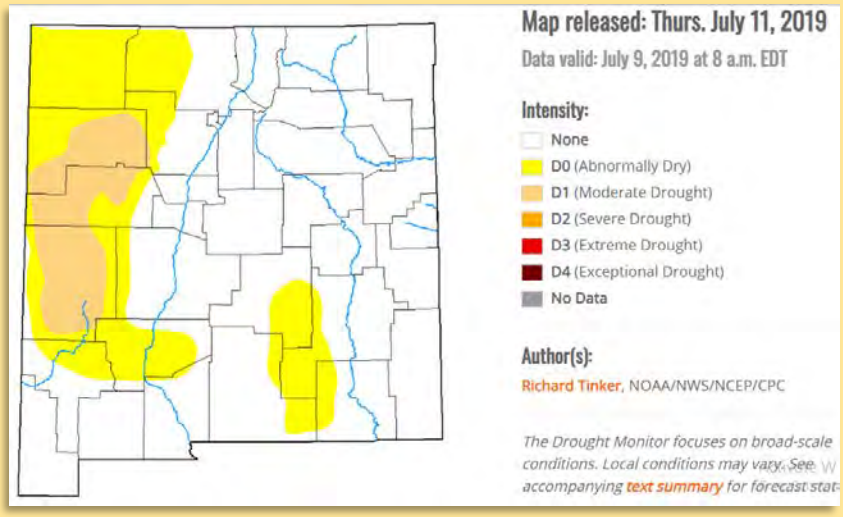
Use a soil moisture meter to determine moisture needs of greens and tees.

Managers of golf greens cannot afford to wait until symptoms occur, because unacceptable turf quality may result.

Be prepared for extended drought/restrictions by developing a written drought management plan.

Best Management Practices

- Waiting until visual symptoms appear before irrigating is a method best used for low-maintenance areas, such as golf course roughs and, possibly, fairways.
- Use soil moisture meters to determine moisture thresholds and plant needs.
- Irrigating too shallowly encourages shallow rooting, increases soil compaction, and favors pest outbreaks.
- For golf greens and tees, the majority of roots are in the top several inches of soil.
- For fairways and roughs, use infrequent, deep irrigation to supply sufficient water for plants and to encourage deep rooting.
- Proper cultural practices such as mowing height, irrigation frequency, and irrigation amounts should be employed to promote healthy, deep root development and reduce irrigation requirements.
- Create a drought management plan for the facility that identifies steps to be taken to reduce irrigation/water use and protects critical areas, etc.
- Use appropriate turfgrass species adapted to the location of the golf course being managed.



The U.S. Drought Monitor is a map released every Thursday, showing parts of the U.S. that are in drought. The map uses five classifications: abnormally dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought: moderate (D1), severe (D2), extreme (D3) and exceptional (D4).

What agencies or organizations are responsible for the USDM? The Drought Monitor has been a team effort since its inception in 1999, produced jointly by the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of Agriculture (USDA). The NDMC hosts the web site of the drought monitor and the associated data, and provides the map and data to NOAA, USDA and other agencies. **It is freely available at droughtmonitor.unl.edu.**

Irrigation System Quality

Principles

Irrigation system maintenance on a golf course involves four major efforts: calibration or auditing, preventive maintenance (PM), corrective maintenance, and record keeping.

Personnel charged with maintaining any golf course irrigation system face numerous challenges. This is particularly true for courses with older or outdated equipment.

Good system management starts with good preventive maintenance (PM) procedures and recordkeeping. Maintaining a system is more than just fixing heads.

Corrective maintenance is simply the act of fixing what is broken. It may be as simple as cleaning a clogged orifice, or as complex as a complete renovation of the irrigation system.

As maintenance costs increase, the question of whether to renovate arises. Renovating a golf course irrigation system can improve system efficiencies, conserve water, improve playability, and lower operating costs.

Best Management Practices

- Respond to day-to-day failures in a timely manner, maintain the integrity of the system as designed, and keep good records.
- System checks and routine maintenance on pumps, valves, programs, fittings, and sprinklers should follow the manufacturer's recommendations.
- The system should be inspected daily for proper operation by checking computer logs and visually inspecting the pump station, remote controllers, and irrigation heads. A visual inspection should be carried out for leaks, misaligned or inoperable heads, and chronic wet or dry spots, so that adjustments can be made.
- Systems need to be observed in operation at least weekly. This can be done during maintenance programs such as fertilizer or chemical applications where irrigation is required, or the heads can be brought online for a few seconds and observed for proper operation. This process detects controller or communications failures, stuck or misaligned heads, and clogged or broken nozzles.
- Check filter operations frequently. An unusual increase in the amount of debris may indicate problems with the water source.
- Even under routine conditions, keeping filters operating properly prolongs the life of an existing system and reduces pumping costs.
- Keep records of filter changes, as this could be an early sign of system corrosion, well problems, or declining irrigation water quality.
- Application/distribution efficiencies should be checked annually. Implement a PM program to replace worn components before they waste fertilizer, chemicals, and water.
- Conduct a periodic professional irrigation audit at least once every five years.
- Document equipment run-time hours. Ensure that all lubrication, overhauls, and other preventive maintenance are completed according to the manufacturer's schedule.
- Gather together all of the documentation collected as part of the PM program, along with corrective maintenance records for analysis.
- Correctly identifying problems and their costs helps to determine what renovations are appropriate.
- Collecting information on the cost of maintaining the system as part of system overall evaluation, allows for planning necessary upgrades, replacement etc. and to compare after changes are made

Strategies to Reduce Water Use: Case Studies from the Southwestern United States

Brian Whitlark USGA Green Section

This article highlights water conservation strategies used by turf managers in the southwestern United States. Practical examples include irrigation redesign and upgrading nozzle technology, modifying irrigation programming, improving soil properties, utilizing new soil moisture sensing technologies and converting to recycled water.

Click here for full article

Figure 3. Utilizing soil improvement methods such as with deep tine aeration can reduce runoff and improved soil water infiltration.

Figure 1. A mini–triangulation system was developed to protect the true location of each sprinkler in the field.

Pond Location and Design

Principles

Understanding natural lake processes and accommodating them in the design and management of a pond can create significant aesthetic value and reduce operational costs.

Lakes and ponds have several distinct defining characteristics. Their size, shape, and depth may all affect how they respond to various environmental inputs.

Most golf courses plan their lakes and water hazards to be a part of the stormwater control and treatment system. This usually works well for all concerned. However, natural waters may not be considered treatment systems and must be protected.

Lakes and ponds may be used as a source of irrigation water. It is important to consider these functions when designing and constructing the ponds.

Careful design may significantly reduce future operating expenses for lake and aquatic plant management.

Best Management Practices

- Consult with a qualified golf course architect, working in conjunction with a stormwater engineer, to develop an effective stormwater management system that complies with the requirements of the water management district/department or other permitting agency.
- When constructing drainage systems, pay close attention to engineering details such as subsoil preparation, the placement of gravel, slopes, and backfilling.
- Where practical, internal golf course drains should discharge through pretreatment zones and/or vegetative buffers to help remove nutrients and sediments.
- Studies of water supplies are needed for irrigation systems, and studies of waterbodies or flows on, near, and under the property are needed to properly design a course's stormwater systems and water features, and to protect water resources.
- Peninsular projections and long, narrow fingers into ponds may prevent water mixing. Ponds that are too shallow may reach high temperatures, leading to low oxygen levels and promoting algal growth and excess sedimentation.
- In shallow or nutrient-impacted ponds, the use of aeration equipment may be required to maintain acceptable dissolved oxygen (DO) levels in the water.

Pond Use and Maintenance

Principles

Successful pond management should include a clear statement of goals and priorities to guide the development of the BMP necessary to meet those goals. Some of the challenges facing superintendents in maintaining the quality of golf course ponds are as follows:

- Low DO
- Sedimentation
- Changes in plant populations
- Nuisance vegetation
- Maintenance of littoral shelves
- Vegetation on the lakeshore

Each pond has regions or zones that significantly influence water quality and are crucial in maintaining the ecological balance of the system. It is important for the manager to understand their function and how good water quality can be maintained if these zones (riparian zone, littoral zone, limnetic zone, and benthic zone) are properly managed.

Surface water sources can present problems with algal and bacteria growth. Algal cells and organic residues of algae can pass through irrigation system filters and form aggregates that may plug emitters.

Pond leaks should be controlled and managed properly.

Use an expert in aquatic management to help develop and monitor pond management programs.

USGA®

COURSE CARE

Pond Management

This USGA Green Section Collection was assembled to supplement the June 3, 2016 issue of the USGA *Green Section Record* (vol. 54, issue 11) and provides material on managing golf course water features. The materials in this collection are not all-inclusive but provide insight into sustainable management practices for water features.

[Common And Troublesome Weeds Of Golf Course Ponds]

[Golf Course Water Features Need Management]

[Littorally Speaking]

[Much To Do About Wetlands]

[Dredging Up A New Idea]

[Managing Runoff With Constructed Wetlands]

[Selecting An Aerator To Enhance Water Circulation]

[Habitat Value of Golf Course Wetlands To Waterbirds]

[Buffer Strips, Runoff, and Leachate]

[Pond Aeration]

[What Is A Buffer?]

Pond Use and Maintenance Best Management Practices

- Use leak controls in the form of dike compaction, natural-soil liners, soil additives, commercial liners, drain tile, or other approved methods.
- Maintain a riparian buffer to filter the nutrients and sediment in runoff.
- Reduce the frequency of mowing at the lake edge and collect or direct clippings to upland areas.
- Prevent overthrowing fertilizer into ponds. Practice good fertilizer management to reduce nutrient runoff into ponds, which causes algae blooms and ultimately reduces DO levels.
- Establish a special management zone around pond edges.
- Dispose of grass clippings where runoff will not carry them back to the lake.
- Encourage clumps of native emergent vegetation at the shoreline.
- Maintain water flow through lakes, if they are interconnected.
- Establish wetlands where water enters lakes to slow water flow and trap sediments.
- Maintain appropriate silt fencing and BMP on projects upstream to reduce erosion and the resulting sedimentation.
- Manipulate water levels to prevent low levels that result in warmer temperatures and lowered DO levels.
- Aerate ponds and dredge or remove sediment before it becomes a problem.

Click for full article

Managing golf course ponds, lakes without traditional herbicides

Discover proactive strategies and some of the latest technologies for keeping your course's water bodies stable, eye-pleasing and odor-free.

Benjamin Chen

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Learn more about this topic on the [SOLitude Lake Management website](#).

Common and Troublesome Weeds of Golf Course Ponds

Aquatic plants are familiar and beneficial components of pond systems. However, too much of a good thing can present management challenges.

BY ROB RICHARDSON

It has been said that the two types of ponds are those that have weeds and those that will have weeds. Small ponds are a great environment for nuisance aquatic plant growth because they typically have a high proportion of shallow areas that can easily be invaded by aquatic weeds. Generally, small ponds also collect nutrients and receive high levels of sunlight, providing aquatic plants everything they need to survive and thrive. Many aquatic plants can be found in ponds, so correctly identifying aquatic plant species is critical to developing a management strategy. The species below are some of the most common and troublesome aquatic plants found across the different regions of the U.S.

FILAMENTOUS ALGAE

Algae are found almost everywhere around the world, and there are an abundance of algal species in almost every pond. For management purposes, algae usually are grouped into categories: planktonic, filamentous, and macroalgae. The filamentous algae are more troublesome in most ponds and generally more difficult to control. Algae can rapidly grow, doubling their biomass in as few as two or three days. Filamentous algae can grow either on the bottom or surface of a pond and form sheets, clumps, mats, or other aggregations. There are a large number of filamentous algal species that can be troublesome, so proper species identification is important when selecting the most appropriate management strategy.

Limiting nutrient inputs is the best long-term strategy for controlling filamentous algae. Reduce direct nutrient inputs like grass clippings, leaves, and

A bloom of filamentous algae can create dense, unsightly mats on the surface of golf course ponds.

Filamentous algae can cause a variety of problems for golf course ponds, with aesthetic concerns being among the most significant issues.

Golf Course Water Features Need Management

Well-designed water features that receive basic management will attract more than errant golf shots.

BY JIM SKORULSKI

While traveling across New England, I come across good, bad, and downright ugly ponds and lakes. The good ponds appear to be healthy, vibrant systems that serve many functions while complementing the landscape. On the other hand, bad ponds and lakes may be functional but are usually disfigured with deteriorating banks and seasonal algae and weed problems. The design of ugly lakes and ponds is often about as inspiring as stock farm ponds (no offense to stock-farm-pond owners who may read this).

How do water features at your facility rate? Are they assets or liabilities to your facility? What level of management do they receive? This article provides an overview of typical golf course water features, including techniques and practices that are used to evaluate and manage them.

POND ECOLOGY

Ponds are complex, living systems composed of bacteria, algae, plants, insects, amphibians, crustaceans, fish, and mammals. Bacteria and algae are the most abundant organisms and most important components of pond ecosystems. Bacteria act as decomposers in aquatic systems and break down organic substrate into inorganic material. Most bacteria require oxygen to survive, but some, the anaerobic bacteria, actually thrive in the absence of oxygen. Algae are mostly microscopic, single-celled or multicelled, plant-like organisms found floating in the water or attached to substrate. There are many species of algae in pond and lake systems. Furthermore, algae are the primary food producers in aquatic systems. Similar to vascular plants, algae consume carbon dioxide

The staff cuts and pulls phragmites, or the common reed, from the edge of a golf course pond to slow the spread of the invasive weed and encourage the growth of native emergent plants.

Filamentous green algae extends to the surface of this shallow pond. Increasing the pond depth, circulating the water, and creating a vegetative buffer around the pond edges could help reduce the nutrients available to the algae and produce a more pleasing and natural-looking body of water.

Vegetated littoral zones improve water quality and can be attractive features.

Littorally Speaking

Littoral zones play an important role in the health of lakes and ponds

BY TODD LOWE

Lakes and ponds are important features on golf courses. In addition to providing strategic value on golf holes, lakes enhance golf course aesthetics and create habitats for wildlife. Some might feel that a green, grassy lake bank that slopes down to a clear body of water is the ideal standard. Some may feel that aquatic plants create a "dirty" look along a shoreline and make it difficult to find lost balls. However, aquatic plants can be an important component of water bodies, and certain aquatic plant species should be encouraged.

While some golf course ponds are natural, many are man-made impoundments that are designed to capture and treat runoff from surrounding communities. Stormwater ponds help filter pollutants like heavy metals from automobiles, salts, fecal matter from animals, and sediments from entering the local watershed. The littoral zone of a lake is the shallow area nearest the shore where enough sunlight penetrates the water to provide aquatic

Pond Water-Level Monitor

Principle

Evaporation losses are higher in some regions than others and vary from year to year and within the year. However, evaporative losses could approach 6 inches per month during the summer. Aquatic plants are more difficult to control in shallow water.

Best Management Practices

- A pond should hold surplus storage of at least 10 percent of full storage.
- Provide an alternative source for ponds that may require supplemental recharge from another water source such as a well during high-demand periods.
- Estimated losses from evaporation and seepage should be added to the recommended depth of the pond.

Metering

Principles

Rainfall may vary from location to location on a course; the proper use of rain gauges, rain shut-off devices, flow meters, soil moisture sensors, and/or other irrigation management devices should be incorporated into the site's irrigation schedule.

It is also important to measure the amount of water that is actually delivered through the irrigation system, via a water meter or a calibrated flow-measurement device.

Knowing the flow or volume will help determine how well the irrigation system and irrigation schedule are working.

Best Management Practices

- Calibrate equipment periodically to compensate for wear in pumps, nozzles, and metering systems.
- Properly calibrated flow meters, soil moisture sensors, rain shut-off devices, and/or other automated methods should be used to manage irrigation.
- Flow meters should have a run of pipe that is straight enough — both downstream and upstream — to prevent turbulence and bad readings.
- Flow meters can be used to determine how much water is applied.

Irrigation Leak Detection

Principle

Irrigation systems are complex systems that should be closely monitored to ensure leaks are quickly detected and corrected.

Golf courses without hydraulic pressure-sustaining valves are much more prone to irrigation pipe and fitting breaks because of surges in the system, creating more downtime for older systems. A good preventive maintenance program is very important.

Best Management Practices

- Monitor water meters or other measuring devices for unusually high or low readings to detect possible leaks or other problems in the system. Make any needed repairs.
- An irrigation system should also have high- and low-pressure sensors that shut down the system in case of breaks and malfunctions.
- The system should be monitored daily for malfunctions and breaks. It is also a good practice to log the amount of water pumped each day.
- Document and periodically review the condition of infrastructure (such as pipes, wires, and fittings). If the system requires frequent repairs, determine why these failures are occurring. Pipe failures may be caused not only by material failure, but also by problems with the pump station.
- Ensure that control systems provide for emergency shutdowns caused by line breaks, and allow maximum system scheduling flexibility.

Sprinkler Maintenance

Principles

Good system management starts with good preventive maintenance (PM) procedures and record keeping. This can be done during maintenance programs such as fertilizer or chemical applications where irrigation is required, or the heads can be brought on-line for a few seconds and observed for proper operation.

Maintaining a system is more than just fixing heads. It also includes documenting system- and maintenance-related details so that potential problems can be addressed before expensive repairs are needed. It also provides a basis for evaluating renovation or replacement options.

Be proactive; if the system requires frequent repairs, it is necessary to determine why these failures are occurring.

- Pipe failures may be caused not only by material failure, but also by problems with the pump station.
- Wiring problems could be caused by corrosion, rodent damage, or frequent lightning or power surges.
- Control tubing problems could result from poor filtration.

Best Management Practices

- System checks and routine maintenance on pumps, valves, programs, fittings, and sprinklers should follow the manufacturer's recommendations.
- The system should be inspected routinely for proper operation by checking computer logs and visually inspecting the pump station, remote controllers, and irrigation heads.
- A visual inspection should be carried out for leaks, misaligned or inoperable heads, and chronic wet or dry spots, so that adjustments can be made or replaced.
- Flush irrigation lines regularly to minimize emitter clogging. To reduce sediment buildup, make flushing part of a regular maintenance schedule. If fertigating, prevent microbial growth by flushing all fertilizer from the lateral lines before shutting down the irrigation system.
- Clean and maintain filtration equipment.

Systems must be observed in operation at least weekly. This process detects controller or communication failures, stuck or misaligned heads, and clogged or broken nozzles.

- Check filter operations frequently. An unusual increase in the amount of debris may indicate problems with the water source.
- Even under routine conditions, keeping filters operating properly prolongs the life of an existing system and reduces pumping costs.
- Keep records of filter changes, as this could be an early sign of system corrosion, well problems, or declining irrigation water quality.
- Application/distribution efficiencies should be checked annually. Conduct a periodic professional irrigation audit at least once every five years. Implement a PM program to replace worn components before they waste fertilizer, chemicals, and water.
- Document equipment run-time hours.
- Ensure that all lubrication, overhauls, and other preventive maintenance are completed according to the manufacturer's schedule.
- Monitor pump station power consumption. Monthly bills should be monitored over time to detect a possible increase in power usage. Compare the power used with the amount of water pumped. Requiring more power to pump the same amount of water may indicate a problem with the pump motor(s), control valves, or distribution system. Quarterly checks of amperage by qualified pump personnel may more accurately indicate increased power usage and thus potential problems.
- Monitor and record the amount of water being applied, including system usage and rainfall. By tracking this information, you can identify areas where minor adjustments can improve performance. Not only is this information essential in identifying places that would benefit from a renovation, but it is also needed to compute current operating costs and compare possible future costs after a renovation.
- Document and periodically review the condition of infrastructure (such as pipes, wires, and fittings).

When Is It Time To Replace An Irrigation System?

There is never a good time to replace an irrigation system, but when the cost of not replacing it becomes high enough . . . it's time.

BY PATRICK J. GROSS

USGA

System Maintenance

Principles

Course owners/superintendents do routine maintenance to ensure water quality and responsible use of the water supply.

System checks and routine maintenance include: pumps, valves, programs, fittings, and sprinklers.

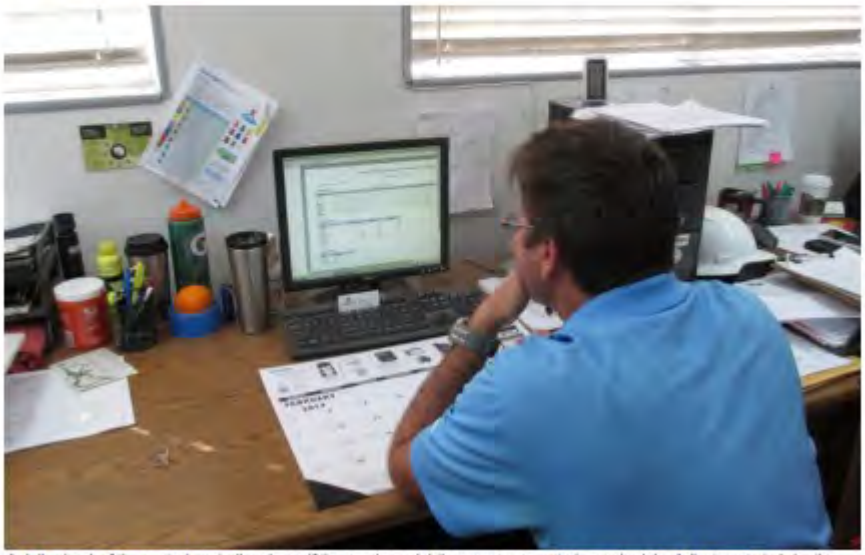
To ensure that it is performing as intended, an irrigation system should be calibrated regularly by conducting periodic irrigation audits to check actual water delivery and nozzle efficiency.

- power usage that indicates potential problems.
- Monitor and record the amount of water being applied, including system usage and rainfall. By tracking this information, you can identify areas where minor adjustments can improve performance.
- Document and periodically review the condition of infrastructure (such as pipes, wires, and fittings). If the system requires frequent repairs, it is necessary to determine why these failures are occurring.
- Increase frequency of routine inspection/calibration of soil moisture sensors that may be operating in high-salinity soils.
- Winterize irrigation system to prevent damage.

Developing a Preventive Maintenance Checklist for Golf Course Irrigation Systems

Proper maintenance can reduce labor and materials costs and may also help save water and energy while improving playing conditions.

BY BRIAN VINCHESI



A daily check of the central controller shows if the previous night's program operated on schedule. Adjustments to irrigation run times also can be made before the next irrigation cycle.

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Irrigation systems are an integral part of golf course maintenance, just like maintenance staff, mowing equipment, and maintenance facilities. Without a functional irrigation system, it is virtually impossible to maintain golf course turf in playable condition. However, while mowers and other equipment are regularly seen working on a golf course, irrigation systems are a mystery to many golfers because they are buried underground and most frequently operate at night. Therefore, it can be difficult for golfers to understand that irrigation systems wear out and are very expensive to replace. A new irrigation system can cost $1.5 million or more, depending on location and complexity. Not surprisingly, most golf courses try to avoid this expense for as long as possible, especially since the true value of an irrigation system often is not fully understood.

Golf course irrigation systems can quickly deteriorate from lack of maintenance. Irrigation system maintenance is primarily reactive at most golf courses — i.e., when a component of the irrigation system breaks or is not properly working, an irrigation technician or assistant superintendent is dispatched to make repairs.

Continued on next page

System Maintenance Best Management Practices

- Irrigation audits should be performed by trained technicians.
- A visual inspection should first be conducted to identify necessary repairs or corrective actions. It is essential to make repairs before carrying out other levels of evaluation.
- Pressure and flow should be evaluated to determine that the correct nozzles are being used and that the heads are performing according to the manufacturer's specifications.
- Pressure and flow rates should be checked at each head to determine the average application rate in an area.
- Catch-can tests should be run to determine the uniformity of coverage and to accurately determine irrigation run times.
- Catch-can testing should be conducted on the entire golf course to ensure that the system is operating at its highest efficiency.
- Conduct an irrigation audit annually to facilitate a high-quality maintenance and scheduling program for the irrigation system.
- Inspect for interference with water distribution.
- Inspect for broken and misaligned heads.
- Check that the rain sensor is present and functioning.
- Inspect the backflow device to determine that it is in place and in good repair.
- Examine turf quality and plant health for indications of irrigation malfunction or needs for scheduling adjustments.
- Schedule documentation; make adjustments and repairs on items diagnosed during the visual inspection before conducting pressure and flow procedures.

Sprinklers should be checked every week to ensure that they properly pop up, turn, and retract. Check that they rotate at the correct speed and that they are not leaking.

Sprinkler nozzles should be checked frequently for clogs and wear. Also, ensure that the proper nozzles are installed in each sprinkler.

Turf can grow over sprinklers and disrupt irrigation coverage, especially in rough and naturalized areas. Check and trim turf around sprinklers every month.

Continued from previous page

Preventive maintenance can reduce the amount of reactive maintenance and improve playing conditions. Developing a preventive maintenance program is the best way to extend the life of an irrigation system, maintain performance, and minimize the severity and frequency of problems.

Preventive maintenance programs must be customized to meet the unique needs of an irrigation system, and they should be based on a thorough check of the system and its components. As with any preventive maintenance regime, some tasks will need to be accomplished on a daily, weekly, or monthly basis, while others may require attention quarterly, semiannually, or annually. Of course, while preventive maintenance reduces irrigation system problems, it does not eliminate some tasks that must be completed on an as-needed basis.

So, what does a preventive maintenance program look like for the irrigation system at your golf course? It depends on the type of irrigation equipment and its age, but a typical program includes the observation, adjustment, and maintenance at regular intervals of sprinklers, valves, controllers, pump systems, and other components. The following sections of this article can be used to create a customized preventive maintenance checklist for any irrigation system.

Click here for full article

System Maintenance
Best Management Practices

Preventive Maintenance

♦ In older systems, inspect irrigation pipe and look for fitting breaks caused by surges in the system.

♦ Install thrust blocks to support conveyances.

The system should be inspected daily for proper operation by checking computer logs and visually inspecting the pump station, remote controllers, and irrigation heads. A visual inspection should be carried out for leaks, misaligned or inoperable heads, and chronic wet or dry spots so that adjustments can be made.

♦ Maintain air-relief and vacuum-breaker valves.

♦ Systems need to be observed in operation at least weekly to detect controller or communication failures, stuck or misaligned heads, and clogged or broken nozzles.

♦ Check filter operations frequently; keeping filters operating properly prolongs the life of an existing system and reduces pumping costs.

♦ Keep records of filter changes, as this could be an early sign of system corrosion, well problems, or declining irrigation water quality.

♦ Application/distribution efficiencies should be checked annually.

♦ Conduct a periodic professional irrigation audit at least once every five years.

♦ Document equipment run-time hours. Ensure that all lubrication, overhauls, and other preventive maintenance are completed according to the manufacturer's schedule.

♦ Monitor the power consumption of pump stations for problems with the pump motors, control valves, or distribution system.

♦ Qualified pump personnel should perform quarterly checks of amperage to accurately identify increased power usage that indicates potential problems.

♦ Monitor and record the amount of water being applied, including system usage and rainfall. By tracking this information, you can identify areas where minor adjustments can improve performance.

♦ Document and periodically review the condition of infrastructure (such as pipes, wires, and fittings). If the system requires frequent repairs, it is necessary to determine why these failures are occurring.

♦ Increase frequency of routine inspection/calibration of soil moisture sensors that may be operating in high-salinity soils.

♦ Winterize irrigation system to prevent damage.

Corrective Maintenance

Replace or repair all broken or worn components before the next scheduled irrigation.

♦ Replacement parts should have the same characteristics as the original components.

♦ Record keeping is an essential practice; document all corrective actions.

Irrigation System Preventive Maintenance

Irrigation systems are a bit of a mystery to most golfers – some components such as sprinklers, valve boxes and field satellite controllers are aboveground and easy to see, but most of the infrastructure is buried underground or placed in areas that do not come into play. In addition, you probably seldom see the irrigation system running because most irrigation occurs overnight. It might be surprising to learn, but modern golf course irrigation systems can consist of 2,500 sprinklers, 300 hundred miles of underground wire and can cost $1.5 million or more to install or replace. Visible or not, routine maintenance is essential to keep irrigation systems operational so that high-quality playing conditions can be maintained.

Droughts, an increasing emphasis on water conservation and the goal of providing the best possible playing conditions has superintendents taking a closer look at their irrigation systems to make sure that water is being efficiently applied. Irrigation breakdowns often occur during the hottest and driest times of year, which can result in a rapid decline in playing conditions if repairs take a few days. Identifying problems early with a sound preventive maintenance program helps limit breakdowns and maintain quality playing conditions. Other benefits of a preventive maintenance program include:

* Water conservation.
* Prevent catastrophic failures.
* Reduced energy consumption.
* Maintain irrigation efficiency.
* Prolong the life of an irrigation system and reduces long-term costs.

Click here for full article

System Maintenance
Best Management Practices

System Renovation

- Appropriate golf course renovations can improve system efficiencies, conserve water, improve playability, and lower operating costs.
- Correctly identify problems and their cost to determine which renovations are appropriate.
- Determine the age of the system to establish a starting point for renovation.
- Identify ways to improve system performance by maximizing the efficient use of the current system.
- Routinely document system performance to maximize the effectiveness of the renovation.
- Evaluate cost of renovation and its return on benefits both financial and management.

American Society of Golf Course Architects

Making Your Case For An Irrigation Renovation

Kenne James, Senior Marketing Manager, Golf Irrigation International Business, The Toro Company

The life expectancy of a typical irrigation system varies from 10 to 30 years, depending on the geographic location of the course and the demands on the system. Good preventive maintenance can extend a system's longevity, but sooner or later, your irrigation will need to be renovated or replaced. Then what? As the course superintendent, you know better than anyone when it's time for new irrigation. Maybe you've been struggling with an outdated system for years, and now you're finally ready to approach your greens committee about renovating.

However, even though you know first-hand how serious the situation has become, your board members and club officials probably don't . . . which is actually a compliment to you! If you've done a great job of maintaining the course's aesthetics and playability in spite of a poor irrigation system, other people might not even suspect the problem exists!

Demonstrating The Need
If the true condition of an aging or substandard irrigation system isn't obvious to your greens committee or board members, it's up to you to make them aware of it.

Answering Financial Questions
Once you convince your club of the need to renovate, then comes the issue of cost.

Addressing Logistics
After financial issues, usually the next big question is about members' ability to play the course during system renovation.

Reaping the Rewards
The process of renovating an irrigation system may take a lot of time, documentation and other legwork, but the end result is well worth the effort.

Renovating an out-of-date system will not only improve your efficiency, provide better-quality turfgrass and enhance aesthetics it can also give your course a competitive advantage. And as golf courses continue to vie for more members and rounds that might be the biggest benefit of all.

Click here for full article

Winterization and Spring Startup

Principle

Winterization of the irrigation system is important to protect the system and reduce equipment failures resulting from freezing.

Best Management Practices

- Conduct a visual inspection of the irrigation system: inspect for mainline breaks, low pressure at the pump, and head-to-head spacing.
- Conduct a catch-can test to audit the system.
- Flush and drain above-ground irrigation system components that could hold water.

Remove water from all conveyances and supply and distribution devices that may freeze with compressed air or open drain plugs at the lowest point on the system.

- Clean filters, screens, and housing; remove drain plug and empty water out of the system.
- Secure systems and close and lock covers/ compartment doors to protect the system from potential acts of vandalism and from animals seeking refuge.
- Remove drain plug and drain above-ground pump casings.
- Record metering data before closing the system.
- Secure or lock irrigation components and electrical boxes.
- Perform pump and engine servicing/repair before winterizing.
- Recharge irrigation in the spring with water and inspect for corrective maintenance issues.
- Ensure proper irrigation system drainage design.

NM Climate Center - Click Here

Office of the New Mexico State Climatologist - This website provides weather and climate information to our community members. Included are the most current observations from the ZiaMet weather station network, the current CoCoRaHS precipitation map, and the US Drought Monitor map for New Mexico.

Sensor Technology

Principles

To prevent excess water use, irrigation scheduling should take into account plant water requirements, recent rainfall, recent temperature extremes, and soil characteristics.

Irrigation management and control devices need to be installed correctly for proper irrigation management.

Soil moisture sensors and other irrigation management tools should be installed in representative locations and maintained to to provide the information necessary for making good irrigation management decisions.

Rain gauges are necessary measurement tools to track how much rain has fallen at a specific site on the golf course. On some courses, more than one station may be necessary to get a complete measure of rainfall or evaporation loss. The use of soil moisture probes and inspections for visual symptoms such as wilting turf, computer models, and tensiometers may supplement these measurements. Computerized displays are available to help visualize the system.

Predictive models based on weather station data and soil types are also available. These are relatively accurate and applicable, especially as long-term predictors of annual turf water requirements.

Weather data such as rainfall, air and soil temperature, relative humidity, and wind speed are incorporated into certain model formulas, and soil moisture content is estimated. Models, however, are only as effective as the amount of data collected and the number of assumptions made.

It is best to have an on-site weather station to daily access weather information and ET to determine site specific water needs.

Best Management Practices

- Irrigation controllers/timers should be reset as often as practically possible to account for plant growth requirements and local climatic conditions.
- Properly calibrated flow meters, soil moisture sensors, rain shut-off devices, and/or other automated methods should be used to manage irrigation.
- Irrigation rates should not exceed the maximum ability of the soil to absorb and hold the water applied in any one application.
- Irrigation should not occur on a calendar-based schedule, but should be based on ET rates and soil moisture replacement.
- Computerized control systems should be installed on all new course irrigation systems to help ensure efficient irrigation application. These allow for timing adjustments at every head.
- Rain shut-off devices and rain gauges should be placed in open areas to prevent erroneous readings.
- Use multiple soil moisture sensors/meters for accuracy and to reflect soil moisture levels.

NRCS Soil Climate Analysis Network

Click Here

Maintained Turf Areas

Principle

Courses should use well-designed irrigation systems with precision scheduling based on soil infiltration rates, soil water-holding capacity, plant water-use requirements, the depth of the root zone, and the desired level of turfgrass appearance and performance in order to maximize efficient watering.

Best Management Practices

The irrigation system should be designed and installed so that the putting surface, slopes, and surrounding areas can be watered independently.

- Account for nutrients in effluent supply when making fertilizer calculations.
- Install part-circle heads that conserve water and reduce unnecessary stress to greens and surrounds.
- Avoid use of a global setting; make adjustments to watering times per head.
- Base water times on actual site conditions for each head and zone.
- Adjust irrigation run times based on current local meteorological data.
- Use computed daily ET rate to adjust run times to meet the turf's moisture needs.
- Manually adjust automated ET data to reflect wet and dry areas on the course.
- Install rain switches to shut down the irrigation system if enough rain falls in a zone.
- Use soil moisture sensors to bypass preset or to create on-demand irrigation schedules.
- Permanent irrigation sprinklers and other distribution devices should be spaced according to the manufacturer's recommendations.
- Spacing should be based on average wind conditions during irrigation.
- Triangular spacing is more uniform than square spacing.
- Periodically perform catch-can uniformity tests.
- Reducing dry spots and soil compaction improves water infiltration, which in turn reduces water use and runoff in other areas.
- Irrigation should occur in the early morning hours before air temperatures rise and relative humidity drops.
- Base plant water needs on evapotranspiration rates, recent rainfall, recent temperature extremes and soil moisture.
- Use mowing, verticutting, aeriation, wetting agents, nutrition, and other cultural practices to control water loss and to encourage conservation and efficiency.
- Depending on physical soil characteristics and turf type, using solid-tine aeration equipment in place of verticutting is an option.
- Slicing and spiking help relieve surface compaction and promote better water penetration and aeration.
- Visually monitor for localized dry conditions or hot spots to identify poor irrigation efficiency or a failed system device.
- Use predictive models to estimate soil moisture and the best time to irrigate.
- Install in-ground (wireless) soil moisture sensors or use hand-held moisture meters in the root zone for each irrigation zone to enhance scheduled timer-based run times.
- An irrigation system should also have high- and low-pressure sensors that shut down the system in case of breaks and malfunctions.
- Place soil moisture sensors in a representative location of the irrigation zone.
- Install soil moisture sensors in the driest irrigation zone of the irrigation system.
- Wireless soil moisture systems should be installed to prevent damage from aeration.

Non-Play and Landscape Areas

Principles

Map any environmentally sensitive areas such as sinkholes, wetlands, or flood-prone areas, and identify species classified as endangered or threatened by federal and state governments, and state species of special concern.

Natural vegetation should be retained and enhanced for non-play areas to conserve water.

The most efficient and effective watering method for non-turf landscape is micro-irrigation.

Older golf courses may have more irrigated and maintained acres than are necessary. With the help of a golf course architect, golf professional, golf course superintendent, and other key personnel, the amount of functional turfgrass can be evaluated and transitioned into non-play areas.

Best Management Practices

- Designate 50% to 70% of the non-play area to remain in natural cover according to "right-plant, right-place," a principle of plant selection that favors limited supplemental irrigation and on-site cultural practices.
- Incorporate natural vegetation in non-play areas.
- Use micro-irrigation and low-pressure emitters in non-play areas to supplement irrigation.
- Routinely inspect non-play irrigation systems for problems related to emitter clogging, filter defects, and over-all system functionality.

Golf Course Turfgrass Reduction:
Environmentally and Strategically Sustainable

Many golf clubs are reducing the amount of regularly maintained turfgrass on a golf course. The golf course superintendent and a golf course architect should agree on a plan for keeping the strategic intent of the course intact and ensuring appropriate installation of replacement materials. A survey of members of the American Society of Golf Course Architects (ASGCA) revealed 93 percent of respondents are helping their clients reduce the acreage of maintained turfgrass while preserving the course's strategic intent. Here are some examples:

Lowering Maintenance Costs

Reducing the amount of turfgrass can bring a reduction in labor, equipment, fertilizer and water costs. Energy budgets can also be reduced as less water use results in lower electrical costs.

Using Less Water

Reducing regularly maintained turfgrass and replacing it with native grasses or native plants requiring less irrigation can realize signifcant reduction in water usage.

Greater Sustainability

Replacing turfgrass in out-of-play areas with native grasses or plants can be a good way to improve sustainability. Some out-of-play areas can even be non-irrigated and covered with wood mulch or pine straw from low-cost reclaimed tree materials.

In the photos above, a golf hole is shown in its "Before" state, and with computer-generated "After" effects of turfgrass reduction. ASGCA members routinely prepare visual examples of how a course can look when turfgrass reduction techniques are employed to help club members picture results.

AMERICAN SOCIETY OF GOLF COURSE ARCHITECTS

Wellhead Protection

Principles

Wellhead protection is the establishment of protection zones and safe land-use practices around water supply wells in order to protect aquifers from accidental contamination. It also includes protecting wellheads from physical impacts, keeping them secure, and sampling wells according to the monitoring schedule required by the regulating authority, which is often a local health department or state department of environmental quality.

When installing new wells, contact the regulating authority to determine the permitting and construction requirements and the required isolation distances from potential sources of contamination.

Locate new wells up-gradient as far as possible from likely pollutant sources, such as petroleum storage tanks, septic tanks, chemical mixing areas, or fertilizer storage facilities.

Licensed water-well contractors may be needed to drill new wells to meet state requirements, local government code, and water management districts' well-construction permit requirements.

Best Management Practices

- Use backflow-prevention devices at the wellhead, on hoses, and at the pesticide mix/load station to prevent contamination of the water source.
- Properly plug abandoned or flowing wells.
- Surround new wells with bollards or a physical barrier to prevent impacts to the wellhead.
- Inspect wellheads and the well casing at least annually for leaks or cracks; make repairs as needed.
- Maintain records of new well construction and modifications to existing wells.
- Obtain a copy of the well log for each well to determine the local geology and how deep the well is; these factors will have a bearing on how vulnerable the well is to contamination.
- Sample wells for contaminants according to the schedule and protocol required by the regulating authority.
- Never apply a fertilizer or pesticide next to a wellhead.
- Never mix and load pesticides next to a wellhead if not on a pesticide mix/load pad.

Wellhead Protection Program

Recognizing that the best way to maintain high quality drinking water is to prevent contaminants from reaching drinking water sources, in 1986 the Safe Drinking Water Act was amended to require states to develop Wellhead Protection Programs.

Click here for information

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 3

Surface Water Management

Although golf courses are typically large properties ranging in size from 60 to 200 acres, they are just one link in a stormwater management chain. Generally, a quantity of stormwater enters the golf course area, supplemented by what falls on the golf course proper, and then the stormwater leaves the golf course. Therefore, golf courses are realistically capable of having only a small impact on major stormwater flow. That impact should be to add only small increments of water over a given period of time. Engineers call this function "detention."

When golf courses are designed and built, their drainage capability concept is guided by an average rainfall event of a given frequency. For example, typically, a golf course drainage system is designed to detain a two- or five-year rain event. In other words, when that rain event happens, the golf course will be able to be reasonably drained in a matter of hours, as excess water not absorbed by the soil flows through the drainage system, is temporarily held, and finally leaves the property. In some instances, golf courses and other recreational facilities are mandated to be designed to handle a 20-, 50- or 100-year rain event, which means the golf course must detain more water for perhaps a longer period of time. This ability to detain large amounts of water requires accurate engineering and extensive construction to prevent physical or financial damage to the facility.

Best Management Practices are intended to prolong the detention process as long as practical, harvest as much of the stormwater in surface or underground storage as reasonable, and to improve the quality of water leaving the property when possible.

Stormwater Capture

Principles

When the golf course is properly designed, rain and runoff captured in water hazards and stormwater ponds may provide most or all of the supplemental water necessary under normal conditions, though backup sources may be needed during drought conditions.

Capture systems should be considered part of the overall treatment.

Stormwater capture is desirable where the lowest quality of water is needed to conserve potable water, maintain hydrologic balance, and improve water treatment.

This practice uses natural systems to cleanse and improve water treatment.

Best Management Practices
Stormwater Capture

- Install berms and swells to capture pollutants and sediments from runoff before it enters the irrigation storage pond.
- Monitor pond water level for water loss (seepage) to underground systems. If seepage is occurring, it may be necessary to line or seal the pond or install pumps to relocate water.
- Install water-intake systems that use horizontal wells placed in the subsoil below the storage basin; use a post pump to filter particulate matter.
- A backup source of water should be incorporated into the management plan.
- Inspect irrigation pumps, filtration systems, conveyances and control devices to prevent/correct system issues.

South Central New Mexico Stormwater Management Coalition

Elephant Butte Irrigation District

The Need for Regional Stormwater Management in Southern New Mexico

Across Doï¿½a Ana and Sierra counties there are 2,400 square miles of watershed stretching from the Black Range northwest of the Caballo Dam, south to the NM-TX state line. For 800 square miles, or one-third of the area, there is no existing infrastructure to manage stormwater. This results in severe erosion, flooding, and large quantities of sediment and debris being dumped on residences, farm fields, highways, and streets during severe weather. The existing dams, constructed in the 1960's to protect farmland, have now exceeded their engineered lifetime. In addition, these dams are now protecting urban and residential areas which they were never designed to protect. Currently there is very little funding available to implement the necessary dam upgrades needed to protect residential areas. Stormwater management is typically planned, funded, and implemented independently by a variety of public agencies in towns, cities, and districts spread throughout the region. Recognizing that stormwater does not respect political boundaries, it has become apparent that the needs of the region would best be served by a regional watershed management approach.

Regional Watershed and Stormwater Management

Several local agencies that manage stormwater as part of their responsibilities have joined the South Central New Mexico Stormwater Management Coalition. The first step was the development of a memorandum of understanding between agencies with the foresight to realize that their efforts to manage stormwater would be enhanced through sharing of information and ideas, coordinated planning, consolidation of funding requests, and sharing of staff resources. Bringing the various authorities together under the current joint powers agreement (JPA) allows for greater planning and development of stormwater projects and flood control within the region, as well as recognition by the state of New Mexico. According to the JPA, the Coalition will share staff time, resources, data, and documentation, and work to improve the effectiveness of stormwater management. The Coalition is authorized to apply for, receive, and utilize grants, loans, bonds, or other financial aid from any source approved by the Coalition board of directors. The Coalition will not use mil levy funding collected by any of the participating agencies. The JPA is scheduled to be replaced by new bylaws after the bylaws are approved by the Coalition members.

Read More of the Report

Regulatory Considerations

Principle

Course owners and superintendents should investigate regulatory requirements that apply to the golf facility to protect surface and groundwater quality.

Best Management Practices

♦ Aquatic management of plants may be regulated under construction permitting and regulatory licensing requirements. Consult with federal, state, and local water management agencies before managing golf course lakes and wetland areas.

♦ Consult with federal, state, and local water management agencies, and/or consult an approved management plan before performing cultural practices: fertilization, installation of plants, hand removal of plants, or mechanical harvesting.

The introduction of aquatic triploid grass carp, biological controls, aeration, and chemical controls (herbicide/algaecide) must be approved and monitored according to permit and licensing protocols and compliance.

♦ The disposal of sediments from surface water ponds (stormwater detention) may be subject to regulation.

♦ Golf course management may be affected by Total Maximum Daily Loading (TMDL), mitigation, and watershed basin management action plans (BMAP).

♦ Wetlands are protected areas; consult with federal and state agencies before altering natural aquatic areas.

♦ Constructed wetlands should have an impervious bottom to prevent groundwater contamination.

♦ Studies of water supplies are needed for irrigation systems, including studies of waterbodies or flows on, near, and under the property to properly design a course's stormwater system and water features to protect water resources.

Water Quality Protection

Principle

An aquatic plant management strategy should address the intended uses of the waterbody to maintain water quality. Proper documentation of the site's physical attributes and location, the presence of invasive or weedy species, aesthetics, watershed and groundwater assessments, and other environmental considerations.

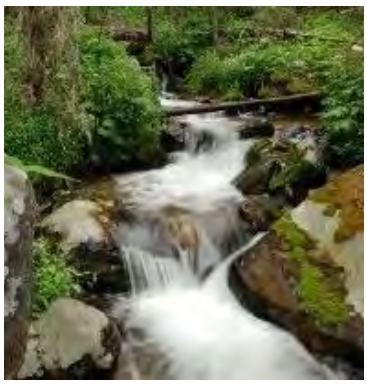
Only licensed individuals or contractors should be allowed to select and apply aquatic pesticides.

Best Management Practices

- Accommodate natural lake processes in the construction of lakes and ponds; include herbaceous and woody vegetation and emergent and submergent shoreline plants to reduce operational costs.
- Use integrated pest management (IPM) strategies and native or naturalized vegetation wherever practical.
- Apply appropriate herbicides to minimize damage to non-target littoral plantings.

Maintain a narrow band of open water at the pond edge to control the expansion of plants into more desirable littoral plantings.

- Use appropriate aquatic herbicides to prevent turfgrass injury and to protect water quality and wildlife habitat.
- Irrigation should not directly strike or run off to waterbodies, and no-fertilization buffers should be maintained along water edges.
- Outline goals and priorities to guide the development of the BMP necessary to support the lake/ aquatic management plan.
- Superintendents should monitor designated waters in their area for the persistence of toxic herbicides and algaecides in the environment.
- Secondary environmental effects on surface water and groundwater from the chemical control of vegetation should be monitored and recorded.
- Apply fertilizer and reclaimed (reuse) irrigation/ fertigation appropriately to avoid surface water and groundwater contamination.
- Apply copper products per label instructions to reduce the risk of impairing water quality and causing negative biological impacts.
- Identify position of property in relation to its watershed.
- Identify overall goals and validate concerns of the local watershed.
- Identify surface water and flow patterns.
- Indicate stormwater flow as well as existing and potential holding capacity.
- Indicate impervious surfaces, such as buildings, parking lots, or pathways.
- Indicate major drainages and catch basins that connect to local surface water bodies.
- Identify and understand depth to water tables and soil types.
- Locate and protect wellheads.



Water Resources and Management

As all New Mexicans know, water in our state is a very precious – and at times elusive – resource. Even with New Mexico's wonderful diversity of ecosystems , the mostly desert landscape receives an average of 10 inches of precipitation annually.

Click for more information

Dissolved Oxygen

Principles

Every golf course should have a plan to monitor the state of the environment and the effects the golf course may be having on the environment.

Monitoring is used to determine whether outside events are changing the water quality entering the golf course, or whether the golf course is having a positive, neutral, or negative effect on water quality. It also provides a body of evidence on the golf course's environmental impact.

A water-quality monitoring plan should be prepared to ensure the ongoing protection of groundwater and surface-water quality after construction has been completed. The same sites should be monitored during the pre-construction phase, although the monitoring plan can be modified based on site-specific conditions.

Sampling parameters are determined based on golf course operation and basin-specific parameters of concern (these may be identified by local/state Total Maximum Daily Load (TMDL) Programs). Typically, samples should be analyzed for nutrients, pH and alkalinity, sediments, and suspended solids, dissolved oxygen (DO), heavy metals, and any pesticides expected to be used on the golf course.

Ongoing, routine water sampling provides meaningful trends over time. A single sample is rarely meaningful in isolation.

Post-construction sampling of surface-water quality should begin with the installation and maintenance of golf course turf and landscaping. Samples should be collected a minimum of three times per year.

If there is no discharge on the scheduled sample date, samples should be taken during the next discharge event.

Post-construction surface-water quality sampling should continue through the first three years of operation and during the wet and dry seasons every third year thereafter, provided that all required water-quality monitoring has been completed and the development continues to implement all current management plans. It may also be wise to sample if a significant change has been made in course operation or design that could affect nearby water quality.

Sampling parameters should be determined based on golf course operation and any basin-specific parameters of concern (identified by the TMDL program or local regulators).

The purpose of quality assurance/quality control (QA/QC) is to ensure that chemical, physical, biological, microbiological, and toxicological data are appropriate and reliable. Data should be collected and analyzed using scientifically sound procedures.

However, even if the data are only for proprietary use and are not reported to any regulatory agency, it is strongly recommended that a certified laboratory be used and all QA/QC procedures followed.

Best Management Practices
Dissolved Oxygen

- Establish DO thresholds to prevent fish kills (occur at levels of 2 ppm), for example, use artificial aeration (diffusers).
- Reduce stress on fish; keep DO levels above 3 ppm.
- Select algaecides containing hydrogen peroxide instead of copper or endothall to treat high populations of phytoplankton.
- Use IPM principles to limit excess use of pesticides.

- Spot-treat filamentous algae or frequently remove algae by hand to prevent lowering oxygen concentrations in water.
- Use dyes and aeration to maintain appropriate light and DO levels.
- Apply algaecides to small areas to prevent fish mortality; do not treat the entire pond at once.
- Coordinate construction/renovation activities to minimize the amount of disturbed area and possible risk of contamination via runoff.
- Plan construction/renovation activities in phases to limit soil disruption and movement.
- Sod, spring, or reseed bare or thinning turf areas.
- Mulch areas under tree canopies to cover bare soil.
- Avoid the use of trimmers along the edge of the water body.
- Mow lake and pond collars at a higher height to slow and filter overland flow to waterbodies.
- Remove excess sediments to reduce irrigation system failures.
- Treat dredged materials as a toxic substance. Avoid contact with turf.
- Locate littoral shelves at the pond's inlets and outlets to reduce problems with the playability and maintainability of a water hazard.
- Seek professional assistance from an environmental specialist to design an appropriate water sample collection strategy.
- Determine which sites will be analyzed, and use reputable equipment and qualified technicians.

Demonstrate responsible land and water use practices based on water data.

- Define data values appropriately based on the associated BMP used to protect water quality.
- Record observations of fish, wildlife, and general pond conditions.

Dissolved oxygen (DO) is a measure of how much oxygen is dissolved in the water - the amount of oxygen available to living aquatic organisms. The amount of dissolved oxygen in a stream or lake can tell us a lot about its water quality.

The USGS has been measuring water for decades. Some measurements, such as temperature, pH, and specific conductance are taken almost every time water is sampled and investigated, no matter where in the U.S. the water is being studied. Another common measurement often taken is dissolved oxygen (DO), which is a measure of how much oxygen is dissolved in the water - DO can tell us a lot about water quality.

Although water molecules contain an oxygen atom, this oxygen is not what is needed by aquatic organisms living in natural waters. A small amount of oxygen, up to about ten molecules of oxygen per million of water, is actually dissolved in water. Oxygen enters a stream mainly from the atmosphere and, in areas where groundwater discharge into streams is a large portion of streamflow, from groundwater discharge. This dissolved oxygen is breathed by fish and zooplankton and is needed by them to survive.

Click here for more information

Aquatic Plants

Principles

Phytoplankton, which give water its green appearance, provide the base for the food chain in ponds. Tiny animals called zooplankton use phytoplankton as a food source.

Large aquatic plants (aquatic macrophytes) can grow rooted to the bottom and supported by the water (submersed plants), rooted to the bottom or shoreline and extended above the water surface (emersed plants), rooted to the bottom with their leaves floating on the water surface (floating-leaved plants), or free-floating on the water surface (floating plants). Different types of aquatic macrophytes have different functions in ponds.

Plant life growing on littoral shelves may help to protect receiving waters from the pollutants present in surface water runoff, and a littoral shelf is often required in permitted surface water-retention ponds. Floating plants suppress phytoplankton because they absorb nutrients from the pond water and create shade.

The use of aquatic plants to improve the appearance of a pond (aquascaping) can be included as part of the overall landscape design.

Ponds may be constructed on golf courses strictly as water hazards or for landscape purposes, but they often have the primary purpose of drainage and stormwater management, and are also often a source of irrigation water.

Best Management Practices

♦ Properly designed ponds with a narrow fringe of vegetation along the edge are more resistant to problems than those with highly maintained turf.

In ponds with littoral plantings, problem plants should be selectively controlled without damaging littoral shelves.

♦ Encourage clumps of native emergent vegetation at the shoreline.

♦ A comprehensive lake management plan should include strategies to control the growth of nuisance vegetation that can negatively affect a pond's water quality and treatment capacity.

♦ Frequently remove filamentous algae by hand and/or frequently apply algaecide to small areas of algae (spot treatment).

♦ To reduce the risk of oxygen depletion, use an algaecide containing hydrogen peroxide instead of one with copper or endothall.

Human Health Concerns

Principles

The use of pesticides should be part of an overall pest management strategy that includes biological controls, cultural methods, pest monitoring, and other applicable practices, referred to altogether as IPM.

Address areas where standing water may provide habitat for nuisance organisms.

Best Management Practices

- Use IPM principles to address insects that may pose a hazard to human health.
- Drain areas of standing water during wet seasons to reduce insect populations.
- Use Bacillus thuringiensis (Bt) products according to label directions to manage waterborne insect larvae.

Drinking water in our state comes from a variety of sources including groundwater wells and surface waters. NMED oversees activities surrounding the treatment and deliverance of safe, clean drinking water and ensures compliance of federal and state drinking water regulations.

Laws & Regulations:

- The primary law governing public water systems is the federal SAFE DRINKING WATER ACT (SDWA). This law was first passed in 1974 and amended in 1986 and 1996.
- NMED has primacy for SDWA which means it has the authority to implement and enforce the primary SDWA regulations.
- The basic authority for water quality management in New Mexico is provided through the State Water Quality Act which establishes the Water Quality Control Commission (WQCC). The WQCC is the state water pollution control agency for purposes of the Federal Clean Water and portions of the Safe Drinking Water Acts. The Environmental Improvement Board (EIB) is responsible for rules relating to water supply and capacity development.

Drinking Water Systems:

- **Public Water Systems** – A Public Water System (PWS) is any water system having at least 15 service connections or regularly serves an average of at least 25 individuals daily for at least 60 days out of the year. All PWS must meet the requirements of the federal Safe Drinking Water Act (SDWA) and state drinking water regulations.
- **System Owners & Operators** – All Public Water Systems (PWS) must be operated by a certified operator in accordance with the New Mexico Utility Operator Certification Act . NMED and other organizations offer many opportunities for board and operator training.
- **Capacity Development** – Capacity is a water system's ability to operate effectively and maintain compliance with the Safe Drinking Water Act and other regulatory requirements over the long term. NMED assists and trains water systems to enhance their capacity.

Water Reuse Systems – New Mexico's dry climate and persistent drought conditions create the need to use water and wisely and efficiently as possible. Reuse of highly treated wastewater is one way to maximize water use in water-vulnerable communities. NMED is working with New Mexico communities to develop such reuse systems based on technology proven in other parts of the country and around the world.

Click for more information

Drinking Water Bureau

Our mission is to preserve, protect and improve New Mexico's drinking water quality for present and future generations.

In support of this mission, Drinking Water Bureau (DWB) regulates water quality at public water systems in New Mexico. A public water system is any water system that serves at least 15 service connections or 25 individuals at least 60 days out of the year.

DWB Directory – *Contact information for all Drinking Water Bureau staff statewide*

Drinking Water Watch – *Information about any New Mexico public water system*

Drinking Water Watch Tutorial – *Tutorial about using the Drinking Water Watch Website*

Boil Water Advisories – *Information on Current and Previous Advisories*

More Information

Floodplain Restoration

Principles

Reestablishment of natural water systems helps mitigate flooding and control stormwater.

Address high sediment and nutrient loads and vertical and lateral stream migration causing unstable banks, flooding, and reductions in groundwater recharge.

Land use decisions and engineering standards must be based on the latest research science available.

Best Management Practices

Install stream buffers to restore natural water flows and flooding controls.

- Install buffers in play areas to stabilize and restore natural areas that will attract wildlife species.
- Install detention basins to store water and reduce flooding at peak flows.

DHSEM New Mexico

NEW MEXICO DEPARTMENT OF HOMELAND SECURITY & EMERGENCY MANAGEMENT

FLOODPLAIN MANAGEMENT OVERVIEW

LIVING IN A FLOODPLAIN - Approval by the local community Floodplain Administrator is required before construction or development begins within any Special Flood Hazard Area. If FEMA has not defined the Special Flood Hazard Area within a community, the community shall require permits for all proposed construction or other development in the community including the placement of manufactured homes, so that it may determine whether such construction or other development is proposed within flood-prone areas.

Approval by the local community Floodplain Administrator is required to ensure that proposed development projects meet the requirements of the National Flood Insurance Program and the community's floodplain management ordinance.

FEMA MAP Service Center

National Flood Hazard Layer

More Information

Stormwater, Ponds, and Lakes

Stormwater is the conveying force behind what is called nonpoint source pollution. Nonpoint pollution, which is both natural and caused by humans, comes not from a pipe from a factory or sewage treatment plant, but from daily activity. Pollutants commonly found in stormwater include the microscopic wear products of brake linings and tires; oil; shingle particles washed off roofs; soap, dirt, and worn paint particles from car washing; leaves and grass clippings; pet and wildlife wastes; lawn, commercial, and agricultural fertilizers; and pesticides.

Principles

The control of stormwater on a golf course is more than just preventing the flooding of the clubhouse, maintenance, and play areas. In addition to controlling the amount and rate of water leaving the course, it involves storing irrigation water, controlling erosion and sediment, enhancing wildlife habitat, removing waterborne pollutants, and addressing aesthetic and playability concerns.

Most golf courses plan their lakes and water hazards to be a part of the stormwater control and treatment system. However, natural waters of the state cannot be considered treatment systems and must be protected.

Lakes and ponds may also be used as a source of irrigation water.

It is important to consider these functions when designing and constructing the ponds. Peninsular projections and long, narrow fingers may prevent mixing. Ponds that are too shallow may reach high temperatures, leading to low oxygen levels and promoting algal growth and excess sedimentation.

Stormwater treatment is best accomplished by a treatment train approach, in which water is conveyed from one treatment to another by conveyances that themselves contribute to the treatment.

Source controls are the first car on the BMP treatment train. They help to prevent the generation of stormwater or introduction of pollutants into stormwater. The most effective method of stormwater treatment is not to generate stormwater in the first place, or to remove it as it is generated.

Best Management Practices

- Install swales and slight berms where appropriate around the water's edge, along with buffer strips, to reduce nutrients and contamination.
- Design stormwater treatment trains to direct stormwater across vegetated filter strips (such as turfgrass), through a swale into a wet detention pond, and then out through another swale to a constructed wetland system.
- Ensure that no discharges from pipes go directly to water.
- Eliminate or minimize directly connected impervious areas.
- Use vegetated swales to slow and infiltrate water and trap pollutants in the soil, where they can be naturally destroyed by soil organisms.
- Use depressed landscape islands in parking lots to catch, filter, and infiltrate water, instead of letting it run off. When hard rains occur, an elevated stormwater drain inlet allows the island to hold the treatment volume and settle out sediments, while allowing the overflow to drain away.
- Maximize the use of pervious pavements, such as brick or concrete pavers separated by sand and planted with grass. Special high-permeability concrete is available for cart paths or parking lots.
- Disconnect runoff from gutters and roof drains from impervious areas, so that it flows onto permeable areas that allow the water to infiltrate near the point of generation.
- Golf course stormwater management should include "natural systems engineering" or "soft engineering" approaches that maximize the use of natural systems to treat water.
- Ensure that no discharges from pipes go directly to water.
- Use a treatment train approach.
- Institute buffers and special management zones.

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 4

Water Quality Monitoring and Management

Regulatory Considerations

Principle

Golf course owners and superintendents should investigate regulatory requirements that may exist in their location to protect surface and groundwater quality.

Best Management Practices

- Aquatic management of plants may be regulated under construction permitting and regulatory licensing requirements. Consult with federal, state, and local water management agencies before managing golf course lakes and wetland areas.
- Consult with federal, state, and local water management agencies, and/or consult an approved management plan before performing cultural practices: fertilization; installation of plants; hand removal of plants or mechanical harvesting.
- The introduction of aquatic triploid grass carp, biological controls, aeration, and chemical controls (herbicide/algaecide) must be approved and monitored according to permit and licensing protocols and compliance.
- The disposal of sediments from surface-water ponds (stormwater detention) may be subject to regulation.
- Golf course owners are responsible for Total Maximum Daily Loading (TMDLs), mitigation, and watershed basin management action plans (BMAP).
- Wetlands are protected areas; consult with federal and state agencies before altering natural aquatic areas.
- Constructed wetlands should have an impervious bottom to prevent groundwater contamination.
- Studies of water supplies are needed for irrigation systems, including studies of waterbodies or flows on, near, and under the property are needed to properly design a course's stormwater system and water features to protect water resources.

New Mexico's ground water resources are of vital importance in sustaining life and must be preserved and protected for both present and future generations.

New Mexico Environment Department

Approximately 78% of New Mexicans depend on ground water for drinking water. 81% of New Mexicans are served by public systems with water derived from ground water sources and over 170,000 New Mexicans depend on private wells for drinking water.

Ground water makes up nearly half of the total water annually withdrawn for all uses in New Mexico, including agriculture and industry, and is the only practicable source of water in many areas of the state.

Continued on next page

Adequate supplies of uncontaminated groundwater are crucial not only to the health of our families but also for the continued growth of agricultural production and cutting-edge industries in New Mexico.
Learn more @ NM BGMR or USGS

New Mexico Environment Department

Laws & Regulations:

NMED is mandated by the NM Water Quality Act and Water Quality Control Commission (WQCC) regulations to prevent or abate water pollution in the State at sites which pose a significant risk to human health and the environment. In addition, NMED cooperates with local and federal governments on various programs relevant to ground water pollution control.

Activities and Responsibilities Include:

- Issuing ground water discharge permits to prevent ground water contamination from discharges that have the potential to impact ground water quality
- Implementing requirements for reporting and addressing spills and releases
- Developing ground water quality standards for ground water contaminants
- Developing ground water pollution assessment and abatement regulations and underground injection control requirements
- Conducting all permit, spill response, abatement, and public participation activities for mining facilities in New Mexico
- Identifying, investigating, and remediating inactive hazardous waste sites through implementation of the federal Superfund program
- Overseeing ground water investigation and remediation activities
- Implementing the Voluntary Remediation Program
- Conducting free testing of domestic wells at “water fairs” throughout the state and educating well owners about

Discharges to Ground Water

NMED monitors and issues Ground Water Discharge Permits to address a wide variety of discharges including:

- Commercial land farms (contaminated soil treatment)
- Commercial laundries (not served by sanitary sewers)
- Dairies
- Domestic wastewater facilities (with flows over 2,000 gal/day)
- Food processing operations
- Ground water remediation systems
- Industrial discharges
- Large capacity septic tank leach fields
- Mines
- Power generating plants
- Reclaimed wastewater reuse

Site Analysis

Principles

Design an aquatic plant management strategy that addresses the intended uses of the waterbody to maintain water quality. Identify the site's physical attributes and location, the invasive or weedy species present, aesthetics, watershed and groundwater assessments, and other environmental considerations.

Best Management Practices

- Accommodate natural lake processes in the construction of lakes and ponds; include herbaceous and woody vegetation and emergent and submergent shoreline plants to reduce operational costs.
- Use Integrated Pest Management (IPM) and native or naturalized vegetation wherever practical.
- Apply appropriate herbicides to minimize damage to non-target littoral plantings.
- Maintain a narrow band of open water at the pond edge to control the expansion of plants into more desirable littoral plantings.
- Use appropriate aquatic herbicides to avoid turfgrass injury.
- Irrigation should not directly strike or runoff to waterbodies and no-fertilization buffers should be maintained along edges.
- Outline goals and priorities to guide the development of the BMP necessary to support the lake/aquatic management plan.
- Superintendents should monitor designated waters in their area for the persistence of highly toxic herbicides and algaecides in the environment.
- Secondary environmental effects on surface water and groundwater from the chemical control of vegetation should be monitored and recorded.
- Apply fertilizer and reclaimed (reuse) irrigation/fertigation appropriately to avoid surface and groundwater contamination.
- Apply copper products per label instructions to reduce the risk of negative biological impacts and impairing water quality.
- Identify position of property in relation to its watershed.
- Identify overall goals and qualify concerns of the local watershed.
- Indicate surface water and flow patterns.
- Indicate stormwater flow as well as existing and potential holding capacity.
- Indicate impervious surfaces, such as buildings, parking lots, or pathways.
- Indicate major drainages and catch basins that connect to local surface water bodies.
- Identify and understand depth to water tables and soil types.
- Locate and protect wellheads.

Water Quality Sampling Program

Principles

- Every golf course should have a plan to monitor the state of the environment and the effects the golf course may be having on the environment.

Monitoring is the method used to determine whether outside events are impacting the water quality entering the golf course, or whether the golf course is having a positive, neutral, or negative effect on water quality. It also provides a body of evidence on the golf course's environmental impact.

A water quality monitoring plan should be prepared to ensure the ongoing protection of groundwater and surface-water quality after construction is completed. The same sites should be monitored during the preconstruction phase, although the monitoring plan can be modified based on site-specific conditions.

Sampling parameters are determined based on golf course operation and basin-specific parameters of concern (these may be identified by local/state Total Maximum Daily Load [TMDL] Programs). Typically, samples should be analyzed for nutrients, pH and alkalinity, sediments, suspended solids, dissolved oxygen (DO), heavy metals, and any pesticides expected to be used on the golf course.

Ongoing, routine water sampling provides meaningful trends over time. A single sample is rarely meaningful in isolation.

Post-construction surface-water quality sampling should begin with the installation and maintenance of golf course turf and landscaping. Samples should be collected a minimum of three times per year.

Should there be no discharge on the scheduled sample date, samples should be taken during the next discharge event.

Post-construction surface-water quality sampling should continue through the first three years of operation and during the wet and dry seasons every third year thereafter, provided that all required water quality monitoring has been completed and the development continues to implement all current management plans. It may also be wise to sample if a significant change has been made in course operation or design that could affect nearby water quality.

Sampling parameters should be determined based on golf course operation and any basin-specific parameters of concern (identified by the TMDL program or local regulators).

Golf courses should also sample for macroinvertebrates as determined useful by water quality specialists.

Best Management Practices

- Establish dissolved oxygen (DO) thresholds to prevent fish kills (occur at levels of 2 ppm), for example, use artificial aeration (diffusers).
- Reduce stress on fish; keep DO levels above 3 ppm.
- Select algaecides containing hydrogen peroxide instead of one containing copper or endothall to treat high populations of phytoplankton.
- Use IPM principles to limit excess use of pesticides.
- Spot-treat filamentous algae or frequently remove algae by hand to prevent lowering oxygen concentrations in water.
- Use dyes and aeration to maintain appropriate light and DO levels.
- Apply algaecides to small areas to prevent fish mortality; do not treat the entire pond at once.

Water Quality Sampling Program (Cont.)
Best Management Practices

- Coordinate construction/renovation activities to minimize the amount of disturbed area and possible risk of contamination via runoff.
- Plan construction/renovation activities in phases to limit soil disruption and movement.
- Sod, sprig, or reseed bare or thinning turf areas.
- Mulch areas under tree canopies to cover bare soil.
- Avoid the use of trimmers along the edge of the water body.
- Mow lake and pond collars at 2 inches or higher to slow and filter overland flow to water bodies.
- Remove excess sediments to reduce irrigation system failures.
- Treat dredged materials as a toxic substance. Avoid contact with turf.
- Locate littoral shelves at the pond's inlets and outlets to reduce problems with the playability and maintainability of a water hazard.

Ground Water Quality Bureau

New Mexico Environment Department

Mission: To preserve, protect and improve New Mexico's groundwater quality for present and future generations.

Overview: The role of the Ground Water Quality Bureau is to protect the environmental quality of New Mexico's groundwater resources as mandated by the Water Quality Act and the New Mexico Ground and Surface Water Protection Regulations (20.6 NMAC), and to identify, investigate, and clean-up contaminated sites which pose significant risks to human health and the environment.

The Ground Water Quality Bureau:

- Issues ground water pollution prevention permits
- Implements the department's responsibilities under the New Mexico Mining Act to ensure that environmental issues are addressed and standards are met
- Oversees groundwater investigation and remediation activities
- Identifies, investigates, and remediates inactive hazardous waste sites through implementation of the federal Superfund program
- Oversees agreements between the state and responsible parties
- Implements the Voluntary Remediation Program

The Bureau also strives to increase industry and public understanding and awareness of the importance of safe groundwater supplies in sustaining the quality of life in New Mexico for this and future generations, and the importance of protecting groundwater quality through pollution prevention initiatives.

GWQB Sections:

The Bureau is comprised of the following five technical sections, to learn more about each section please visit their webpage:

Agriculture Compliance Section
Mining Environmental Compliance
Pollution Prevention Section
Remediation Oversight Section
Superfund Oversight Section

GROUND WATER QUALITY BUREAU GUIDANCE: ABOVE GROUND USE OF RECLAIMED DOMESTIC WASTEWATER

Sampling Parameters, Collection, and Analysis

Principles

A water quality monitoring program must include monitoring of surface water, groundwater, and pond sediments. It should be implemented in three phases: background, construction, and long-term management.

Sampling of all watershed ingress and egress points is important to know what is coming into the property to identify potential impacts and baseline of water quality data.

- The purpose of quality assurance/quality control (QA/QC) is to ensure that chemical, physical, biological, microbiological, and toxicological data are appropriate and reliable, and are collected and analyzed using scientifically sound procedures.

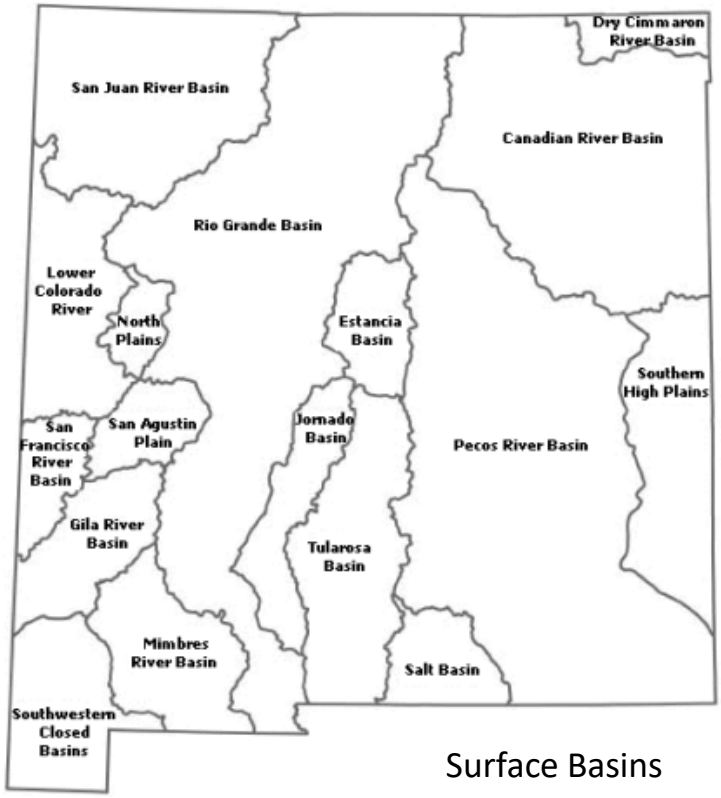
It is strongly recommended that a certified laboratory be used even if the data are only for proprietary use and are not reported to any regulatory agency

QA/QC procedures should be followed. Golf course management must have good data to make good decisions, and if a golf course should ever want to produce data for an agency or in court to defend the facility from unwarranted charges, those data must meet QA/QC standards to be defensible as evidence.

Best Management Practices

- Seek professional assistance from an environmental specialist to design an appropriate water sample collection strategy.
- Determine what sites will be analyzed and use reputable equipment and qualified technicians.
- Demonstrate responsible land and water use practices based on water data.
- Define data values appropriately based on the associated BMP used to protect water quality.
- Record observations of fish, wildlife, and general pond conditions.

New Mexico Office of the State Engineer
Underground Water Basins in New Mexico



Surface Basins

Buffer Zones

Principles

Buffers around the shore of a waterbody or other sensitive areas filter and purify runoff as it passes across the buffer. Ideally, plant buffers with native species provide a triple play of water quality benefits, pleasing aesthetics, and habitat/food sources for wildlife. As discussed above, it is important to continue these plantings into the water to provide emergent vegetation for aquatic life, even if the pond is not used for stormwater treatment.

Effective BMP in these areas include filter and trap sediment, site-specific natural/organic fertilization, and limits on pesticide use, primarily focusing on the control of invasive species.

♦ Golf course stormwater management should include “natural systems engineering” or “soft engineering” approaches that maximize the use of natural systems to treat water.

Best Management Practices

♦ Riparian buffer areas are above the high-water mark and should be unfertilized and left in a natural state.

♦ Reduce the frequency of mowing at the lake edge and collect or direct clippings to upland areas.

♦ Institute buffers and special management zones.

♦ The placement of bunkers and the shaping of contours surrounding a green should allow proper drainage and provide for the treatment and absorption of runoff from the green.

♦ Use turf and native plantings to enhance buffer areas. Increase height of cut in the riparian zone to filter and buffer nutrient movement to the water.

♦ Use a deflector shield to prevent fertilizer and pesticide prills from contacting surface waters.

♦ Apply fertilizer and pesticides based on the effective swath; keep application on target and away from buffers or channel swales.

♦ Use a swale and berm system to allow for resident time (ponding) for water to infiltrate through the root zone to reduce lateral water movement to the surface water body.

♦ Maintain a riparian buffer to filter the nutrients in stormwater runoff.

♦ An appropriate-sized buffer (steeper slope requires great buffer width) of turf mowed at a higher height of cut and minimally fertilized with enhanced-efficiency fertilizers can provide an effective buffer.

♦ Use plant buffers with native species to provide pleasing aesthetics, habitat, and food sources for wildlife.

♦ Ideally, littoral zones should have a slope of about 1 foot vertical to 6-10 foot horizontal.

♦ Encourage clumps of native emergent vegetation at the shoreline.

♦ Establish special management zones around pond edges.

♦ Reverse-grade around the perimeter to control surface water runoff into ponds and reduce nutrient loads.

♦ Planting on slopes with less than a 6-foot horizontal to a 1-foot vertical may not be as successful over the long term.

♦ Construct random small dips and ridges of a few inches to a foot to promote diversity within the plant community and provide a healthier and more productive littoral zone.

Buffer Zones (Cont.)
Best Management Practices

- All or most of the out-of-play water bodies should have shoreline buffers planted with native or well-adapted noninvasive vegetation to provide food and shelter for wildlife.
- Practice good fertilizer management to reduce the nutrient runoff into ponds that causes algae blooms and ultimately reduces DO levels.
- Manipulate water levels to prevent low levels that result in warmer temperatures and lowered DO levels.
- Aerate shallow lakes less than 6 feet in depth to maintain acceptable DO levels.
- Where applicable, aerate at night to control oxygen depletion in any pond.
- Install desirable plants to naturally buffer DO loss and fluctuation.
- Dispose of grass clippings where runoff and wind will not carry them back to the lake.
- Nutrient rich runoff encourages alga blooms and other phytoplankton; apply appropriate fertilizer rates and application setbacks.
- Dredge or remove sediment to protect beneficial organisms that contribute to the lakes food web and overall lake health.

Buffer strips around bodies of water filter runoff and provide valuable habitat for wildlife.

Buffer Strips Protect And Enhance Water Hazards

HERITAGE PALMS GOLF AND COUNTRY CLUB, FORT MYERS, FLA.

By USGA Green Section

Issue - Water hazards create strategic and aesthetic interest and they enhance the environmental value of golf courses. They also can hold and filter stormwater runoff from the course and surrounding community. Filtering runoff before it reaches a water hazard is important because runoff can contain sediments, turf clippings and chemicals that could adversely affect water quality. Heritage Palms wanted to do more to filter runoff and improve water quality at their facility.

Action - Heritage Palms Golf and Country Club uses a variety of techniques to filter runoff entering the water hazards on the course. The perimeter of each water hazard has vegetated littoral zones – areas of shallow water planted with aquatic vegetation that provide habitat, filter runoff and reduce erosion. Director of Golf Course Operations Greg Kriesh decided to add buffer strips around the water hazards as well. A buffer strip is an area of taller grass and vegetation that filters runoff before it can enter a body of water.

The buffer strips at Heritage Palms are maintained at a height of 4 inches and they are mowed every two to four weeks, depending on the time of year. A mower that is normally used for other rough areas is adjusted to mow the buffers, then it is returned to its normal mowing height once buffer maintenance is complete.

Results - Creating buffer strips around the water hazards at Heritage Palms has provided a number of benefits. First and foremost, they help to protect and enhance the environmental quality of the water hazards. In addition, golfers have commented positively that the buffer strips help keep wayward shots from trickling into the water. There is also a small labor savings associated with mowing these areas less frequently than the normal rough. Lastly, buffer strips provide more cover for wading birds as they forage for food.

One challenge with creating buffer strips was educating the staff responsible for rough mowing to stop mowing to the water's edge. Getting the staff accustomed to the new system took some reminding, but once the height and density of the buffers was established it was easy to see which areas should be mown during normal rough maintenance.

Wetland Protection

Principles

Several states protect wetlands as waters of the state by rule of law. Wetlands act both as filters for pollutant removal and as nurseries for many species. Many people do not realize the vital role they play in purifying surface waters.

The biological activity of plants, fish, animals, insects, and especially bacteria and fungi in a healthy, diverse wetland is the recycling factory of our ecosystem. While wetlands do pose a special concern, their mere presence is not incompatible with the game of golf. With care, many golf holes have been threaded through sensitive areas, and with proper design and management golf can be an acceptable neighbor.

When incorporated into a golf course design, wetlands should be maintained as preserves and separated from managed turf areas with native vegetation or structural buffers.

Constructed or disturbed wetlands may be permitted to be an integral part of the stormwater management system.

Best Management Practices

- Establish wetlands where water enters lakes to slow water flow and trap sediments.
- Maintain appropriate silt fencing and BMP on projects upstream to prevent erosion and sedimentation.
- Natural waters cannot be considered treatment systems and must be protected. (Natural waters do not include treatment wetlands.)
- Establish a low- to no-maintenance level within a 75-foot buffer along non-tidal and tidal wetlands.
- Establish and maintain a 100-foot riparian buffer around wetlands, springs, and spring runs.

Keeping Santa Fe County Wetlands Viable and Functioning

A Wetlands Action Plan For Santa Fe County

This Wetlands Action Plan was prepared in partnership with the New Mexico Environment Department's Surface Water Quality Bureau Wetlands Program with additional support from Santa Fe County.

The Wetlands Action Plan was written to satisfy the grant objectives of a U.S. EPA CWA Section 104(b)(3) Wetlands Grant (Assistance Agreement No. CD-966558-01-0-C (FY2007)), entitled: "Comprehensive Wetland Restoration and Protection in Santa Fe County".

Click for more information

Ecotone
Conservation Planning for Landscapes in Transition

Stormwater Management

Principle

Controlling stormwater on a golf course is more than just preventing the flooding of the clubhouse, maintenance, and play areas. In addition to controlling the amount and rate of water leaving the course, stormwater involves storing irrigation water, controlling erosion and sedimentation, enhancing wildlife habitat, removing waterborne pollutants, and addressing aesthetic and playability concerns. Keep in mind that not all stormwater on a golf course originates there; some may be from adjoining lands, including residential or commercial developments.

Best Management Practices

- Use vegetated swales to slow and infiltrate water and trap pollutants in the soil, where they can be naturally destroyed by soil organisms.
- Maximize the use of pervious pavements, such as brick or concrete pavers separated by sand and planted with grass.
- Special high-permeability concrete is available for cart paths or parking lots.
- Design stormwater control structures to hold stormwater for appropriate residence times in order to remove total suspended solids.
- Use a stormwater treatment train to convey water from one treatment structure to another.
- Eliminate or minimize directly connected impervious areas as much as possible.
- Disconnect runoff from gutters and roof drains from impervious areas, so that it flows onto permeable areas that allow the water to infiltrate near the point of generation.
- Use depressed landscape islands in parking lots to catch, filter, and infiltrate water, instead of letting it run off. When hard rains occur, an elevated stormwater drain inlet allows the island to hold the treatment volume and settle out sediments, while allowing the overflow to drain away.
- Ensure that no discharges from pipes go directly to water.

The National Pollutant Discharge Elimination System (NPDES) **Stormwater Program** as established in Section 402 of the federal Clean Water Act is responsible for the protection of surface water quality through the State by regulating point source discharges of pollutants to surface watercourses.

New Mexico Environment Department

United States Environmental Protection Agency is the administrator (regulatory authority) for the stormwater permitting program in New Mexico.

The Bureau's **Point Source Regulation Section (PSRS)** assists in the regulation of stormwater discharges by performing inspections on behalf of EPA and by serving as a local point of contact for providing information to operators and other agencies regarding this federal regulatory program.

Sediment

Principle

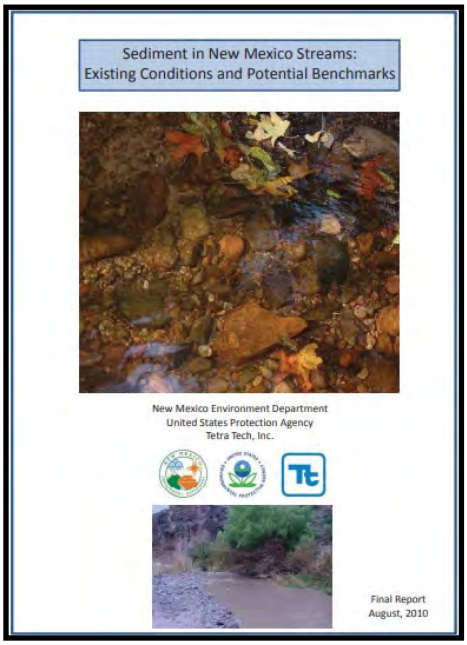
During construction and/or renovation, temporary barriers and traps must be used to prevent sediments from being washed off-site into water bodies. Wherever possible, keep a vegetative cover on the site until it is actually ready for construction, and then plant, sod, or otherwise cover it as soon as possible to prevent erosion.

Best Management Practices

- Use shoreline grasses to prevent bank erosion.
- Use dry detention basins/catchments to buffer flooding and excessive runoff that may contain sediment.
- When constructing drainage systems, pay close attention to engineering details such as subsoil preparation, the placement of gravel, slopes, and backfilling.
- Internal golf course drains should not drain directly into an open water body, but should discharge through pretreatment zones and/or vegetative buffers to help remove nutrients and sediments.
- Maintain a vegetative cover on construction sites until it is actually ready for construction.

Sedimentation Assessment

Excessive deposition of sediment on the bottom substrate of streams and rivers can negatively impact aquatic life. Bottom substrate without excessive fine sediment filling the interstitial spaces provides optimum habitat for many fish and aquatic insect communities. Excessive fine sediment, or substrate fining, occurs when biologically-important habitat components such as spawning gravels and cobble surfaces are physically covered by fines (Chapman and McLeod 1987). Substrate fining results in decreased intergravel oxygen and reduced or eliminated quality and quantity of habitat for fish, macroinvertebrates, and algae (Lisle 1989; Waters 1995). Sediment loads that exceed a stream's sediment transport capacity can also trigger changes in stream morphology (Leopold and Wolman 1964). Streams that become overwhelmed with sediment often go through a period of accelerated channel widening and streambank erosion. These morphological changes can reduce habitat diversity (pools, riffles, etc.) and place additional stress on the designated aquatic life use.



Bedded sediments cannot be treated as introduced pollutants such as pesticides because they are not uniquely generated through human input or disturbance. Rather, bedded sediments are components of natural systems that are present even in pristine settings and to which stream organisms have evolved and adapted. Therefore, the detection of a sediment imbalance is more difficult than detecting an absolute concentration or percentage that represents a clear biological impact (Jessup et al. 2010).

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Sodic/Saline Conditions

Principles

All natural waters contain soluble salts; however, the amount and type of salts they contain vary greatly.

Irrigation water can degrade when wells are pumped at high rates or for prolonged periods. Sometimes "up-coning" can occur from pumping, whereby saline water, rather than freshwater, is drawn into the well.

Saline water typically is unsuitable for irrigation because of its high content of TDS.

Saltwater intrusion from groundwater pumping near coastal areas can create a problem with some irrigation wells.

Best Management Practices

- Use surface water to mix (blend) affected groundwater to lower the total salt concentration.
- Routinely monitor water quality to ensure that salt concentrations are at the acceptable levels.
- Consider fertilizer that uses soluble nitrogen forms with a relatively low concentration of salts in frequent applications.
- Consider a controlled-release fertilizer to reduce salt injury.
- Identify salt additions and saline sources that contribute to the total salt concentration.
- Base management plan on routine soil tests to determine sodium adsorption ration (SAR), exchangeable sodium percentage (ESP), electrical conductivity saturated paste method/unit (ECe), and free calcium carbonate content.
- Select alternative turfgrass and landscape plants that are more salt-tolerant.
- Reduce salt accumulations in the soil by flushing soils as needed with a higher-quality water source.
- Design irrigation systems to account for flushing of salt accumulation from soil.
- Amend soil and water to remove salt ions from affected areas.
- Evaluate BMP to determine effectiveness toward managing sodic/saline conditions.

GCM GCSAA

Reducing soil salinity caused by high-salinity irrigation

Can cultural practices or commercial products decrease soil salinity on their own, without the need for additional irrigation?

Joseph Young, Ph.D.

Use of alternative water resources in golf course management continues to expand as demand for potable water increases in urban areas. These alternative water resources tend to contain higher salt, sodium or contaminants that affect the growth and health of turfgrasses.

Golf courses on the Southern High Plains of Texas irrigate with groundwater from the Ogallala Aquifer. Water quality in this southernmost portion of the aquifer has diminished with extensive water depletion and minimal recharge. Although the quality of this groundwater source may be better than the quality of the water used in other locations, high salinity and bicarbonates raise concerns for golf course superintendents throughout this region.

Click for full article

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 5

Nutrient Management

Proper nutrient management plays a key role in the reduction of environmental risk and increases course profitability. Among other benefits, applied nutrients inflate the available pool of nutrients and allow turfgrass to recover from damage, increase its resistance to stress, and increase its playability. However, the increase in available nutrients also increases the potential risk of environmental impact. Nutrients may move beyond the turfgrass via leaching or runoff, which may directly impact our environment. Other organisms also respond to increases in nutrients and, in some cases, these organisms may deleteriously alter our ecosystem. The goal of a proper nutrient management plan should be to apply the minimum necessary nutrients to achieve an acceptable playing surface and apply these nutrients in a manner that maximizes their plant uptake.

Regulatory Considerations

Principles

Local and state regulations are in place to better manage nutrient risks based on the unique conditions that exist in your location. Designing a nutrient management plan within these regulations addresses local concerns and minimizes risk within your unique ecosystem.

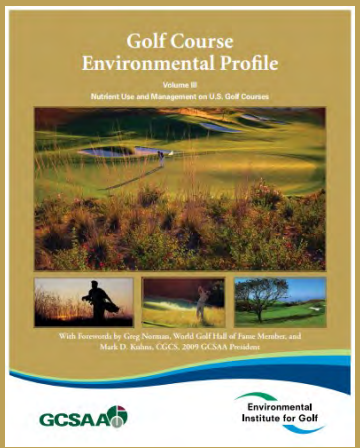
Depending on your location, regulatory agencies may include federal, state, or local policies.

In general, if your location is regulated by nutrient policies (such as nutrient management plans), all of your nutrient BMP will be designed according to these policies.

Understand the importance of nutrient licensing.

Best Management Practices

- Identify who must be licensed.
- Describe differing licenses, if applicable.
- Provide the minimum requirement.
- Detail the Continued Education Unit required to maintain the license.
- Understand the value of training programs.
- Contact local and state organizations for regulatory restrictions.



Phase 1 Volume 3
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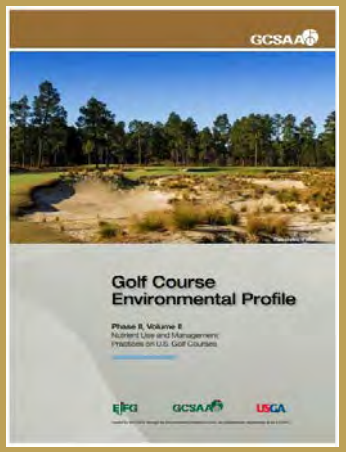
GCSAA

Golf Course Environmental Profile

Nutrient Use and Management Practices on US Golf Courses

Environmental Institute for Golf



Phase 2 Volume 2
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Soil Testing

Principles

Soil testing may or may not provide the appropriate answers to your nutrient management questions. Consult with your local land-grant university to get the most current information and to better understand which soil test values are relevant in your location.

Through proper sampling, laboratory analysis, interpretation of results, recommendations, and record keeping, soil testing can be used to manage nutrients more efficiently.

Best Management Practices

- Accurate and consistent sampling is essential to providing useful soil test information over time.
- Divide the course into logical components such as greens, fairways, tees, roughs, etc., for each hole.
- Ten to 15 soil samples should be randomly taken from each section and blended together to provide a representative, uniform soil sample.
- Each soil sample should be taken from the same depth.
- Use an extractant appropriate for your soils.
- The same extractant must be used for each test in order to compare soil test results over time.
- The purpose of a soil test is to provide the grower with a prediction of a plant's response to an applied nutrient.
- If the location has correlation data between a given nutrient applied to soil and a response to that nutrient by turfgrass, then recommendations may provide expected results.
- If your location does not have correlation data, then soil test recommendations may be of little value.
- Keeping soil tests from prior years will allow you to observe changes over time.
- This practice can provide good evidence of the impact of your nutrient management plan.

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Agronomy - Publications

Interpreting Soil Tests: Unlock the Secrets of Your Soil

Soil Analysis: A key to soil nutrient management

Understanding Soil Health for Production Agriculture

Test Your Garden Soil

An Introduction to Soil Salinity and Sodium Issues

Appropriate Analyses for New Mexico Soils

Minimum Levels for Sustainable Nutrition Soil Guidelines

The Minimum Level for Sustainable Nutrition (MLSN) Guideline is a new, more sustainable approach to managing soil nutrient levels that can help you to decrease fertilizer inputs and costs, while still maintaining desired turf quality and playability levels. The MLSN guidelines were developed in a joint project between PACE Turf and the Asian Turfgrass Center. All soil analyses were conducted at Brookside Laboratories, New Bremen, OH.

For more information, see the Facebook MLSN page at: www.facebook.com/mlsnturf

PACE TURF

ASIAN TURFGRASS CENTER

	MLSN Soil Guideline
pH	>5.5
Potassium (K ppm)	37
Phosphorus (P ppm)	21
Calcium (Ca ppm)	331
Magnesium (Mg ppm)	47
Sulfur as sulfate (S ppm)	7

Plant Tissue Analysis

Principles

Because of the mobility and conversion of elements within the soil; soil sampling can be less predictable than tissue testing. Tissue testing provides a precise measurement of nutrients within the plant. Tissue test sufficiency ranges are only as good as the correlation data of a given element to an acceptable quality level of a given turfgrass. Typically, tissue correlation data are more prevalent than soil test correlation data and, therefore, programs designed around tissue testing may provide more reliable results.

Through proper sampling, consistent intervals, and record keeping, tissue sampling may be used to measure existing turf health.

Best Management Practices

- Tissue samples may be collected during regular mowing.
- Do not collect tissue after any event that may alter the nutrient analysis. Events may include fertilization, top-dressing, pesticide applications, etc.
- Place tissue in paper bags, not plastic.
- If possible, allow tissue samples to air-dry at your facility before mailing them.
- Poor-quality turfgrass that is of concern should be sampled separately from higher-quality turfgrass.
- When turfgrass begins to show signs of nutrient stress, a sample should be collected immediately.
- More frequent tissue sampling allows a more accurate assessment of your turfgrass nutrient status changes over time.
- The quantity of tissue analysis you choose to use is entirely up to you and your needs. However, two to four tests per year are common on greens and one to two tests per year are common on tees and fairways.
- Keeping tissue tests from prior years will allow you to observe changes over time.
- Tissue testing can provide good evidence of the impact of your nutrient management plan.

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Agronomy Publications

Sampling for Plant Tissue Analysis

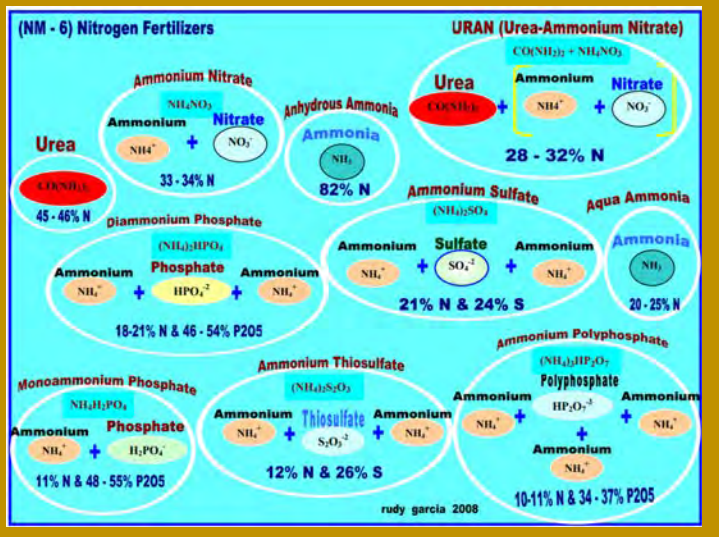
(NM – 4) Developing a basic Nitrogen Budget

Nitrogen Source	Units example	Units your result	conversion	lbs. N/acre e.g.	lbs. N/acre your result
Soil Nitrate-Nitrogen (NO_3^--N): • The amount of residual soil nitrate-nitrogen can vary considerably depending on the soil type, irrigation efficiency, fertility program and plant uptake of previous crop. A conversion factor of 2.0 is used for a 0 – 6"soil sample depth to convert ppm N to lbs./ac.	7 ppm		Multiply by 2.0 to get lbs. N/ac.	14.0	
Estimated Nitrogen Release (ENR) from the mineralization of Soil Organic Matter (SOM): • About 15 – 25 lbs. of N/acre/yr. is mineralized from each % of SOM	1 % SOM		Assume 20 lbs. of N is mineralized/ac	20.0	
Irrigation Water Nitrate-Nitrogen (NO_3^--N): • Typically low levels are found in most irrigation waters. For this example, 2.5 ac-ft of irrigation water is used.	2 ppm		Multiply by 2.72 to get lbs. N/ac-ft (2.5 ac-ft used)	13.6	
Manure N credits for the first year after application: • Moisture content can be 10 – 50% of the total weight and N content is about 1.5 – 2.0% on a dry weight basis. Approximately 30 – 70% of the N is made available to the crop during the first year.	5.0 tons/ac. @ 30% moisture & 1.5% N		Assume 45% of the total N is available during the first year	47.25	
Legume N credits from previous crop: • About 25 – 100 lbs. of N/ac. can be provided by the legume crop (i.e., pounds of legume crop residue/ac. and crop quality determines the amount of N made available)	= 30 lbs. of N/ac. (low crop residues)			30.0	
			Total Available Nitrogen per acre =	124.85	

Crop: Corn Silage; Yield: 20 tons/acre; N requirement: 160 lbs./acre (Ref. Crop Nutrient Uptake Tool @ http://npk.nrcs.usda.gov/)
Crop N Requirement (160.0 lbs./ac.) – Total Available N (124.85 lbs./ac) = 35.15 lbs. of N/ac. needed as fertilizer
Fertilizer used: Urea ($CO(NH_2)_2$; 45 – 46% N)

Cost/lb. of N:	Enter your Cost/lb. of N:	Note: All N sources should be split-applied in order to increase N uptake efficiency. It is recommended that the producer take soil & petiole/leaf samples in order to monitor the effectiveness of their nutrient management program and to modify it as needed.
➢ $500/ton of Urea ➢ 46% N = 920 lbs. of actual N/ton of Urea ➢ $500/920 = $0.54/lb. of N		

Remember to use realistic yield goals when developing crop N requirements. rudy garcia 2008



Fertilizers Used in Golf Course Management

Principles

Understanding the components of fertilizers, the fertilizer label, and the function of each element within the plant are all essential in the development of an efficient nutrient management program.

Terminology

- Grade or analysis is the percent by weight of Nitrogen (N), Phosphorous fertilizer (P_2O_5) and Potassium fertilizer (K_2O) that is guaranteed to be in the fertilizer.
- A complete fertilizer contains N, P_2O_5, and K_2O.
- The laws governing the labeling of fertilizer vary greatly among states. Consult your land-grant university or the appropriate state agency regarding the laws in your location.

Label

- The label is intended to inform the user about the contents of the fertilizer which, if understood and followed, will result in little to no environmental risk.
- The fertilizer label may contain:
    - Brand
    - Grade
    - Manufacturer's name and address
    - Guaranteed analysis
    - "Derived from" statement
    - Net weight

Macronutrients

Macronutrients are required in the greatest quantities and include nitrogen (N), phosphorus (P), and potassium (K).

Understanding the role of each macronutrient within the plant should provide you with a greater understanding of why these nutrients play such a key role in proper turfgrass management.

The role of nitrogen (N)

Nitrogen is required by the plant in greater quantities than any other element except carbon (C), hydrogen (H), and oxygen (O). Nitrogen plays a role in numerous plant functions including an essential component of amino acids, proteins and nucleic acids.

- *Fate and transformation of N*
- The goal of all applied nutrients is to maximize plant uptake while minimizing nutrient losses. Understanding each process will increase your ability to make sound management decisions and ultimately leads to an increase in course profitability and a reduction in environmental risk.
- *Nitrogen processes*
    - *Mineralization:* the microbial mediated conversion of organic N into plant-available NH_4
    - *Nitrification:* the microbial-mediated conversion of NH_4 to NO_3
    - *Denitrification:* the microbial mediated conversion of NO_3 to N gas; this primarily occurs in low-oxygen environments and is enhanced by high soil pH
    - *Volatilization:* the conversion of NH_4 to NH_3 gas
    - *Leaching:* the downward movement of an element below the rootzone
    - *Runoff:* the lateral movement of an element beyond the intended turfgrass location
- The release mechanism and factors influencing N release from available N sources

Understanding how certain N sources should be blended and applied is an essential component in an efficient nutrient management plan. In many cases, N sources are applied without regard to their release characteristics.

Continued on next page

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Selecting Synthetic Fertilizers in New Mexico

Guide A-134

Shane T. Ball, Extension Agronomist, Robert Flynn, Extension Agronomist, Charles E. Siepel, Hidalgo County Extension Agent, R. Darrell Baker, Extension Agronomist

College of Agricultural, Consumer and Environmental Sciences New Mexico State University (Print Friendly PDF)

What's in this Guide

All soils should be tested for available plant nutrients before adding fertilizer. Be sure to follow NMSU Extension Guide A-109, Test Determine Soil Needs, when sampling to assure an accurate representation of your soil conditions. If fertilizer is required, then follow this guide to determine what might be best for your conditions (table 1) .

A fertilizer is any organic or inorganic material (or combination) that is added to the soil to supply sufficient amounts of one or more elements essential to the growth of plants. A profitable harvest will depend upon choosing how, when, where, and what kind of fertilizer to apply. Recent scrutiny over the effects of synthetic fertilizers on the environment, poor fertilizer efficiency, high fertilizer prices, and low crop prices have prompted the need for a rational approach to choosing fertilizers in New Mexico. Additionally, a rational approach to fertilization includes knowing plant needs, type of tillage, availability of equipment, short- and long-term effects on the soil, and labor.

Click here for full article

This is an improper practice and increases the risk of negative environmental impact. Each N source (particularly slow-release forms) is unique and therefore should be managed accordingly. Applying a polymer-coated urea in the same manner one would apply a sulfur-coated urea greatly reduces the value of the polymer-coated urea. Similarly, applying 2 pounds of N from ammonium sulfate may cause burning, while applying 2 pounds of N from certain polymer-coated ureas may not provide the desired turfgrass response. Rate, application date, location, and turfgrass species all should be included in your nutrient application decision.

- *Soluble nitrogen sources*
  - Urea (46-0-0)
  - Ammonium nitrate (34-0-0)
  - Ammonium sulfate (21-0-0)
  - Diammonium phosphate (18-46-0)
  - Monoammonium phosphate (11-52-0)
  - Calcium nitrate (15.5-0-0)
  - Potassium nitrate (13-0-44)

Slow-release nitrogen sources

A slow-release N source is any N-containing fertilizer where the release of N into the soil is delayed either by requiring microbial degradation of the N source, by coating the N substrate which delays the dissolution of N, or by reducing the water solubility of the N source.

These include:

- Sulfur-coated urea
- Polymer/resin-coated
- Isobutylidene diurea
- Urea-formaldehyde/ureaformaldehyde reaction products
- Natural organic

Continued on next page

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Agronomy - Publications

Calculating Fertilizer Costs

- *Urease and nitrification inhibitors*
    - Urease inhibitors reduce the activity of the urease enzyme resulting in a reduction of volatilization and an increase in plant-available N.

Nitrification inhibitors reduce the activity of *Nitrosomonas* bacteria, which are responsible for the conversion of NH_4 to NO_2. This reduced activity results in a reduction of N lost via denitrification and an increase in plant-available N.

The role of phosphorous (P)

Phosphorus can be a growth-limiting factor for many unintended organisms and is a major contributor to eutrophication of water bodies. Thus, proper timing and rates should be implemented to reduce the risk of off-site movement of phosphorus.

Phosphorus forms high-energy compounds that are used to transfer energy within the plant. Phosphorus may remain in an inorganic form or may become incorporated into organic compounds. Phosphorous application rates should be based upon soil test results derived from documented correlations demonstrating a turf response to soil test phosphorous levels.

- *P deficiency symptoms*
    - Initially, reduced shoot growth and dark green color may be observed
    - Later, lower leaves may turn reddish at the tips and then the color may progress down the blade
- *P sufficiency ranges*
    - Consult your land-grant university for sufficiency ranges in your location.
- *P fertilizer sources*
    - Diammonium phosphate
    - Concentrated superphosphate
    - Monoammonium phosphate
    - Natural organics

The role of potassium (K)

Potassium is of no environmental concern, but can be an economic concern, particularly when potassium is over-utilized, which can be quite common. Generally, potassium concentrations in turfgrass tissue are about 1/3 to ½ that of nitrogen.

Potassium is not a component of any organic compound and moves readily within the plant. Potassium is key component of osmoregulation which has been documented to increase stress resistance.

K deficiency symptoms

Except under severe, documented deficiencies, K may not have an observable influence on turfgrass quality. Yellowing of older leaves followed by tip dieback and scorching of leaf margins have been reported.

K sufficiency ranges

Consult your land-grant university for sufficiency ranges in your location.

- *K fertilizer sources*
    - Potassium sulfate
    - Potassium chloride
    - Potassium nitrate

Secondary Macronutrients

Secondary macronutrients are essential to plant function and are required in quantities less than N, P, and K, but more than micronutrients. These include calcium (Ca), magnesium (Mg), and sulfur (S)

The role of calcium (Ca)

- Primarily a component of cell walls and structure
- Consult your land-grant university for sufficiency ranges in your location
- Found in gypsum, limestone, and calcium chloride

The role of sulfur (S)

- Metabolized into the amino acid, cysteine, which is used in various proteins and enzymes
- Consult your land-grant university for sufficiency ranges in your location
- Found in ammonium sulfate, elemental sulfur, gypsum, potassium sulfate

Continued on next page

The role of magnesium (Mg)

- Central ion in the chlorophyll molecule and chlorophyll synthesis
- Consult your land-grant university for sufficiency ranges in your location
- Found in S-Po-Mg, dolomitic limestone, and magnesium sulfate

Micronutrients

Understanding the role of each micronutrient within the plant should provide you with a greater understanding of why these nutrients play such a key role in proper turfgrass management.

Micronutrients are just as essential for proper turfgrass health as macronutrients, but they are required in very small quantities compared to macronutrients. Micronutrients include iron (Fe), manganese (Mn), boron (B), copper (Cu), zinc (Zn), molybdenum (Mo), and Chlorine (Cl).

Consult your land-grant university for micronutrient sufficiency ranges in your location.

The role of iron (Fe)

- Is part of the catalytic enzymes and is required for chlorophyll synthesis
- Affects photosynthesis, nitrogen fixation, and respiration
- Consult your land-grant university for sufficiency ranges in your location

The role of manganese (Mn)

- Involved in photosynthesis
- Required as a cofactor for ~35 enzymes
- Lignin biosynthesis depends on Mn

The role of boron (B)

- Found in the cell wall; probably required for the structural integrity of the cell wall

The role of copper (Cu)

- Cu-protein plastocyanin is involved in photosynthesis
- Cofactor for a variety of oxidative enzymes

The role of zinc (Zn)

- Structural component of enzymes
- Protein synthesis requires Zn
- Carbohydrate metabolism affected by Zn

The role of molybdenum (Mo)

- Primarily related to nitrogen metabolism
- Structural and catalytical functions of enzymes

The role of chlorine (Cl)

- Required for the oxygen-evolving reactions of photosynthesis
- Also appears to be required for cell division in both leaves and shoots

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Agronomy - Publications

An Introduction to Soil Salinity and Sodium Issues in New Mexico

Most of us are familiar with table salt, Epsom salt, and sea salt, but there are many kinds of salts, including several fertilizers such as ammonium sulfate, potassium chloride, and potassium sulfate. Technically, salts are ionic compounds formed by the neutralization of an acid and a base. Salts are necessary for providing many of the minerals that both plants and humans need in order to be healthy. Too much salt is unhealthy for humans as well as plants. High salt in the plant root zone interferes with the uptake of water and can cause death. It does not matter to the plant what kind of salt it is. Thankfully, plants have different levels of tolerance to salts found in the soil or in irrigation water. Since salts can conduct electricity when dissolved in water, we can measure the total "saltiness" of a soil by using a water extract and measuring how well the water conducts electricity. We can combine this measure of saltiness with knowledge of how plants respond to the salt to improve productivity using optimum soil management and plant selection.

Turfgrass Fertilization For Golf Courses

This USGA Green Section Collection was assembled to supplement the May 6, 2016 issue of the USGA *Green Section Record* (vol. 54, issue 09) and provides material on turfgrass fertilization. The materials in this collection are not all-inclusive but provide insight into environmentally and economically sustainable turfgrass fertilization practices.

Click for full collection

Turfgrass Fertilization

Supplement only when needed to provide better turf and playability

BY BLAKE MEENTEMEYER AND BRIAN WHITLARK

Soil is a living, breathing environment that provides many of the building blocks required to sustain healthy turf growth. However, supplemental nutrition is typically necessary to strengthen critical plant components so turf can provide desirable playing surfaces. The judicious use of resources including fertilizer is a high priority in meeting the golf industry's goal of sustainability. When considering fertilizer programs, it is important to remember that they do not need to be expensive to be effective. A "back to basics" approach to fertilization was nicely described by the great golf course architect Dr. Alister MacKenzie when he said, "One cannot emphasize too frequently the importance of leaving God's gifts alone and never fertilizing unless it is certain that time and nature will fail to cure."[1] This article covers several aspects of turfgrass nutrition, such as determining how much fertilizer is actually needed, fertilizing for enhanced playability, the economics of turfgrass fertilization, and dispelling some of the myths surrounding fertilizer applications.

DETERMINING FERTILIZER REQUIREMENT

The first step in determining how much fertilizer should be applied to turf is assessing the nutrient status of the soil and comparing the results to established guidelines for sustainable turf nutrition. To do this, collect soil samples from representative areas of the golf course and submit them to a soil testing laboratory for analysis. There are many different methods of soil testing and a variety of guidelines for interpreting the results, so it can be difficult to decide which methods and guidelines to use. With the introduction of new soil test interpretation methods, now a simplified process is available that helps determine just how much fertilizer turf actually needs.

SLAN vs. BCSR — Is one method more effective than the other? The primary methods used to interpret soil test data are the sufficiency level of available nutrients (SLAN) method and a modified version known as the minimum level of sustainable nutrition (MLSN) method. The SLAN method attempts to quantify the amount of available nutrients in the soil and ranks the sufficiency level for individual nutrients from low to high. The nutrient sufficiency levels originally were developed based on crop response but have been modified over the years to better correlate with turfgrass response.

Another method for interpreting soil test data is the base cation saturation ratio (BCSR) method, which compares the ratios of calcium, magnesium, potassium, and sodium to what is found in an "ideal soil." A limitation of the BCSR method is that it often leads to overapplication of calcium and potassium in an effort to achieve an "ideal" cation ratio.[2, 3, 4, 5] This is not to suggest that the BCSR approach will be harmful, at least in the short term, but it does not make agronomic or financial sense to apply nutrients for the sole purpose of achieving a set ratio when sustainability is paramount.

MLSN – Are you being sustainable? The MLSN method seeks to maintain turfgrass performance while managing soil nutrients at or slightly above minimum threshold nutrient values.[4] The minimum threshold values used by the MLSN method are based on 20 years of laboratory soil testing data from a wide range of golf courses. The integrity of the guidelines, originally based on approximately 17,000 samples, continues to improve as more soil samples are analyzed. The MLSN guidelines are representative of soils where turfgrass is performing well, and 90 percent of the soil samples contain nutrients at or above the threshold values necessary to maintain healthy turfgrass. To increase the robustness of the MLSN guidelines, golf course superintendents are encouraged to participate in the Global

CASE STUDY: IS SOIL SAMPLE DEPTH IMPORTANT?

Sample depth plays a key role in the decision-making value of any soil test. For example, a golf course in the desert of southern California was struggling with bermudagrass recovery from overseeding. Soil tests collected at a depth of 5 to 6 inches did not show any indication that turf health would be compromised based on nutrition, salinity, or soil pH. However, soil samples collected from the top 1.5 to 2.0 inches revealed a pH of 4.6, as opposed to the 5- to 6-inch depth sample that had a pH of 7.1. At such a low pH, the turf was suffering from nutrient toxicity. An application of calcium carbonate — i.e., lime — quickly raised the pH and turf health improved.

In another example, at a golf course irrigated with reclaimed water in southern Arizona, soil samples from the top 1 to 2 inches revealed paste extract electrical conductivity values of 4.8 decisiemens per meter (dS/m). Salinity values were only 1.8–2.0 dS/m in soil samples harvested from the 4- to 5-inch depth. In this case sodium and other salts had accumulated at the surface in the absence of leaching from rain or irrigation, a common situation in the Desert Southwest.

It is critically important to identify the relevant soil strata for testing and submit soil samples for chemical analysis that represent the individual layers. Such an analysis will provide better information for decision making.

Soil pH

Principle

Identifying pH levels may be the most important soil test result for turfgrass managers. In most cases, a pH of 6.3 is ideal because it provides the greatest probability of micronutrient availability. Soil pH adjustments may occur slowly and are temporary.

Best Management Practices

- To increase soil pH, apply a liming material (calcium carbonate, calcium oxide, dolomitic limestone) that contains Ca^{2+} and neutralizes acidity.
- To lower soil pH, products containing elemental sulfur should be applied.
- In some cases, utilizing injection pumps into irrigation water to address pH can be beneficial.

STATE OF NEW MEXICO

NUTRIENT REDUCTION STRATEGY
FOR PROTECTING AND IMPROVING WATER QUALITY

2014

CLICK

Prepared by

Surface Water Quality Bureau
New Mexico Environment Department

February 2014

Comprehensive Nutrient Management Planning Technical Guidance, New Mexico

September, 2001, updated October, 2006

The Natural Resources Conservation Service, formerly the Soil Conservation Service, works hand-in-hand with the American people to conserve natural resources on private lands.

AN EQUAL OPPORTUNITY EMPLOYER

(180-vi-NPPH, Amendment NM 11, October 2006)

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COMPREHENSIVE NUTRIENT MANAGEMENT PLANNING TECHNICAL GUIDANCE, NEW MEXICO

September, 2001, updated October, 2006

Contents

Nutrient Management

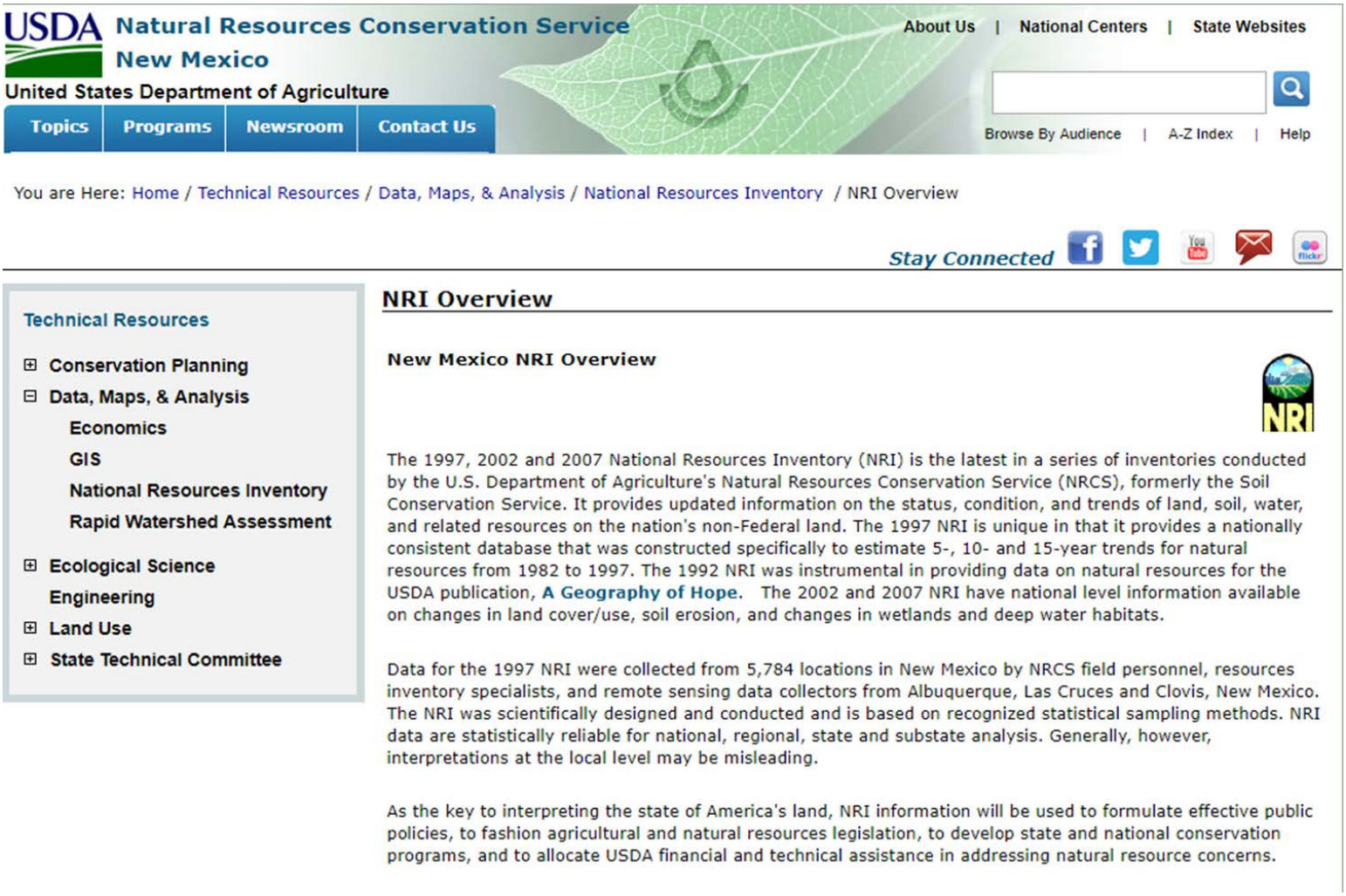
Principles

Within each state, environmental conditions vary greatly including differences among soils, topography, rainfall, and temperature. These differences require that a nutrient management plan be flexible enough to allow turfgrass managers to address their unique needs.

Understand the importance of application timing for effective use of applied nutrients.

Best Management Practices

- The objective of all nutrient applications is plant uptake and the corresponding desirable response.
- Apply nutrients when turfgrass is actively growing.
- Apply slow-release N fertilizers at the appropriate time of year to maximize the products' release characteristics. For example, an application of slow-release N to warm-season turfgrasses in fall may not be as effective as the same application applied in early summer because of the prolonged release time in fall.
- Follow N application rate recommendations from your local land-grant university.
- N application rates from slow-release materials should take into consideration the release rate of the chosen material. If insufficient material is applied, the desired response may not be observed.
- Consult your local land-grant university for efficient N:K in your location.
- The reduced height of cut and excessive traffic damage on putting greens results in an increased need for growth leading to an increase in nutrition.
- Tees and landing areas often have higher fertility requirements than fairways and roughs because they suffer constant divot damage.



Nutrient Management (Cont.)
Best Management Practices

♦ Fairways and roughs often require less nutrient inputs than other locations because of their increased height of cut, less damage, and clipping return.

♦ Exercise caution when applying nutrient applications during turfgrass establishment as these applications are particularly susceptible to loss via leaching and runoff.

♦ Provide appropriate rates and products to minimize N loss without reducing turfgrass establishment.

- Increased water applications
- Increased nutrients to hasten establishment
- Reduced root mass

♦ Be aware of the different types of spreaders and understand the advantages and disadvantages of each.

♦ Not all fertilizers can be spread with every spreader. For example, if sulfur-coated urea was spread through a drop spreader, the sulfur coating could be damaged, essentially leading to an application of soluble urea.

♦ Choose the appropriate spreader for a given fertilizer material.

- Walk-behind rotary
- Drop spreader
- Bulk rotary
- Spray

♦ Calibration reduces environmental risk and increases profitability.

♦ Proper fertilizer storage, loading, and clean-up reduce environmental risk.

♦ Avoid applying fertilizer to soils that are at, or near, field capacity or following rain events that leave the soils wet.

♦ Do not apply fertilizer when the National Weather Service has issued a flood, tropical storm, or hurricane water or warning, or if heavy rains are likely.

United States Department of Agriculture

NRCS
Natural Resources Conservation Service

Comprehensive Nutrient Management Planning

Guidelines for New Mexico

USDA

United States Department of Agriculture

Why Manage Nutrients?

New Mexico farmers and livestock producers are responsible for producing a safe and abundant food supply. They also take pride in being good stewards of land, air, and water resources.

This paper describes successful farm nutrient management practices, and is meant to assist farmers and livestock producers in developing a comprehensive nutrient management plan (CNMP).

Comprehensive Nutrient Management Planning

The benefits of manure have long been recognized. However, many farmers may not know the nutrient value of manure produced on their farm, how much is being applied to each field, and whether the application is meeting or exceeding crop nutrient needs. The objective of nutrient management planning is to use both manures and inorganic fertilizers to maximize economic benefits and minimize impacts on the environment.

Comprehensive nutrient management planning addresses all aspects of manure production, collection, storage, and land application, as well as land management practices, record keeping, and other manure utilization options. Managing nutrients efficiently involves developing and maintaining a written comprehensive nutrient management plan (CNMP). According to the *Unified National Strategy for Animal Feeding Operations*, all facilities with more than 1000 animal units are required to develop and implement a CNMP. Facilities with less than 1000 animal units but with unacceptable environmental conditions can also satisfy permitting requirements by developing and implementing a CNMP. Smaller facilities with no environ- mental concerns are strongly encouraged to develop a CNMP. The recent Farm Bill requires a CNMP on all facilities which receive animal waste management practice cost-share funds.

The Three E's

Economics. The majority of New Mexico farmers raise some type of livestock. It is estimated that more than 15 million tons of manure are produced by these livestock in New Mexico each year. The Nitrogen (N)-Phosphorus (P)- Potassium (K) fertilizer value of this resource exceeds $ 69 million. (Source: New Mexico Agricultural Statistics and USDA-Natural Resources Conservation Service (NRCS).

Efficiency. Farmers can test manure to determine its nutrient value. Using manure and soil tests together when developing a nutrient management plan can reduce the need for chemical fertilizers. All or most of the needed nutrients can come from manure.

Environment. Manure is a valuable resource. It benefits plant growth by improving soil structure and fertility. However, if manure is handled improperly, water pollution may result. Responsible farmers who manage manure appropriately gain maximum benefits while protecting the environment. This guide describes how nutrient management practices can be integrated into an economical, efficient and environmentally-sound CNMP.

Planning Considerations

Step 1. Assess Operation

The first and perhaps the most important step in nutrient management planning is to assess your operation and Current manure management practices. Throughout the year are there any farm practices that result in discharges to

Rio Grande Chapter GCSAA
Golf Course Superintendents Association of America

Best Management Practices

Section 6

Cultural Practices

Cultivation practices are an important part of golf course turf management. Certain cultural practices such as mowing, verticutting, and rolling are necessary to provide a high-quality playing surface, while others such as aerification are required to enhance plant health.

Heavily used areas such as putting greens often deteriorate because of compacted soil, thatch accumulation, and excessive use. Soil problems from active use are usually limited to the top 3 inches of the soil profile and should be actively managed to enhance turf health and improve nutrient and water uptake.

Unlike annual crops, which offer the opportunity for periodic tilling of the soil profile to correct problems like soil compaction that might develop over time, turfgrass does not offer opportunities for significant physical disturbance of the soil without destroying the playing surface.

Mowing

Principles

Mowing is the most basic yet most important cultural practice to consider when developing a management plan.

The mowing practices implemented on a facility will have an impact on turf density, texture, color, root development, and wear tolerance.

Mowing practices affect turfgrass growth. Frequent mowing will increase shoot density and tillering. It will also decrease root and rhizome growth as a result of plant stress associated with removal of leaf tissue.

Infrequent mowing results in alternating cycles of vegetative growth followed by scalping, which further depletes food reserves of the plants.

Proper mowing height is a function of the species/cultivar being managed and the intended use of the site. Other factors influencing mowing height include mowing frequency, shade, mowing equipment, time of year, root growth, and abiotic and biotic stress.

Maintaining an optimal root-to-shoot ratio is critical. Turfgrass plants that are mowed too low will require a substantial amount of time to provide the food needed to produce shoot tissue for future photosynthesis. If turf is mowed too low in one event, an imbalance occurs between the remaining vegetative tissue and the root system, resulting in more roots being present than the plant needs physiologically. As a result, the plants will slough off the unneeded roots. Root growth is least affected when no more than 30% to 40% of leaf area is removed in a single mowing.

Failure to mow properly will result in weakened turf with poor density and quality.

Best Management Practices

- Mowing frequency should increase during periods of rapid growth and decrease during dry, stressful periods.
- If turf becomes too tall, it should not be mowed down to the desired height all at once. Such severe scalping reduces turf density and can result in a dramatic reduction in root growth. Tall grass should be mowed frequently and height gradually decreased until desired height of cut is achieved.
- Shade affects turfgrass growth by filtering out photosynthetically active radiation. As a result, turfgrass plants respond by growing upright in an effort to capture more light to meet their photosynthetic needs. As a result, mowing height should be increased by at least 30% to improve the health of turf grown in a shaded environment.
- The use of the plant growth regulator trinexapac-ethyl has been shown to improve overall turf health when used as a regular management tool for grasses growing in shaded environments.
- Environmental stresses such as prolonged cloudy weather or drought can have a significant impact on turf health. Increase mowing heights as much as use will allow in order to increase photosynthetic capacity and rooting depth of plants.
- Use proper mowing equipment.
- Reel mowers are ideally suited for maintaining turfgrass stands that require a height of cut below 1.5 inches. They produce the best quality when compared to other types of mowers.
- Rotary mowers, when sharp and properly adjusted, deliver acceptable cutting quality for turf that is to be cut above 1 inch in height. Dull blades will result in shredding of leaf tissue, increasing water loss and the potential for disease development.
- Flail mowers are most often used to maintain utility turf areas that are mowed infrequently and do not have a high aesthetic requirement.
- Mowing patterns influence both the aesthetic and functional characteristics of a turf surface.
- Turfgrass clippings are a source of nutrients, containing 2% to 4% nitrogen on a dry-weight basis, as well as significant amounts of phosphorus and potassium.
- Nutrients contained in clippings can be sources of pollution and should be handled properly.

- Clippings should be returned to the site during the mowing process unless the presence of grass clippings will have a detrimental impact on play. Cases when clippings should be removed include times when the amount of clippings is so large that it could smother the underlying grass or on golf greens where clippings might affect ball roll.
- Collected clippings should be disposed of properly to prevent undesirable odors near play areas and to prevent fire hazards that can occur when clippings accumulate. Consider composting clippings or dispersing them evenly in natural areas where they can decompose naturally without accumulating in piles.

Table 7-1. Recommended golf course mowing heights, by area

Turf Species	Greens Healthy Maintenance	Greens Tournament Play	Tees, Collars Approaches	Fairways
	Inches			
Creeping bentgrass	0.125–0.180	0.090–0.135	0.250–0.500	0.350–0.625
Hybrid bermudagrass	0.125–0.180	0.100–0.140	0.375–0.500	0.375–0.625
Common bermudagrass	NA	NA	0.500–0.625	0.500–0.750
Zoysiagrass	NA	NA	0.400–0.625	0.500–0.750
Perennial ryegrass	NA	NA	0.375–0.500	0.375–0.625
Kentucky bluegrass	NA	NA	0.500–0.750	0.625–1.000

Table 7-2. Recommended mowing heights for roughs*

K. bluegrass	P. ryegrass	Tall fescue	Fine fescues	Bermudagrass
Inches				
1.0–6.0	1.0–6.0	2.0–6.0	2.5–6.0	0.75–2.5

* For intermediate, primary and secondary roughs. Intermediate rough cuts are defined as a narrow (<10') step-up cut immediately adjacent to the fairway. HOC for intermediate roughs are usually in the lower part of the specified ranges, typically 1.0–1.75".

Figure 7-1. Higher HOC generally results in deeper roots.

Table 7-3. Mowing frequency required during active growth to conform to the 1/3 rule based on various mowing heights

Mowing Height (inches)	1/3 rule Height (inches)	Frequency
0.12	0.18	Every 1-1.5 days
0.25	0.37	Every 2 days
0.50	0.75	Every 2-3 days
1.00	1.50	Every 3-4 days
1.50	2.25	Every 4-5 days
2.00	3.00	Every 5-6 days
3.00	4.50	Every 6-7 days
4.00	6.00	Every 7-8 days

Cultivation

Principles

Cultivation involves disturbing the soil or thatch through the use of various implements to achieve important agronomic goals that include relief of soil compaction, thatch/organic matter reduction, and improved water and air exchange.

Cultivation techniques will result in disturbance of the playing surface that can require significant time for recovery.

Frequency of cultivation should be based on traffic intensity and level of soil compaction.

Core aerification is effective at managing soil compaction and aiding in improvement of soil drainage.

Accumulation of excessive thatch and organic matter will reduce root growth, encourage disease, and create undesirable playing conditions.

Light and frequent applications of sand will smooth the playing surface, control thatch, and potentially change the physical characteristics of the underlying soil when done in conjunction with core aerification.

Best Management Practices

- Core aerification involves removal of small cores or plugs from the soil profile. Cores are usually 0.25 to 0.75 inch in diameter. Annual core aerification programs should be designed to remove 15%-20% of the surface area. High-traffic areas may require a minimum of two to four core aerifications annually.
- Core aerification should be conducted only when grasses are actively growing to aid in quick recovery of surface density.
- Vary depth of aerification events by incorporating varying length tines to prevent development of compacted layers in the soil profile as a result of cultivation.
- Solid tines cause less disturbance to the turf surface and can be used to temporarily reduce compaction and soften surface hardness during months when the growth rate of grasses has been reduced. Benefits of solid-tine aerification are temporary because no soil is removed from the profile.
- Deep-drill aerification creates deep holes in the soil profile through use of drill bits. Soil is brought to the surface and distributed into the canopy. Holes can be backfilled with new root-zone materials if a drill-and-fill machine is used. These machines allow replacement of heavier soils with sand or other materials in an effort to improve water infiltration into the soil profile.
- Slicing and spiking reduce surface compaction and promote water infiltration with minimal surface damage.
- Slicing is faster than core aerification but is less effective. Slicing is best accomplished on moist soils.

Continued on next page

- A spiker can break up crusts on the soil surface, disrupt algae layers, and improve water infiltration.
- Vertical mowing (verticutting) can be incorporated into a cultural management program to achieve a number of different goals. The grain of a putting green can be reduced by setting a verticutter to a depth that just nicks the surface of the turf. Deeper penetration of knives will stimulate new growth by cutting through stolons and rhizomes while removing accumulated thatch.
- Verticutting depth for thatch removal should reach the bottom of the thatch layer and extend into the surface of the soil beneath the thatch.
- Dethatching with a verticutter is an aggressive practice that is not recommended on golf putting greens because of the damage that occurs and the extensive recovery time required.
- Initiate vertical mowing when thatch level reaches 0.25 to 0.5 inch in depth. Shallow vertical mowing should be completed at least monthly on putting greens to prevent excessive thatch accumulation.
- Groomers, or miniature vertical mowers attached to the front of reels, are effective at improving management of grain and improving plant density through cutting of stolons.
- Topdress the playing surface with sand following core aerification and heavy vertical mowing to aid in recovery of turf. Rates will vary from 0.125 to 0.25 inch in depth and will depend on the capacity of the turf canopy to absorb the material without burying the plants.
- Light, frequent applications of topdressing sand on putting greens can smooth out minor surface irregularities, aiding in the management of thatch accumulation.
- Use only weed-free topdressing materials with a particle size similar to that of the underlying root zone.
- Use of finer materials can result in layering and can have a negative impact on water infiltration.
- Daily rolling of putting surfaces following mowing can increase putting speeds by roughly 10%, allowing for improved ball roll without lowering height of cut.
- To minimize potential for compaction caused by rolling, use light weight rollers.

Table 7-4. Turfgrass cultivation methods and rankings of agronomic benefits

Method	Compaction Relief Inches	Thatch Control	Water/air Movement	Disruption of Play
Core aerification	High	Good[1]	High	Medium to high[1]
Deep drilling	Medium	Low	High	High
Verticutting	Low	Best[1]	Medium	Low to high[2]
Grooming	None	Very low	Very low	None
Solid tining	Low[3]	None	High	Medium-low
Spiking/slicing	None	Very low	Low	None
High pressure water injection	Very low	None	Medium-High	Very low

[1] Verticutting removes a greater amount of thatch, but does so only to a maximum of about 0.7"; core aerification is a better approach if excess thatch and organic matter accumulation from 0- 3" must be removed
[2] Use of bigger tines when core aerifying disrupts play for longer; similarly, use of verticutters with wider blades, closer blade spacing, and deeper settings increases length of play disruption.
[3] Compaction relief with solid tining is low except when equipped with a "kicking action" that results in some soil loosening.

Overseeding Warm-Season Turfgrass

Principles

The fundamental purpose of overseeding is to establish a temporary cool-season grass into the warm-season base for improved color and playability during the fall and winter when the warm-season grass enters dormancy.

Overseeding increases the need for irrigation and routine mowing and may result in significant thinning of the base grass during spring transition.

Successful overseeding programs require year-long planning and incorporate all aspects of root-zone cultivation and weed control in an effort to maintain health of the warm-season turfgrass while allowing successful establishment of the overseeded cool-season grass species.

Best Management Practices

- Thatch depth greater than 0.5 inch in the warm-season turfgrass base will prevent good seed-to-soil contact and will result in sporadic germination and establishment. Remove thatch as part of an active cultivation program before overseeding.
- Reduce or eliminate fertilization of the base grass three to four weeks before the planned seeding date to minimize growth and competition.
- Core-aerify the soil four to six weeks before the planned overseeding date to open turf canopy and aid in uniform establishment of overseeded grass.
- Select grass species/cultivars that are adapted to the desired use, taking note of disease resistance and spring transition traits. Cultivars with improved heat tolerance can delay spring transition and create increased competition for water, nutrients, and light with the warm-season turfgrass base.
- Irrigate newly planted overseed to maintain constant moisture levels, not allowing the soil surface to dry out. Gradually reduce irrigation once the seedlings have been mowed.
- Do not fertilize with nitrogen immediately before or during establishment of overseed as the N may encourage warm-season turfgrass competition and increase disease potential.
- Move hole locations on putting greens daily during the establishment period to minimize damage to seedlings from foot traffic.
- Reduce fertilizer rates in spring to slow growth of overseeded grass. Once warm-season turfgrass regrowth is apparent, restore fertilizer applications to stimulate growth of the warm-season turfgrass.
- Colorants (dyes and pigments) can be used to provide winter color to dormant grasses.
- Overseeding practices can generate significant dust that may require dust control measures.

USGA CASE STUDY

Best Management Practices
Resource Management

Using Turf Colorants Instead Of Overseeding

Brunswick Plantation And Golf Resort — **Calabash, N.C. 28467**
Robert Vaughan, superintendent

OVERSEEDING: DARNED IF YOU DO AND DARNED IF YOU DON'T

GCSAA

Darned if you do and darned if you don't. That's overseeding for you. If there is ever an unnecessary task in golf course management that is by most accounts necessary, it's winter overseeding.

To put it in another perspective, if the love of money is indeed the root of all evil, then overseeding is a necessary evil – an agronomic procedure aimed more at wooing winter play in the southern environs of America than for any meaningful enhancement of turf health.

Overseeding is most commonly done by courses that use bermudagrass, which goes dormant in winter. Courses that overseed will prepare their bermudagrass for overseeding through a combination of processes that include aeration, verticutting and scalping. The ryegrass seed is then distributed on top of the bermudagrass and nurtured for several weeks as it germinates and grows in the upper profile of the bermudagrass that is entering dormancy. In late spring as the weather warms up, the golf course superintendent will encourage the bermudagrass as it comes out of dormancy and the ryegrass is loosing its ability to withstand the warmer weather.

Presented by the Golf Course Superintendents Association of America

Click for full article

Shade and Tree Management

Principles

In general, most turfgrasses perform best in full sun.

Excessive shade reduces photosynthesis and air circulation, thus increasing the susceptibility of the turf to pest and disease problems.

Best Management Practices

- .Prune tree limbs and roots as needed to reduce competition for sunlight, water, and nutrients.
- When possible, trees located near closely mowed areas such as tees and greens should be removed or their canopy should be thinned to promote good turf growth.
- Understand the variability in sun angles at different times of the year and how this affects turf health.
- Conduct a shade audit to identify problem areas.
- Conduct a tree survey that identifies each tree's location, species, health, life expectancy, safety concerns, value and special maintenance requirements.

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 7

Integrated Pest Management

The philosophy of integrated pest management (IPM) was developed in the 1950s because of concerns over increased pesticide use, environmental contamination, and the development of pesticide resistance. The objectives of IPM include reducing pest management expenses, conserving energy, and reducing the risk of pesticide exposure to people, animals, and the environment. Its main goal, however, is to reduce pesticide use by using a combination of tactics to control pests, including cultural, biological, genetic, and chemical controls.

Pest management on golf courses results in significant inputs of time, labor, and financial resources. To grow healthy turfgrass, it is important for golf course superintendents to know what IPM is and how to implement it for each pest group (arthropods, nematodes, diseases, and weeds). They must be well-versed in pest identification, understand pest life cycles and/or conditions that favor pests, and know about all possible methods of controlling pests.

Regulatory Considerations

Principles

Some federal or state regulations cover practically anyone who manufactures, formulates, markets, and uses pesticides.

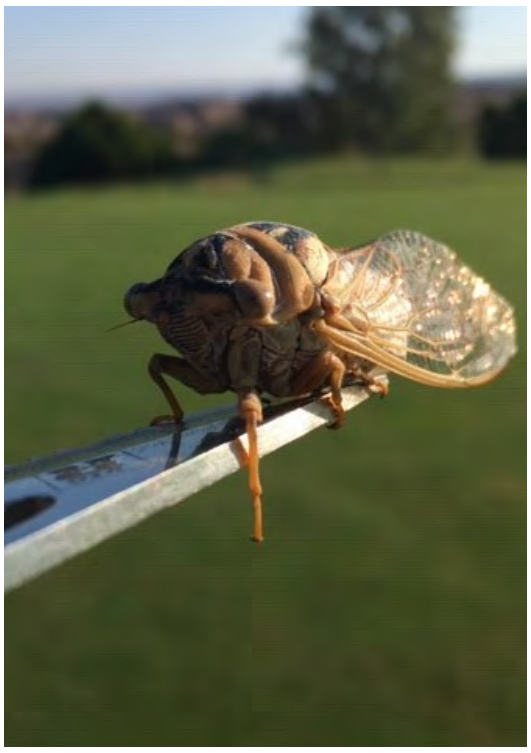
Record keeping of pesticide use may be required by law. IPM principles suggest that you keep records of all pest control activity so that you may refer to information on past infestations or other problems to select the best course of action in the future.

Best Management Practices

♦ .Proper records of all pesticide applications should be kept according to local, state, or federal requirements.

♦ Use records to establish proof of use and follow-up investigation of standard protocols regarding:

- Date and time of application
- Name of applicator
- Person directing or authorizing the application
- Weather conditions at the time of application
- Target pest
- Pesticide used (trade name, active ingredient, amount of formulation, amount of water)
- Adjuvant/surfactant and amount applied, if used
- Area treated (acres or square feet) and location
- Total amount of pesticide used
- Application equipment
- Additional remarks, such as the severity of the infestation or life stage of the pest
- Follow-up to check the effectiveness of the application



IPM Overview

Principles

The fundamental basis of an environmentally sound pest control program is a process called IPM.

IPM focuses on the basics of identifying the pests, choosing pest-resistant varieties of grasses and other plants, enhancing the habitat for natural pest predators, scouting to determine pest populations and determining acceptable thresholds, and applying biological and other less toxic alternatives to chemical pesticides whenever possible.

Chemical controls should have minimal effect on beneficial organisms and the environment and minimize the development of pesticide resistance.

What is IPM?

Integrated Pest Management is a science-based approach that combines a variety of techniques. By studying their life cycles and how pests interact with the environment, IPM professionals can manage pests with the most current methods to improve management, lower costs, and reduce risks to people and the environment.

IPM tools include:

- Alter surroundings
- Add beneficial insects/ organisms
- Grow plants that resist pests
- Disrupt development of pest
- Prevention of pest problem developing
- Disrupt insect behaviors
- Use pesticides

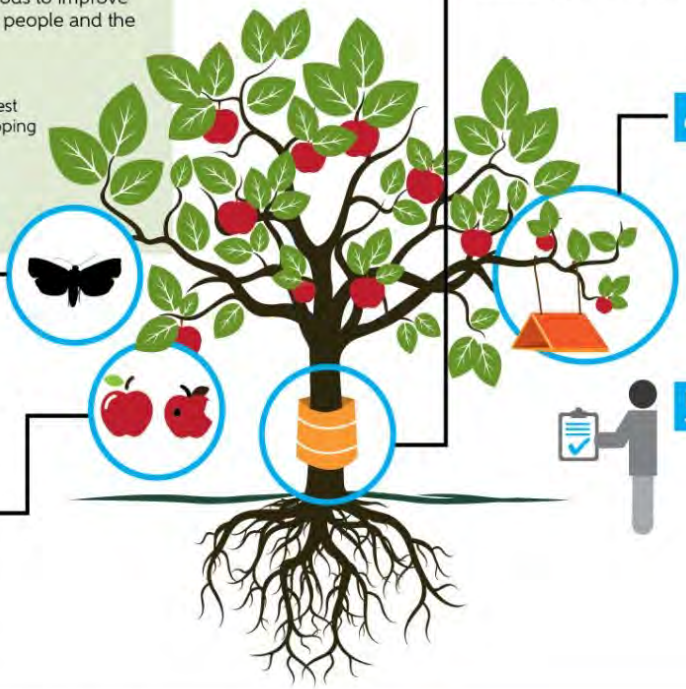
1 IDENTIFY/ MONITOR
Determine the causal agent and its abundance (contact your local extension agent for help).

2 EVALUATE
The results from monitoring will help to answer the questions: Is the pest causing damage? Do we need to act? As pest numbers increase toward the economic threshold further treatments may be necessary.

3 PREVENT
Some pest problems can be prevented by using resistant plants, planting early, rotating crops, using barriers against climbing pests, sanitation, and sealing cracks in buildings.

4 ACTION
IPM uses multiple tools to reduce pests below an economically damaging level. A careful selection of preventive and curative treatments will reduce reliance on any one tactic and increase likelihood of success.

5 MONITOR
Continue to monitor the pest population. If it remains low or decreases, further treatments may not be necessary, but if it increases and exceeds the action threshold, another IPM tool should be used.



WHERE CAN YOU PRACTICE IPM?

Buildings and Homes:
Inspect, identify pests, keep pests out, clean to deny pests food and water, vacuum, trap, or use low-risk pesticides.

Farms:
Check for pests/pest damage regularly, identify accurately, choose pest-resistant plant varieties, encourage/introduce beneficial insects, time planting to avoid pests, and if needed use low-risk pesticides.

Managed Natural Systems:
Identify the pest and use management options that have minimal risks to pollinators, humans, and pets.

Click graphic for more information

The Entomological Society of America is the largest organization in the world serving the needs of entomologists and other insect scientists. ESA stands as a resource for policymakers and the general public who seek to understand the importance and diversity of earth's most diverse life form—insects. Learn more at www.entsoc.org.

IPM Overview

Best Management Practices

- Chemical pesticide applications should be carefully chosen for effective and site-specific pest control with minimal environmental impact.
- Identify key pests on key plants.
- Determine the pest's life cycle, and know which life stage to target (for an insect pest, whether it is an egg, larva/nymph, pupa, or adult).
- Use cultural, mechanical, or physical methods to prevent problems from occurring (for example, prepare the site, select resistant cultivars), reduce pest habitat (for example, practice good sanitation, carry out pruning and dethatching), or to help promote biological control (for example, provide nectar or honeydew sources).
- Decide which pest management practice is appropriate and carry out corrective actions. Direct control where the pest lives or feeds.
- Use preventive chemical applications only when your professional judgment indicates that properly timed preventive applications are likely to control the target pest effectively while minimizing the economic and environmental costs.
- Determine whether the corrective actions actually reduced or prevented pest populations, were economical, and minimized risks. Record and use this information when making similar decisions in the future.

Written Plan

Principles

IPM is an overall pest management strategy that includes biological controls, cultural methods, pest monitoring, other applicable practices, and is a last measure when threshold levels are exceeded.

A pest-control strategy should be used only when the pest is causing or is expected to cause more damage than what can be reasonably and economically tolerated. A control strategy should be implemented that reduces the pest numbers to an acceptable level while minimizing harm to non-targeted organisms.

When a pesticide application is deemed necessary, its selection should be based on effectiveness, toxicity to non-target species, cost, and site characteristics, as well as its solubility and persistence.

Best Management Practices

- Decide which pest management practice(s) are appropriate and carry out corrective actions. Direct control where the pest lives or feeds. Use properly timed preventive chemical applications only when your professional judgment indicates they are likely to control the target pest effectively, while minimizing the economic and environmental costs.
- Determine whether the corrective actions actually reduced or prevented pest populations, were economical, and minimized risks. Record and use this information when making similar decisions in the future.
- Observe and document turf conditions regularly (daily, weekly, or monthly, depending on the pest), noting which pests are present, so intelligent decisions can be made regarding how damaging the pests are and what control strategies are necessary.

Pest Thresholds

Principles

IPM is commonly used in agricultural crop production, where the economic thresholds for key pests have been determined. Pest levels exceeding the site's threshold warrant treatment.

Using IPM is more challenging on golf courses than in an agricultural setting. The golf industry is sensitive to aesthetic damage, and golfers are often intolerant of anything that could affect the appearance of turfgrass and ornamental plants. Increased education of golfers and maintenance personnel could raise their tolerance of minor aesthetic damage without compromising plant health, play, and aesthetics.

Best Management Practices

- Use available pest thresholds to guide pesticide application decisions (see IPM Guide).
- Use preventive chemical applications only when professional judgment indicates that properly timed preventive applications are likely to control the target pest effectively while minimizing the economic and environmental costs.
- Record and use this information when making similar decisions in the future.

CHILE PEPPER: THE HOT HEART OF NEW MEXICO AGRICULTURE

In New Mexico, the chile pepper is king. Hay is grown on 40 times the acreage and pecans rack up nearly 4.5 times the farm sales, but you don't see either of those crops on the "Welcome to New Mexico" signs as you drive into the state. You see red and green chile peppers.

Chile isn't a crop, it's culture. When the summer's crop ripens, families gather to roast, peel and freeze chile for the upcoming year. New Mexicans - natives and transplants alike - know the names of the different varieties grown in the state - Big Jims, Jalmundos and 64s - and argue about the proper way to prepare them. People have favorite varieties, favorite recipes and favorite dishes at local restaurants. Like Florida citrus and Idaho potatoes, New Mexico's identity is tied to a crop.

New Mexico is chile, and chile is New Mexico.

Monitoring

Principles

Monitoring, or scouting, is the most important element of a successful IPM program. Monitoring documents the presence and development of pests, or the conditions that are conducive for pest outbreak throughout the year.

It is essential to record the results of scouting in order to develop historical information, document patterns of pest activity, and document successes and failures.

Best Management Practices

- Train personnel to observe and document turf conditions regularly (daily, weekly, or monthly, depending on the pest), noting which pests are present, so intelligent decisions can be made regarding how damaging they are and what control strategies are necessary.
- Train personnel to determine the pest's life cycle, and know which life stage to target (for an insect pest, whether it is an egg, larva/nymph, pupa, or adult).
- Train personnel to determine whether the corrective actions actually reduced or prevented pest populations, were economical, and minimized risks. Record and use this information when making similar decisions in the future.
- Train personnel to document, identify, and record key pest activities on key plants.
- Look for signs of the pest. These may include mushrooms, animal damage, insect frass, or webbing.
- Identify the symptoms of the pest. Look for symptoms such as chlorosis, dieback, growth reduction, defoliation, mounds, or tunnels.
- Determine the damage. Problem areas might include the edges of fairways, shady areas, or poorly drained areas.
- Document when the damage occurred. Note the time of day, year, and flowering stages of nearby plants.
- Map pest outbreaks locations to identify patterns and susceptible areas for future target applications and ultimate pesticide reductions.

Record Keeping

Principles

It is essential to record the results of scouting in order to develop historical information, document patterns of pest activity, and document successes and failures.

Record keeping is required to comply with the federal Superfund Amendments and Reauthorization Act (SARA, Title III), which contains emergency planning and community right-to-know legislation

Certain pesticides are classified as restricted-use pesticides (RUPs). Very few pesticides in this category are routinely used in turf maintenance, but if you happen to use one of them, certain record-keeping requirements apply.

Best Management Practices

- Document, identify, and record key pest activities on key plants and locations.
- Determine the pest's life cycle, and know which life stage to target (for an insect pest, whether it is an egg, larva/nymph, pupa, or adult).
- Determine whether the corrective actions actually reduced or prevented pest populations, were economical, and minimized risks. Record and use this information when making similar decisions in the future.
- Observe and document turf conditions regularly (daily, weekly, or monthly, depending on the pest), noting which pests are present, so intelligent decisions can be made regarding how damaging they are and what control strategies are necessary.

Western IPM Center

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IPM IN NEW MEXICO

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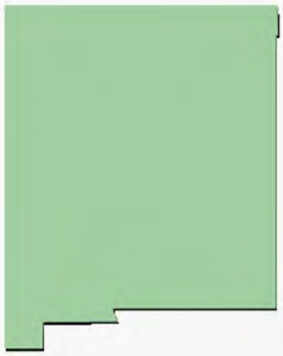


State-by-State: IPM in New Mexico

Population: 2 million

Farm Operations: 24,700

Leading Agricultural Products:

Livestock: Dairy, cattle, sheep and goats
Crops: Hay, pecans, onions, corn, chile peppers, cotton, wheat, beans, sorghum

IPM Adoption Mandates: None

See a photo essay on IPM in New Mexico

Update

Like many states, some of the biggest IPM challenges facing New Mexico are being caused by newly arrived invasive pests, including the Bagrada bug and spotted wing Drosophila.

"The Bagrada bug is a problem for organic producers, especially," said Tessa Grasswitz, New Mexico's state IPM coordinator and an entomologist at New Mexico State University. "A summary of our IPM-related needs would include better controls for squash bugs, grasshoppers and aphids."

Aphids have become a greater concern as more small-scale growers have begun using hoop-houses to extend their growing season, Grasswitz said, which is providing more early season cover for aphid pests.

"Last year, we also found a new aphid pest of cereal crops that had been previously only found in California and Georgia," she said. "We are getting more and more invasive species."

Spotted wing Drosophila arrived in New Mexico in 2013 near Albuquerque, and has spread north to just beyond Santa Fe. Grasswitz was part of a six-state urban and small farms IPM project, and found that small farms on the urban fringe are great places to monitor for invasive pests, which tend to spread along the highway system.

Turfgrass Selection

Principles

Selecting pest-resistant cultivars or plant species is a very important part of IPM, and it leads to reduced pesticide usage. Species grown outside of their zone of adaptation are more prone to pest problems.

Species and cultivars should be managed under conditions similar to their intended use (for example, not exceeding mowing height limitations that a grass was bred for or selected for).

Educate builders, developers, golf course and landscape architects, sod producers, golfers and others on which plants are best suited to their areas.

Turfgrasses must be scientifically selected for the eco-region of the golf course, resulting in minimized irrigation requirements, fertilization needs, and pesticide use.

Best Management Practices

- Select the most suitable turfgrass for existing conditions and one that adheres to design specifications.
- Avoid use of turfgrass in heavy shade.
- Select shade-adapted grasses for areas receiving partial sun or shaded areas.
- Reduce pest and disease pressures by correcting dead spots and air-circulation issues by pruning understory and adjusting irrigation scheduling.
- Reduce fertilizer applications in shaded areas.
- Reduce traffic in shaded areas to protect turfgrasses and trees from injury and soil compaction, if practical.

NM STATE **BE BOLD.** Shape the Future.
New Mexico State University

IPM for New Mexico Home Gardeners

Black swallowtail larva on dill

Pest problems in the garden usually arise either because the plants chosen are poorly adapted to the site (and hence under stress), or because inadequate attention is being paid to maintaining plant health through proper care and maintenance. Following the principles of IPM outlined in the guide below can help prevent pest outbreaks in the garden and benefit a surprising diversity of wildlife - both large and small. The larva on the right, for example, eventually turns into a beautiful Black Swallowtail butterfly - an addition to the garden that is well worth the sacrifice of a few of your dill plants, which will usually re-grow anyway.

An important component of IPM is the suite of naturally occurring biological control agents (predators and parasites) that can help keep potential pests under control. Some of these beneficial insects are illustrated in the guide in the second link below.

Integrated Pest Management (IPM) for Home Gardeners
Revised by Ashley Bennett[1]

Backyard Beneficial Insects in New Mexico

Integrated Pest Management (IPM)

CITY OF SANTA FE IPM PROGRAM

What is IPM?

Integrated Pest Management (IPM) is a decision‐making process for managing pests that uses monitoring to determine pest injury levels and primarily uses cultural, mechanical, physical, and biological tools to minimize health, environmental, and financial risks. The method uses extensive knowledge about pests, such as infestation thresholds, life histories, environmental requirements and natural enemies to complement and facilitate biological and other natural control of pests. The method uses the least toxic synthetic pesticides only as a last resort to manage pests.

The Goal of IPM

The goal of IPM is not to eradicate pests, but to eliminate pest problems by strengthening and stabilizing the landscape so that conditions are more favorable for plants than for pests. By using scouting and monitoring practices for pests (insects, other arthropods, weeds, pathogens or vertebrates), actions to suppress population levels can be made in a timely manner, using a combination of the most environmentally-friendly and cost-effective tactics available.

- Preserving naturally occurring predators such as lady bird beetles is important in the pest management process.

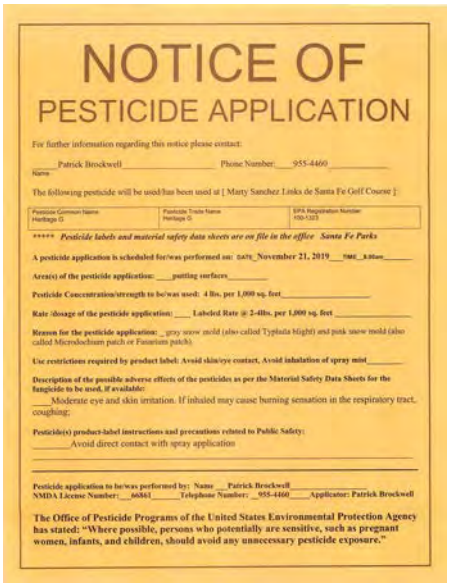
IPM Decision-Making Steps:

1. Identify the pest
2. Determine pest densities
3. Select one or more management options (prevention, cultural control, mechanical control, biological control, chemical control or no control warranted)
4. Implement management options
5. Evaluate the success of management options
6. Record results

Notice of Pesticide Application

The IPM Program Manager will give up to 72 hours prior notice of pesticide application along with a description of area or areas that will receive a pesticide application.Pesticide applications will be cancelled or postponed if weather conditions are not favorable for application including excessive winds or a precipitation event.

Click here for more information



NOTICE OF
PESTICIDE APPLICATION

For further information regarding this notice please contact:

_____Patrick Brockwell_____ Phone Number:___955-4460_____
Name

The following pesticide will be used/has been used at [Marty Sanchez Links de Santa Fe Golf Course]:

Pesticide Common Name Heritage G	Pesticide Trade Name Heritage G	EPA Registration Number 100-1323

***** *Pesticide labels and material safety data sheets are on file in the office Santa Fe Parks*

A pesticide application is scheduled for/was performed on: DATE November 21, 2019 TIME 8:00am

Area(s) of the pesticide application: ____putting surfaces_____

Pesticide Concentration/strength to be/was used: 4 lbs. per 1,000 sq. feet_____

Rate /dosage of the pesticide application: ___ Labeled Rate @ 2-4lbs. per 1,000 sq. feet _____

Reason for the pesticide application: _gray snow mold (also called Typhula blight) and pink snow mold (also called Microdochium patch or Fusarium patch).

Use restrictions required by product label: Avoid skin/eye contact, Avoid inhalation of spray mist_____

Description of the possible adverse effects of the pesticides as per the Material Safety Data Sheets for the fungicide to be used, if available:
____Moderate eye and skin irritation. If inhaled may cause burning sensation in the respiratory tract, coughing;

Pesticide(s) product-label instructions and precautions related to Public Safety:
_____Avoid direct contact with spray application

Pesticide application to be/was performed by: Name ___Patrick Brockwell_____
NMDA License Number:___66861_____Telephone Number:__955-4460____Applicator: Patrick Brockwell

The Office of Pesticide Programs of the United States Environmental Protection Agency has stated: "Where possible, persons who potentially are sensitive, such as pregnant women, infants, and children, should avoid any unnecessary pesticide exposure."

Biological Controls

Principles

The biological component of IPM involves the release and/or conservation of natural predators, such as parasites and pathogens, and other beneficial organisms (pollinators).

Natural enemies (including ladybird beetles, green lacewings, and mantids) may be purchased and released near pest infestations.

Areas on the golf course can also be modified to better support natural predators and beneficial organisms.

Best Management Practices

- Identify areas on the golf course that can be modified to attract natural predators, provide habitat for them, and protect them from pesticide applications.
- Install flowering plants that can provide parasitoids with nectar, or sucking insects (aphids, mealybugs, or soft scales) with a honeydew source.
- Avoid applying pesticides to roughs, driving ranges, or other low-use areas to provide a refuge for beneficial organisms.
- Release insect-parasitic nematodes to naturally suppress mole crickets and white grubs.

BIOCONTROL FOR SALT CEDAR

Another New Mexico State University scientist, weed ecologist Erik Lehnhoff, is working on a different integrated pest management problem, with Western IPM Center funding. He's studying how biocontrol insects can be incorporated with existing management practices to control salt cedar, a water-hungry invasive plant also known as tamarisk, in the Caballo Reservoir outside the town of Truth or Consequences.

"The Bureau of Reclamation manages the reservoir, and they put a lot of effort into managing salt cedar," he explained. "They spend a lot of money mowing - their mowing program goes on for four months - and applying herbicide."

Lehnhoff is looking at how native tamarisk beetles - which feed on tamarisk plants - can be incorporated into that overall management strategy to reduce the effort and cost.

"We're not really trying to kill it, because it will always grow back," he said. "What we want to do is make it stressed so it's not using as much water."

Salt cedar is a problem at lakes and reservoirs throughout the Southwest, and part of Lehnhoff's research is trying to quantify water savings from better salt cedar control.

"It's a complicated problem, but we're hoping that the data lets managers be more comfortable with the concept of letting the beetles do their job and they can cut back on mowing and herbicides," he said. "In a perfect world, we'd use fewer inputs and achieve better control."



Pollinators

Principles

It is important to minimize the impacts on bees and beneficial arthropods. Pesticide applicators must use appropriate tools to help manage pests while safeguarding pollinators, the environment, and humans.

Pollinator-protection language is a label requirement found on pesticide labels.

Be mindful of pollinators; when applying pesticides, focus on minimizing exposure to non-target pollinators in play and non-play course areas.

Pollinators may be negatively impacted when pesticide applications are made based on insufficient information and/or made without regard to the safety of pollinators.

Best Management Practices

- When using pesticides, minimize injury and damage by following label directions.
- Follow label information concerning the application of pesticides when plants may be in bloom. Avoid applying pesticides during bloom season.
- Stay on target by using coarse-droplet nozzles and monitor wind to reduce drift.
- Do not apply pesticides when pollinators are active.
- Before applying a pesticide, scout/inspect area for both harmful and beneficial insect populations, and apply only when the indicated threshold of damage has been reached.
- Mow flowering plants (weeds) before insecticide application.
- If flowering weeds are prevalent, control them before applying insecticides.
- Use insecticides that have a lower impact on pollinators.
- Use the latest spray technologies, such as drift-reduction nozzles to prevent off-site (target) translocation of pesticide.
- Avoid applications during unusually low temperatures or when dew is forecasted.
- Use granular formulations of pesticides that are known to be less hazardous to bees.
- Consider lures, baits, and pheromones as alternatives to insecticides for pest management.

Although an important pollinator, honey bees are not native to the United States and are not the only bees helping pollinate your farms and gardens; there are over 1,000 native bee species in New Mexico. These, along with other pollinators, all contribute to ecosystem services. Many stakeholders seek information on strategies to augment pollinators and increase pollination services to gardens, farms, and natural areas. To design pollinator habitat, our past and present research addresses the attractiveness of plants used in NM as well as the attractiveness of planting combinations for beneficial insects.

Backyard Beneficial Insects in New Mexico

Guide to Native Bees of New Mexico

Current research at the Los Lunas Agricultural Science Center (ASC) is focused around investigating combinations of NM native plants that will specifically target specific beneficial insect groups for conservation and pollination services. A demonstration research plot was established in 2018 to address stakeholder questions regarding ideal planting combinations for pollinators and other beneficial insects. The objective of this applied research is to develop and evaluate three flower mixes that are designed to attract different groups of beneficial insects. The three mixes include: 1) a bumble bee mix, 2) a solitary bee mix, and 3) a natural enemy mix. Anticipated outcomes include increased awareness around the value of specific planting combinations in attracting and conserving pollinators and more habitat installed for pollinators.

Pollinator Plants for New Mexico

Conventional Pesticides

Principles

IPM does not preclude the use of pesticides. However, pesticides should be viewed as one of the many tools used to minimize pest problems.

IPM involves both prevention — keeping the pest from becoming a problem — and suppression — reducing the pest numbers or damage to an acceptable level.

A pest-control strategy using pesticides should be used only when the pest is causing or is expected to cause more damage than what can be reasonably and economically tolerated.

Pesticides are designed to control or alter the behavior of pests. When, where, and how they can be used safely and effectively is a matter of considerable public interest.

Pesticides should be evaluated on effectiveness against the pest, mode of action, life stage of the pest, personnel hazards, non-target effects, potential off-site movement, and cost.

A control strategy should be implemented that reduces the pest numbers to an acceptable level while minimizing harm to non-targeted organisms.

Always follow the directions on the label. These directions have been developed after extensive research and field studies on the chemistry, biological effects, and environmental fate of the pesticide. The label is the single most important document in the use of a pesticide. State and federal pesticide laws require following label directions!

Best Management Practices

- Train employees in proper pest identification and pesticide selection techniques.
- Choose the product most appropriate for the problem or pest.
- Mix only the quantity of pesticide needed in order to avoid disposal problems, protect non-target organisms, and save money.
- Spot-treat pests whenever appropriate.
- Make note of any environmental hazards and groundwater advisories included on the label.
- Rotate pesticide modes-of-action to reduce the likelihood of resistance.
- Follow guidelines and advice provided by the Fungicide Resistance Action Committee (FRAC), Herbicide Resistance Action Committee (HRAC),and Insecticide Resistance Action Committee (IRAC).

Disease

Principles

In the presence of a susceptible host and a conducive environment, plant pathogens can disrupt play by damaging and destroying intensely managed turf.

No measure can completely eliminate the threat of turfgrass disease on a golf course. However, turfgrass managers have multiple tactics and tools that can reduce the likelihood of disease.

Cultural factors that can influence turfgrass stress and the likelihood of disease problems include organic layer management, fertility programs, water management, and mowing height selection. Healthy, well-managed turfgrass is less likely to develop disease problems.

Disease outbreaks that do occur are less likely to be severe on turf that is healthy because it has better recuperative potential than stressed, unhealthy turf.

Best Management Practices

- Correctly identify the disease pathogen. This often involves sending samples to diagnostic clinics.
- Ensure that proper cultural practices that reduce turfgrass stress are used.
- Correct conditions that produce stressful environments for the turf (for example, improve airflow and drainage, reduce or eliminate shade.)
- Fungicide use should be integrated into an overall management strategy for a golf course.
- The appropriate (most effective) preventive fungicide should be applied to susceptible turfgrasses when unacceptable levels of disease are likely to occur.
- Preventively apply appropriate fungicides where diseases are likely to occur and when conditions favor disease outbreaks.
- Record and map disease outbreaks and identify trends that can help guide future treatments and focus on changing conditions in susceptible areas to reduce disease outbreaks.

TUSSOCK MOTH OUTBREAK

In those mountains above Albuquerque, forest managers are dealing with several tree-killing pest species, the latest of which is an outbreak of Douglas fir tussock moths that are feeding on white fir.

"We're in the first year of defoliation from this pest in this area," explained U.S. Forest Service Entomologist Andrew Graves. "When you scout for it, there's a ratio of egg masses per tree that indicates a building population, and we're seeing population densities 10 times higher than that."

In fact, the moth is so prevalent that the easiest place to see evidence of it is on bathroom walls, where pupal cases and egg masses line many crevices. The forest faces many other pest pressures as well, all of them exacerbated by drought and forest density.

"The forests are too dense," Graves said. "One of the biggest hurdle in all of this is getting the public on board with what a properly thinned forest would look like, because it's not what we're used to seeing. What forests look like today are way too dense."

Figure 1. Douglas-fir tussock moth adults: male (left) and female (right). *Photo: Rocky Mountain Region, USDA Forest Service.*

Figure 2. Douglas-fir tussock moth larva. *Photo: Rocky Mountain Region, USDA Forest Service.*

Western IPM Center

Weeds

Principles

Weeds compete with desired plants for space, water, light, and nutrients and can harbor insect pests and diseases.

Weed management is an integrated process where good cultural practices are employed to encourage desirable turfgrass ground cover, and where herbicides are intelligently selected and judiciously used. A successful weed management program consists of:

preventing weeds from being introduced into an area

using proper turfgrass management and cultural practices to promote vigorous, competitive turf

properly identifying weeds

properly selecting and using the appropriate herbicide, if necessary

Weeds are hosts for other pests such as plant pathogens, nematodes, and insects, and certain weeds can cause allergic reactions in humans.

Weeds reproduce from seed, root pieces, and special vegetative reproductive organs such as tubers, corms, rhizomes, stolons, or bulbs. People, animals, birds, wind, and water can distribute seeds.

Weeds complete their life cycles in either one growing season (annuals), two growing seasons (biennials), or three or more years (perennials). Annuals that complete their life cycles from spring to fall are referred to as summer annuals. Those that complete their life cycles from fall to spring are winter annuals.

NM STATE BE BOLD. Shape the Future. New Mexico State University

Troublesome Weeds of New Mexico

Jamshid Ashigh, James Wanstall and Frank Sholedice
College of Agricultural, Consumer and Environmental Sciences, New Mexico State University

(Print Friendly PDF)

Invasive weeds pose a serious and increasing threat to New Mexico's environment and economy. These weeds are tough competitors and can spread rapidly, creating large stands that can persist for many years in the environment and cause many
negative impacts to our ecosystems. While these impacts are
species-specific,weeds have been documented to cause the
following: displacement of native plants and animals,increased fire danger, increased soil erosion, increased flood severity, increased soil salinity, and decreased water quality. In agricultural and rangeland settings, these weeds can cause severe economic impacts by decreasing crop yields and lowering available forage for range animals, resulting in a decrease in livestock health.

Click Here for full article and list

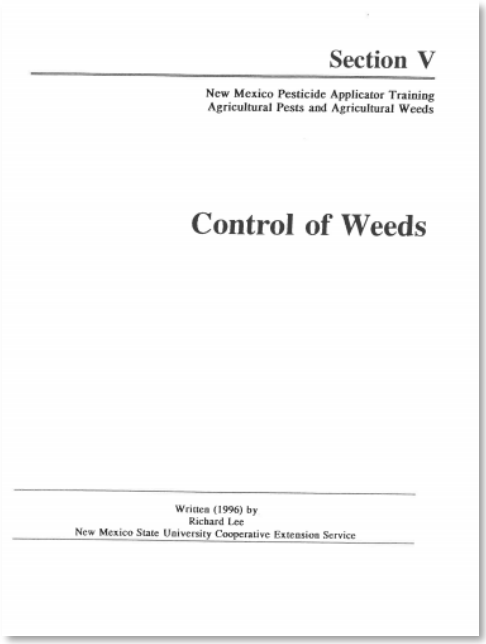
New Mexico Department of Agriculture

NMDA

AGRICULTURAL PEST AND WEED TRAINING MANUAL

Agricultural Pest Control and Agricultural Weed Control

The *NM Training Manual for Agricultural Pest Control and Agricultural Weed Control*, is a comprehensive manual on agricultural pests. This includes insects and mites, plant pathogens, nematodes, and weeds and the use of soil fumigants.


Section V

New Mexico Pesticide Applicator Training
Agricultural Pests and Agricultural Weeds

Control of Weeds

Written (1996) by
Richard Lee
New Mexico State University Cooperative Extension Service

This manual is also used for the Private Applicator exam.

You can access the PDF version below by selecting from the different sections

Best Management Practices

- Proper weed identification is essential for effective management and control.
- Select appropriate turf species or cultivars that are adapted to the prevalent environmental conditions to reduce weed encroachment that may lead to bare soils.
- To prevent weed encroachment, adopt or maintain cultural practices that protect turfgrass from environmental stresses such as shade, drought, and extreme temperatures.
- To reduce weed infestation, address improper turf management practices, such as the misuse of fertilizers and chemicals, improper mowing height or mowing frequency, and improper soil aeration, and physical damage and compaction from excessive traffic.
- Proper fertilization is essential for turfgrasses to sustain desirable color, growth density, and vigor and to better resist diseases, weeds, and insects.
- Avoid scalping; it reduces turf density, increasing weed establishment.
- Weed-free materials should be used for topdressing.
- Address damage from turfgrass pests such as diseases, insects, nematodes, and animals to prevent density/canopy loss to broadleaf weeds.
- Record and map weed infestations to help identify site specific issues for preventative actions.

Nematodes

Principles

Plant-parasitic nematodes adversely affect turfgrass health.

Plant-parasitic nematodes are microscopic roundworms (unsegmented), usually between 0.0156 and 0.125 inch (0.25 and 3 mm) in length, and are difficult to control.

Nematodes debilitate the root system of susceptible turfgrasses; plant-parasitic nematodes cause turf to be less efficient at water and nutrient uptake from the soil and make it much more susceptible to environmental stresses. Additionally, weakened turf favors pest infestation, especially troublesome weeds that necessitate herbicide applications.

Over time, turf in the affected areas thins out and, with severe infestations, may die. The roots of turfgrasses under nematode attack may be very short, with few, if any, root hairs, or they may appear dark and rotten.

Turfgrasses usually begin showing signs of nematode injury as they experience additional stresses, including drought, high temperatures, low temperatures, and wear.

Best Management Practices

- When nematode activity is suspected, an assay of soil and turfgrass roots is recommended to determine the extent of the problem.
- The application of a nematicide on golf course turf should always be based on assay results.
- Divert traffic away from areas that are stressed by insects, nematodes, diseases, or weeds.
- Increase mowing height to reduce plant stress associated with nematodes, root-feeding insects, disease outbreaks, or peak weed-seed germination.
- Reduce/eliminate other biotic/abiotic stresses when nematodes are compromising the root system and plant health.

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 8

Pesticide Management

Pesticide use should be part of an overall pest management strategy that includes biological controls, cultural methods, pest monitoring, and other applicable practices, referred altogether as IPM. When a pesticide application is deemed necessary, its selection should be based on effectiveness, toxicity to non-target species, cost, site characteristics, and its solubility and persistence in the environment.

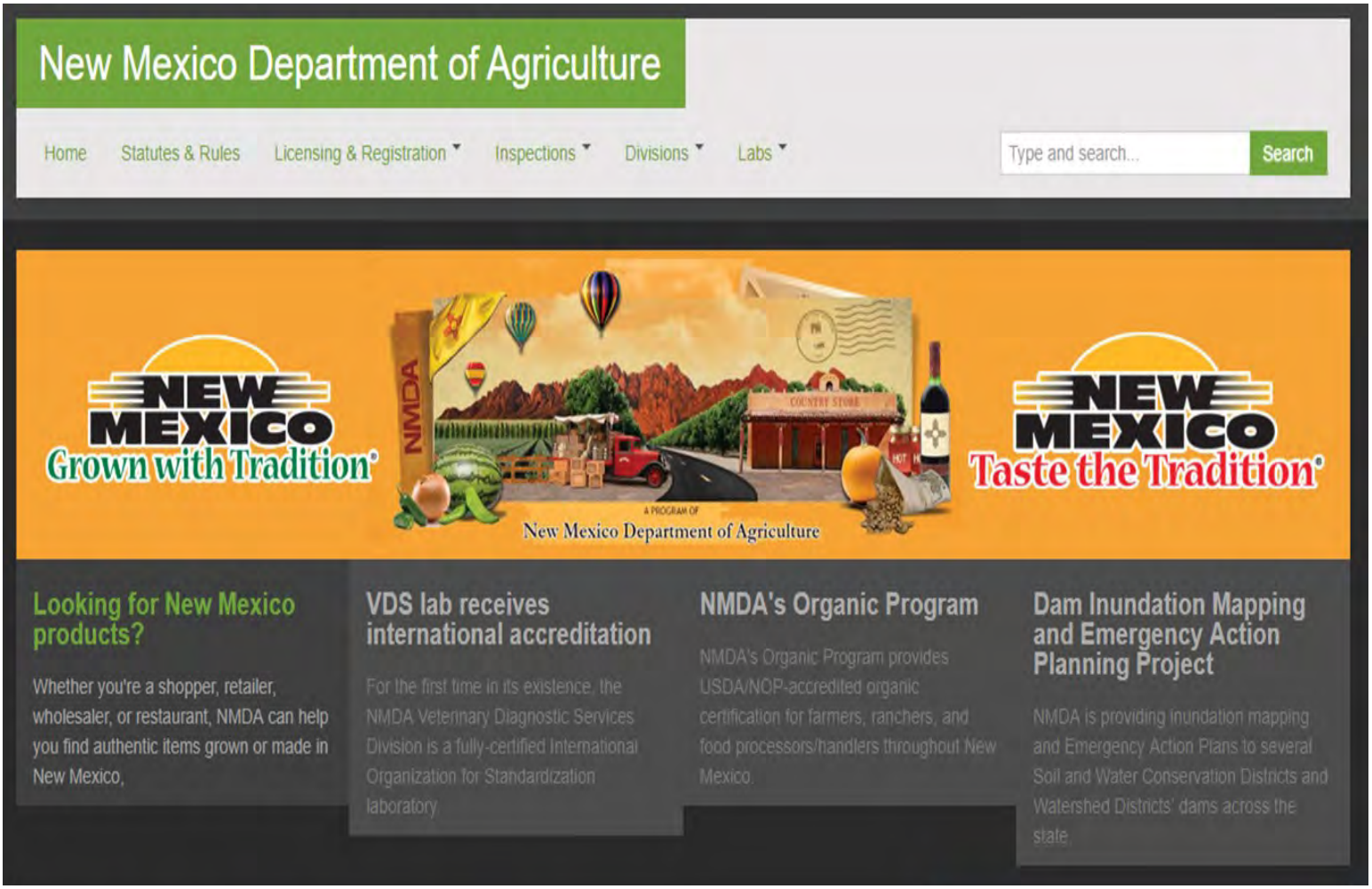
Regulatory Considerations

Principle

Pesticides contain active ingredients (the component that targets the pest) and inert ingredients such as solvents, surfactants, and carriers. Both active and inert ingredients may be controlled or regulated by federal, state, and local laws because of environmental and health concerns.

Best Management Practices

- Only apply pesticides that are legally registered at all levels of jurisdiction.
- Only apply pesticides that are legally registered for use on the facility (for example, do not apply pesticides labeled for agricultural uses even though they may have the same active ingredient).
- Apply according to manufacturer recommendations as seen on label.



Human Health Risks

Principle

Pesticides belong to numerous chemical classes that vary greatly in their toxicity. The human health risk associated with pesticide use is related to both pesticide toxicity and the level of exposure. The risk of a very highly toxic pesticide may be very low if the exposure is sufficiently small.

Best Management Practices

- Select the least toxic pesticide with the lowest exposure potential.
- Know the emergency response procedure in case excessive exposure occurs.

New Mexico Department of Agriculture

NEW MEXICO STATUTES & RULES

NMDA is responsible for the administration of over 30 state statutes and the rules and regulations promulgated under them. The statutes and rules made available here are for the public's convenience. They are meant to be used only as a reference. The department has made every effort to accurately reproduce these statutes here; however, they are not the official statutes of the state. The official statutes are made available on the Internet on the New Mexico Compilation Commission website. The official rules are available at the New Mexico Administrative Code website. If there are any discrepancies between versions provided here and the official version, the official version has precedence.

FEED, SEED & FERTILIZER

Commercial Feed Act *Chapter 76, Article 19A*

Commercial Feeds *21.18.3 NMAC*

Seed Law *Chapter 76, Article 10*

Seed Standards & Classifications *21.18.4 NMAC*

New Mexico Fertilizer Act *Chapter 76, Article 11*

Fertilizer Products *21.18.2 NMAC*

PESTICIDES

Pesticide Control Act *Chapter 76, Article 4*

Pesticides *21.17.50 NMAC*

Control of Wood Destroying Pests *21.17.51 NMAC*

Continuing Education Units for Pesticide Applicators *21.17.53 NMAC*

Restricted-Use Pesticides *21.17.56 NMAC*

M-44 Capsules and the Livestock Protection Col-

NATURAL RESOURCES

Noxious Weed Control Act Chapter 76, Article 7, 1-22

Noxious Weed Act of 1963 Chapter 76, Article 7, 22-30

Noxious Weed Management Act Chapter 76, Article 7D

Rangeland Protection Act Chapter 76, Article 7B

Range Management Plans Chapter 76, Article 7C

Taylor Grazing Act Funds, distribution Chapter 6, Article 11, 5

Farm and Range Improvement Fund Chapter 6, Article 11, 6

Predatory Wild Animals and Rodent Pests Chapter 77, Article 15, 1-5

Acequia and Community Ditch Fund Act Chapter 73, Article 2A, 1-3

Ditches to which applicable Chapter 73, Article 2, 27

Watershed District Act Chapter 73, Article 20, 1-24

Soil and Water Conservation District Act Chapter 73, Article 20, 25-48

Healthy Soil Act Chapter76-25-1 through 76-25-5

Environmental Fate and Transport

Principles

Environmental characteristics of a pesticide can often be determined by the environmental hazards statement found on pesticide product labels.

The environmental hazards statement (referred to as "Environmental Hazards" on the label and found under the general heading "Precautionary Statements") provides the precautionary language advising the user of the potential hazards to the environment from the use of the product. The environmental hazards generally fall into three categories: (1) general environmental hazards, (2) non-target toxicity, and (3) endangered species protection.

Best Management Practices

- .Select pesticides that have a low runoff and leaching potential.
- Before applying a pesticide, evaluate the impact of site-specific characteristics (for example, proximity to surface water, water table, and well-heads; soil type; prevailing wind; etc.) and pesticide-specific characteristics (for example, half-lives and partition coefficients)
- Select pesticides with reduced impact on pollinators.
- Select pesticides that, when applied according to the label, have no known effect on endangered species present on the facility.

New Mexico Department of Agriculture

New Mexico Pesticide Licensing

You will need a license if you:

- Want to purchase, use, sell or recommend restricted-use-pesticides
- Apply any pesticide (including general-use pesticides) for hire
- Inspect structures for wood-destroying organisms

PESTICIDE LICENSE TYPES

STUDY MATERIAL

CERTIFICATION CATEGORIES

APPLYING FOR A LICENSE

PRIVATE APPLICATORS

CONTINUING EDUCATION UNITS

Pesticide Transportation, Storage, and Handling

Principle

Storage and handling of pesticides in their concentrated form poses the highest potential risk to ground or surface waters. For this reason, it is essential that facilities for storing and handling these products be properly sited, designed, constructed, and operated.

Best Management Practices

- Store, mix, and load pesticides away from sites that directly link to surface water or groundwater.
- Store pesticides in a lockable concrete or metal building that is separate from other buildings.
- Locate pesticide storage facilities from other types of structure to allow fire department access.
- Storage facility floors should be impervious and sealed with a chemical-resistant paint.
- Floors should have a continuous sill to retain spilled materials and no drains, although a sump may be included.
- Sloped ramps should be provided at the entrance to allow the use of wheeled handcarts for moving material in and out of the storage area safely.
- Shelving should be made of sturdy plastic or reinforced metal.
- Metal shelving should be kept painted to avoid corrosion. Wood shelving should never be used, because it may absorb spilled pesticides.
- Automatic exhaust fans and an emergency wash area should be provided. Explosion-proof lighting may be required. Light and fan switches should be located outside the building, so that both can be turned on before staff enter the building and turned off after they leave the building.
- Avoid temperature extremes inside the pesticide storage facility.
- Personal protective equipment (PPE) should be easily accessible and stored immediately outside the pesticide storage area.
- Do not transport pesticides in the passenger section of a vehicle.
- Never leave pesticides unattended during transport.
- Place a spill containment kit in the storage area, in the mix/load area, and on the spray rig.

Emergency Preparedness and Spill Response

Principle

Accidents happen. Advance preparation on what to do when an accident occurs is essential to mitigate the human health effects and the impact on the environment.

Best Management Practices

- Develop a golf course facility emergency response plan which includes procedures to control, contain, collect, and store spilled materials.
- Prominently post "Important Telephone Numbers" including CHEMTREC, for emergency information on hazards or actions to take in the event of a spill.
- Ensure an adequately sized spill containment kit is readily available.
- Designate a spokesperson who will speak on behalf of the facility should an emergency occur.
- Host a tour for local emergency response teams (for example, fire fighters, etc.) to show them the facilities and to discuss the emergency response plan. Seek advice on ways to improve the plan.

New Mexico Department of Agriculture

Inspection requirements for Non-Commercial

Below is a list of common things that your inspector will be looking at during their routine inspection. Your annual inspection is a good time to ask questions. If your inspector doesn't know the answer they will find out for you.

- Are all pesticide containers in good condition? Are all labels present and legible?
- Are you in possession of old, unregistered products? If you have questions about products, ask your inspector.
- Have empty containers been triple rinsed, rendered unusable, and disposed of correctly?
- Are your bait boxes labeled with your business name, pesticide name, EPA reg. no., and the NM Poison Control number (1-800-222-1222)?
- Can you secure pesticides and application equipment so it is inaccessible to unauthorized persons?
- Is your application equipment in good working order and clean with good hoses and nozzles that don't leak? Do you have backflow prevention where appropriate?
- Do you have the personal protective equipment (PPE) required by the labels of pesticides you use? Is it clean and stored away from the pesticides?
- Have all your application records for the last two years available. Do your records include everything the law requires? Are they legible?
- The date, time, and location of the application
- The name and EPA registration number of the pesticide or pesticides used
- The concentration or rate applied
- The target pest and site (name of crop or specific site)
- If the application is made outdoors, the wind direction and speed and the temperature at the time of the application
- The total volume of mixed pesticide (use-dilution preparation) applied, whenever the pest control category is agricultural, forest, ornamental, aquatic, right-of-way, public health, or wood destroying pest control
- The name and license number of the individual who applied the pesticide

Check the products you have in storage. Do the EPA registration numbers on the products agree with the numbers on your records? These numbers can change even if the product name is the same.

Pesticide Record Keeping

Principle

Maintaining accurate records of pesticide-related activities (for example, purchasing, storage, inventory, applications, etc.) is essential.

Best Management Practices

- Keep and maintain records of all pesticides used to meet legal (federal, state, and local) reporting requirements.
- Use records to monitor pest control efforts and to plan future management actions.
- Use electronic or hard-copy forms and software tools to properly track pesticide inventory and use.
- Develop and implement a pesticide drift management plan.
- Keep a backup set of records in a safe, but separate storage area.

New Mexico Department of Agriculture

A NON-COMMERCIAL APPLICATORS LICENSE

Noncommercial Applicators are individuals who use pesticides only on their property or their employer's property. Examples of noncommercial applicators are owners or managers of apartment complexes or other property, nursery growers, etc. Noncommercial Applicators must meet the same requirements as Commercial Applicators except for documenting experience and the financial responsibility requirement. To apply, complete the Noncommercial Applicator application form, pass all required exams, and pay the license fee of $75.

Noncommercial Applicators may NOT apply pesticides for hire.

NEW MEXICO PESTICIDE ENFORCEMENT

Complaints

NMDA investigates all allegations of pesticide misuse or other violations of the NM Pesticide Control Act. Anyone may report pesticide exposure or misuse by calling Taryn H. VanWassenhove at (575) 646-2678 or email tvanwassenhove@nmda.nmsu.edu.

Basic information is collected when you call. This includes the site of the complaint, the applicator involved if known, and the nature of the complaint. Your name can be kept confidential if you wish. However, you should be available to answer questions during the course of NMDA's investigation. You will be asked for your phone number and a mailing address. NMDA will accept anonymous complaints but cannot guarantee that anonymity can be maintained. If you don't want to provide contact information, NMDA will still investigate and attempt to follow up.

NMDA's authority covers the use of pesticides. We cannot enforce warranties or other promises made by an applicator. We cannot force an applicator to pay damages, refund your money, or make repairs or other compensations. Nor can we take an action against a company for bad business practices; or similar resolutions.

Investigation

Once a complaint is determined to lie within NMDA's jurisdiction an investigator will be assigned to the case. Our investigators are certified and carry credentials issued by the US EPA. The investigator will contact you to schedule a meeting. This is usually at the site of the complaint; they will collect more information and evidence. He may collect samples, including photographs, documents, swab samples from treated or exposed surfaces, etc. He will visit the other parties as well and collect statements and other information from multiple sources as appropriate. His report will be forwarded to the Enforcement Program Manager for evaluation and a decision on enforcement action.

Click for more information

Sprayer Calibration

Principle

Properly calibrated application equipment is paramount to mitigating environmental and human health concerns.

Best Management Practices

- Personally ensure spray technician is experienced, licensed, and properly trained.
- Minimize off-target movement by using properly configured application equipment.
- Properly calibrate all application equipment at the beginning of each season (at a minimum) or after equipment modifications.
- Check equipment daily when in use.
- Use recommended spray volumes for the targeted pest to maximize efficacy.
- Calibration of walk-behind applicators should be conducted for each person making the application to take into consideration their walking speed, etc.

New Mexico Department of Agriculture

DON'T WAIT! CALIBRATE

Welcome to NMDA's Pesticide Compliance Calibration Toolbox!

Listed below are helpful tutorials, websites, publications and even a few apps to meet all of your calibration needs.

Tutorials on Calibrating your Equipment

Penn State - Boom Sprayer Calibration

https://www.youtube.com/watch?v=MPcC_T0GtkM

Texas A&M - How to Calibrate a Boom Sprayer

https://www.youtube.com/watch?v=AgqtJKcnTDw

Calibration Websites

Center for Integrated Pest Management – Pesticide Environmental Stewardship Calibration Page: https://pesticidestewardship.org/calibration/Pages/default.aspx

Journal of Extension - Calibration of Boom Sprayers Using Charts to Reduce Math Calculations: http://www.joe.org/joe/2001february/tt6.php

eVegetation Manager - Insecticide/Pesticide Sprayer Calibration Guide: http://www.evegetationmanager.com/GA-Pesticide_Sprayer_Calibration.html

NMSU - Boom Sprayer Calibration (1/128 Calibration Method): http://aces.nmsu.edu/county/quay/weeds/boomsprayer.html

Publications on Calibrating Your Equipment

Virginia Cooperative Extension: Calibrating Hand-Held and Backpack Sprayers for Applying Pesticides

North Dakota State University Extension Service: Spray Equipment and Calibration

MontGuide: Calibration of Pesticide Application Equipment

Calibration Apps for your Smartphone

Sprayer Depot - Sprayer Calibration Calculator: http://info.sprayerdepot.com/bid/102977/4-Features-of-the-New-Sprayer-Calibration-Calculator-App

University of Illinois Extension - Sprayer Calibration Calculator: https://engage.illinois.edu/entry/30825

Types of Sprayers

Principle

Various types and sizes of application equipment are readily available. The size of the equipment (tank size, boom width, etc.) should be matched to the scale of the facility.

Best Management Practices

- .Use an appropriately sized applicator for the size of area being treated.
- Equipment too large in size requires greater volumes to prime the system. This can result in significant waste that must be properly handled.

Boom Sprayer Calibration

NM STATE

1 / 128 Calibration Method

8 Steps to Follow

Review the Steps

Things to Consider

USGA

GPS Technology Takes Course Maintenance To The Next Level

GPS-guided sprayers apply products only to desired target areas. A computer controls the nozzles to ensure precise and efficient applications.

Click for full article

How To Spray The Right Way

Golf course superintendents apply materials with precisely calibrated equipment to achieve uniform coverage and maximum efficacy.

Click for full article

The 10-Percent Rule

Measuring nozzle output helps ensure uniform product distribution. Nozzles that are significantly worn need to be replaced.

Click for full article

GCSAA

SPRAYER CALIBRATION CALCULATOR

NM PESTICIDE LAW SUMMARY

NMDA

DISCLAIMER: This summary of the New Mexico Pesticide Control Act and some of the regulations published under it does not cover all provisions of the Act or regulations. This is intended as a snapshot of some of the provisions that applicators must understand. For a complete understanding of the law regarding pesticides, refer to the Act and regulations themselves (76-4-1 through 39, NMSA; and 21.17 sections 50, 51, 53 and 56 NMAC). In case of any discrepancies between this summary and state law, the law takes precedence.

Pesticide Control Act, Chapter 76 Article 4 NMSA

The New Mexico Pesticide Control Act gives the New Mexico Department of Agriculture (NMDA) authority over pesticides and pesticide applicators in the state. It includes a number of definitions, requirements, authorities, fee caps, and grounds for license denials, suspension or revocation. Regulations promulgated under the Act include Pesticides; Control of Wood-Destroying Pests; Continuing Education Units for Pesticide Applicators; and Restricted-Use Pesticides.

NMDA's Authority

NMDA is the "State Lead Agency" for pesticides, and has authority over the distribution and use of all pesticides in the state. The department can require pesticide registrants to submit the complete formula of any pesticide and information on its efficacy or tests of the claims it makes. It can classify pesticides as Restricted that may be federally unrestricted.

NMDA establishes certification requirements for pesticide applicators.

Continued on next page

NM PESTICIDE LAW SUMMARY

It can establish standards and requirements for pesticide use, handling, and supervision of technicians for commercial applicators.

No city, county, or other political subdivision can adopt ordinances or rules that regulate pesticides in New Mexico. (Some municipalities have policies or memorials that govern their own use of pesticides on their own property, but they cannot regulate others' pesticide uses.)

NMDA can inspect and sample any pesticides sold in the state, and can sample land and agricultural products to check for illegal pesticide residues. It can enter public or private property in order to investigate complaints, inspect storage areas, or inspect pesticide equipment. It can review or copy any required records or any other information for the purpose of carrying out the provisions of the Pesticide Control Act. NMDA can seek a warrant if access is denied.

Definitions

Label and Labeling refer to all the printed material that comes with a pesticide. This includes the typical label attached to the container itself plus any material on the registrant's web site, flyers that make any kind of recommendation as to its uses, and supplemental labels distributed by the registrant or their agents. If the label refers to a web site or other reference, information on that site or reference is considered part of the labeling.

Pest means any living thing that may be harmful to other living things (except man and animals) and includes plants, insects, bacteria, viruses, fungi, rodents, etc. Microorganisms harmful to people and animals (human and animal diseases) are not pests under this definition.

Pesticide means any substance intended for killing a pest, repelling a pest, preventing a pest, or otherwise affecting a pest.

Continued on next page

Herbicides, insecticides, fungicides, rodenticides, plant growth regulators, etc. are all pesticides.

Pesticide Dealers are persons who sell restricted-use pesticides. They must be licensed by NMDA.

A Pest Management Consultant is someone who gives advice or recommendations regarding the use of restricted-use pesticides. Pest Management Consultants cannot apply pesticides.

A Commercial Applicator is a person who applies any pesticides for hire.

A Public Applicator is an employee of a government agency whose duties for the agency include the use of pesticides.

A Non-Commercial Applicator is someone who uses pesticides but not in a commercial capacity. Typical Non-Commercial Applicators include apartment complex owners or managers, greenhouse managers, or golf course superintendents.

Private Applicators are farmers or ranchers who use pesticides to produce agricultural commodities on land they own or manage.

Pesticide and Device Labeling and Registration

All pesticides and devices must be registered by NMDA before they can be sold and used in the state. Most pesticides are registered by US EPA and have EPA Registration Numbers on their labels. Some pesticides that are exempt from EPA registration must still be registered by NMDA. NMDA also requires the registration of certain devices. The Pesticide Control Act has requirements for pesticide labels that largely mirror federal requirements.

The Pesticide Control Act makes it illegal to use or distribute unregistered pesticides. It also makes it illegal to distribute pesticides in containers other than the manufacturer's unopened container. This means you cannot purchase a large container of a herbicide, for example, and divide it up to sell or otherwise distribute. It is also illegal to use or distribute any pesticide that does not meet the stated quantity or contents or is in damaged or otherwise hazardous containers.

NMDA

NM PESTICIDE LAW SUMMARY

Types of Licenses

Pesticide licenses are intended for persons who apply, sell, or otherwise work with pesticides. NMDA can review any license, certification or permit if there is evidence that it was obtained or is being used for any other purpose.

Pesticide Dealer licenses are required for any establishment that sells restricted-use pesticides. Dealers are responsible for making sure they do not sell restricted-use pesticides to unlicensed persons or to persons whose certifications do not cover the type of pest control the product is labeled for. They must keep sales records that include the buyer's name, license number, brand name and EPA registration number of the pesticide, the quantity sold, and the date. The Dealer License does not cover giving technical advice or recommendations regarding the use of pesticides. Dealers who also make recommendations or apply pesticides must hold additional licenses.

Pest Management Consultants (PMCs) are individuals who are certified to provide recommendations and advice for using restricted use pesticides. PMCs may NOT apply pesticides. Home inspectors who wish to inspect property for termites and other wood destroying pests may be licensed as PMCs with the 7D category. Agricultural consultants and employees of pesticide dealers who provide recommendations for using pesticides but never actually apply pesticides may also hold this license.

Noncommercial Applicators are individuals who use pesticides only on their property or their employer's property. Examples of noncommercial applicators are owners or managers of apartment complexes or other property, nursery growers, golf course superintendents, etc.

Noncommercial Applicators must meet the same requirements as Commercial Applicators except for the financial responsibility requirement. Noncommercial Applicators may NOT apply pesticides for hire.

Continued on next page

NMDA

NM PESTICIDE LAW SUMMARY

Public Applicators are individuals who work for a government agency and whose duties include applying pesticides. Public Applicators are not required to pay testing or licensing fees, but must pass the General Pesticide exam, the Laws & Rules exam, and category exams for any type of pest control they will be doing.

Commercial Applicators apply or supervise the application of any pesticide for any purpose on someone else's property for compensation. In order to qualify for a Commercial Applicator license an individual must be able to document 2 years of experience applying pesticides, or 20 hours of college credits in biological and/or agricultural sciences plus 1 year experience. Commercial Applicator candidates must also provide proof of financial responsibility in the form of a liability insurance policy or a surety bond. Refer to the regulation for specifics on coverage.

Commercial Operators/Technicians are employees of Commercial Applicators who apply pesticides. Any employee of a Commercial Applicator who applies any pesticides, whether or not the pesticide is classified as Restricted, must be licensed. Commercial Operators/Technicians may only perform the types of pest control in which their Commercial Applicator employer is certified. Operators/Technicians must also be specifically certified in 7D, Wood-Destroying Pest Control, and hold their Termite Technician license, before they can perform any termite control.

Grounds for License Denial, Suspension or Revocation

NMDA can take action against an applicator if there is reason to believe he or she has violated the Pesticide Control Act. NMDA can suspend or revoke any pesticide applicator license, and the courts can also assess a civil penalty of up to $1,000 for each violation. Violations are petty misdemeanors. Some specific violations include:

Continued on next page

- *Using a pesticide "in a manner inconsistent with the labeling." In other words, the language on a label must be followed exactly.*
- *Operating in a "faulty, careless or negligent" manner.*
- *Not keeping the required records.*
- *Making false or fraudulent records.*
- *Applying a pesticide commercially without a license.*
- *Performing pest control in a category without the appropriate certification.*
- *Not complying with any of the regulations passed under the Pesticide Control Act.*
- *Aiding or conspiring with someone to violate the Pesticide Control Act.*
- *Allowing one's license to be used by another person.*
- *Using or supervising the use of a restricted-use pesticide when not certified.*

Regulations

In addition to the Pesticide Control Act, these regulations apply to most commercial, public and noncommercial applicators: Pesticides; Control of Wood Destroying Pests; Continuing Education Units for Pesticide Applicators; and Restricted-Use Pesticides. Remember, for a complete understanding you should refer to the regulations themselves.

Pesticides 21.17.50 NMAC

This is the most detailed and longest of the regulations under the Pesticide Control Act. It provides additional detail and clarification of licensing, pesticide use, record keeping, certification categories, and most of the other information applicators should know.

Definitions:

A Certified Applicator is anyone who has met the requirements to use and supervise the use of restricted-use pesticides. Certified applicators may be Commercial, Public, Private, or Non-commercial applicators.

Competent means qualified to mix, load, apply, and otherwise use pesticide products. Competency requirements are directly related to the nature of the work, the toxicity of the pesticide, and the level of responsibility involved. Competency is demonstrated by passing certification exams.

Direct Supervision is verifiable supervision of pesticide applicators and includes providing training and other guidance; the ability to be contacted whenever needed; and when required, being present at the pesticide use site.

Operators or Technicians are employees of licensed commercial applicators.

Service Containers are used to store or transport a concentrate or mixed pesticide. The original labeled container and application equipment are not service containers.

Service Vehicle means the vehicle used to transport application equipment and/or use-dilution preparations to an application site.

Use-Dilution Preparation means a pesticide that is no longer a concentrate but has been mixed to the rate that will be applied (mixed pesticide; diluted pesticide).

Persons applying for commercial, public, and noncommercial licenses can select which categories of pest control they want to be certified in. Applicators can only apply pesticides in their categories. For descriptions of the categories refer to the regulation itself.

Candidates for licenses can retake failed exams as many times as necessary to pass (70% is passing) but must complete all the license requirements within 60 days. This means that from the date of an application's approval, the candidate must pass all required exams, furnish proof of insurance (for commercial), and pay the license fee, all within 60 days. If licensing is not completed within 60 days the candidate forfeits any exams he or she may have passed and must start over.

Continued on next page

NMDA

NM PESTICIDE LAW SUMMARY

Commercial applicators must document that they hold insurance for applying pesticides that meets the following minimum coverage. NMDA cannot issue a commercial applicator license until proof of insurance has been received.

Liability insurance for applicators using ground or manual equipment: $10,000 each occurrence and $25,000 aggregate bodily injury; property damage of $25,000; and single-limit $50,000. For applicators using aerial equipment (planes or helicopters) the limits go up to $25,000 each occurrence and $50,000 aggregate bodily injury; property damage of $50,000; and single-limit $100,000. The deductible must be $1,000 or less. As an alternative to insurance applicators can take out a surety bond of $100,000.

License fees are $75 for commercial applicators and non-commercial applicators and $50 for operators/ technicians. The exam fee is $10 per exam. Public applicators are not required to pay fees. All licenses expire December 31 of the year issued.

Private applicators are farmers, ranchers, or other producers of agricultural commodities who need to use restricted-use pesticides in the course of their ag production. They must pass an exam and pay a $15 fee for this license; it expires on December 31 five years after issuance.

All persons must follow the label directions, rates, precautions, etc. Failing to follow the label is an illegal use and a violation of state and federal law. Restricted-use pesticides can only be used by licensed applicators. All applicators must have and use all personal protective equipment (PPE) required by the labels of pesticides they are using. PPE must be kept clean and in good working order and users must understand how to wear it properly.

Service vehicles used by commercial applicators and operators must be prominently marked with the name of the firm and the commercial applicator's license number so they are visible from both sides of the vehicle.

Continued on next page

Service containers must be marked with the brand name or the common name of the pesticide they contain.

Pesticides and application equipment in service vehicles cannot be left unattended unless locked up or otherwise inaccessible to other persons.

Pesticides in storage must be secure and safe from unauthorized access and the storage cabinet, room or building must be posted with an English/Spanish warning sign. Products must be stored so they cannot contaminate food, animal feed, fertilizer, seeds, clothing, or personal protective equipment.

Application equipment must be kept in good working order and must be calibrated. It must be cleaned between uses so no potentially incompatible or illegal residue from a previous application will result. Any pesticide left in application equipment at the end of a job must be disposed of properly, not just dumped somewhere. NMDA will inspect application equipment to verify its condition at the time of the inspection and will sticker it with the date inspected.

Pesticide waste must be disposed of properly and empty containers must be crushed or pierced so they cannot be re-used for any other purpose. Waste cannot be allowed to contaminate land or water and cannot be poured down a drain or allowed to go down a storm drain. Open burning or open dumping of pesticide waste or containers is illegal.

Applicators who use bait boxes must label the boxes with their business name, the name of its pesticide or active ingredient and its EPA registration number, and the Poison Control number (800-222-1222).

Commercial, public and noncommercial applicators must keep detailed records of their pesticide applications and the applications made by anyone they supervise. Records must be completed within 24 hours of the pesticide application and must be kept for at least 2 years. NMDA must be furnished with a copy upon written request, and the customer must also be provided a copy at his written request. The application record can be in any format as long as it has all of the following:

- The customer's name;
- the date, time, and location of the application;
- The name and EPA registration number of the pesticide or pesticides used,
- The concentration or rate applied;
- The target pest and site (name of crop or specific site);
- If the application is made outdoors, the wind direction and speed and the temperature at the time of the application;
- The total volume of mixed pesticide (use-dilution preparation) applied, whenever the pest control category is agricultural, forest, ornamental, aquatic, right-of-way, public health, or wood destroying pest control; and
- The name and license number of the individual who applied the pesticide.

NMDA

NM PESTICIDE LAW SUMMARY

Control of Wood Destroying Pests 21.17.51 NMAC

Additional requirements apply to applicators and operators who apply pesticides for termites or other wood-destroying pests, and for pest management consultants who conduct inspections or make recommendations for controlling wood-destroying pests in structures (category 7D). Applicators must document one year of experience in wood-destroying pest control, attend an approved training session, and pass the certification exam. Operators/termite service technicians and pest management consultants must attend approved training and pass the certification exam. In order to maintain 7D certification individuals must earn four 7D-specific CEUs each year in addition to the four non-specific CEUs required to renew their license. Working in this category also requires that additional records be kept.

Continued on next page

Applicators are responsible for creating a detailed graph or drawing of the structure that shows all areas treated and the type of building construction.

NMDA

NM PESTICIDE LAW SUMMARY

Continuing Education for Pesticide Applicators 21.17.53 NMAC

This regulation spells out the requirements for continuing education that must be met by all applicators and defines what kind of information qualifies for CEUs (continuing education units). NMDA approves programs for CEUs if they include information on pesticide use and safety and the laws regarding pesticides. CEUs must be earned before the license expires or the applicator will have to take the exams again.

Commercial, public, and noncommercial applicators must earn four CEUs each year to be eligible to renew their licenses. Applicators and operators who are certified in wood-destroying pest control (termites, or 7D) must have an additional four CEUs specific to that category in order to retain their 7D certification. Private applicators must earn five CEUs during their five-year license period.

Restricted-Use Pesticides 21.17.56 NMAC

This regulation primarily establishes 2,4-D herbicides as state-restricted-use pesticides if they are labeled primarily for use in agriculture, rangelands, rights-of-way, or non-croplands. 2,4-D products intended and labeled primarily for turf, ornamental, and home use are not restricted. Only licensed applicators can purchase restricted 2,4-D herbicides and businesses that sell any restricted 2,4-D must be licensed as Dealers.

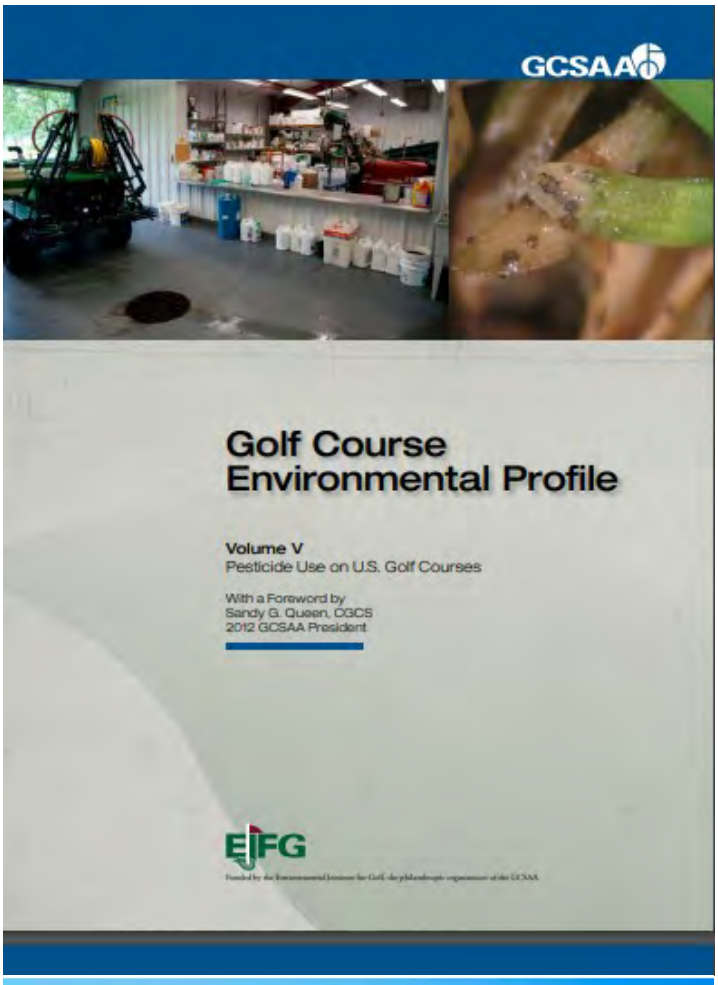
Inventory

Principles

Do not store large quantities of pesticides for long periods. Adopt the “first in–first out” principle, using the oldest products first to ensure that the product shelf life does not expire.

Best Management Practices

An inventory of the pesticides kept in the storage building and the Safety Data Sheets (SDS) for the chemicals used in the operation should be accessible on the premises, but not kept in the pesticide storage room itself.



GCSAA

Golf Course

Environmental Profile

Volume V

Pesticide Use Practices on U.S. Golf Courses

EIFG

Funded by the Environmental Institute for Golf

CLICK here for full report

GCSAA's survey on pesticide use found that golf course superintendents routinely used multiple tactics to manage pests and followed an integrated approach to pest management. Photo © Jim Krajicek

Light traps can be used as a scouting device to determine the presence and population levels of various insect pests, and thereby allow superintendents to initiate control measures in an accurate and timely fashion. Photo by Tom Royer

Shelf Life

Principles

- Pesticides degrade over time. Do not store large quantities of pesticides for long periods.
- Utilize computer software systems to record inventory and use.

Best Management Practices

- .Avoid purchasing large quantities of pesticides that require storage for greater than six months.
- Adopt the “first in–first out” principle, using the oldest products first to ensure that the product shelf life does not expire.
- Many states offer “amnesty” days in order to eliminate potential public health and environmental hazards from cancelled, suspended, and unusable pesticides that are being stored.
- Ensure labels are on every package and container.
- Consult inventory when planning and before making purchases.
- Ensure that labels remain properly affixed to their containers.

PMEP - Pesticide Safety Education Program

Part of the Pesticide Management Education Program

Cornell University Cooperative Extension

Shelf Life of Pesticides

Pesticides left over after the garden season can pose a storage problem. Safety is of course, a concern and all pesticides should be stored out of the reach of children and under lock and key if possible.

Since many home gardeners may use only small quantities of a chemical in any given season, the question often arises. How long can I keep my chemicals before they lose their effectiveness. A study of information by chemical manufacturers by J. Capizzi provides information on ranges of shelf life for pesticides.

All companies contacted in the study recommended not storing pesticides longer than two years. Other recommendations are to keep temperatures below 100 degrees F. And do not allow liquids to freeze. Keep chemicals in original containers and tightly sealed. The following are estimates on the shelf life of various insecticides, fungicides, and herbicides.

It is also important to regularly check stored pesticides, especially if you have stored them for more than a year. Some pesticides, if stored improperly or for too long a time, will not mix properly and may be ineffective.

Source: J. Capizzi, OPEW (Vol. XI, No. 3)

The following are some suggestions for safe storage:

1. Be sure that caps are tightened securely on all bottles and cans. Eliminate leaky containers.
2. Do not store weed killers close to other materials such as wettable powders, dust formulations or granular insecticides. Some weed killers such as 2,4-d and 2,4,5-t are highly volatile substances and can contaminate other materials especially when confined in close quarters.
3. Store wettable powders, dusts and granules of pesticide products in a cool, dry place.
4. Do not store liquid pesticides in a place where the temperature will fall below 40 degres f. Too low temperature may result in a breakdown of liquid material, and if the liquid should freeze, there is the danger that the glass containers will break.
5. Do not carry over pesticide products whose labels have been lost or are not complete and legible.
6. Above all, keep pesticide materials in a locked room or cabinet and out of reach of children and animals.
7. Glass bottles should always be stored within a metal can, not necessarily closeable, such as a coffee can. In the event the bottle breaks, the spillage will be contained.
8. Always purchase pesticides in a container size small enough to be used up within a season or less. This is the best method for reducing storage problems. Although this method may seem somewhat uneconomical, in the long run, it may prove to be a great savings when one looks at the previous six suggestions.

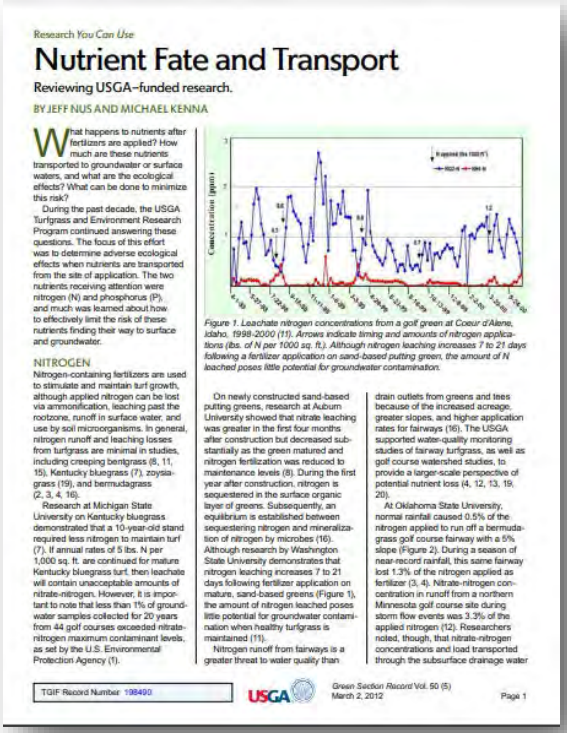
Leaching Potentials

Principles

Weakly sorbed pesticides (compounds with small Koc values) are more likely to leach through the soil and reach groundwater. Conversely, strongly sorbed pesticides (compounds with large Koc values) are likely to remain near the soil surface, reducing the likelihood of leaching, but increasing the chances of being carried to surface water via runoff or soil erosion.

Best Management Practices

- Understand pesticide sorption principles so that appropriate decisions can be made.
- Understand site characteristics that are prone to leaching losses (for example, sand-based putting greens, coarse-textured soils, shallow water tables).
- Identify label restrictions that may pertain to your facility.
- Avoid using highly water-soluble pesticides.
- Exercise caution when using spray adjuvants that may facilitate off-target movement.



Research You Can Use

Nutrient Fate and Transport

Reviewing USGA–funded research.

BY JEFF NUS AND MICHAEL KENNA

What happens to nutrients after fertilizers are applied? How much are these nutrients transported to groundwater or surface waters, and what are the ecological effects? What can be done to minimize this risk?

During the past decade, the USGA Turfgrass and Environment Research Program continued answering these questions. The focus of this effort was to determine adverse ecological effects when nutrients are transported from the site of application. The two nutrients receiving attention were nitrogen (N) and phosphorus (P), and much was learned about how to effectively limit the risk of these nutrients finding their way to surface and groundwater.

NITROGEN

Nitrogen-containing fertilizers are used to stimulate and maintain turf growth, although applied nitrogen can be lost via ammonification, leaching past the rootzone, runoff in surface water, and use by soil microorganisms. In general, nitrogen runoff and leaching losses from turfgrass are minimal in studies, including creeping bentgrass (8, 11, 15), Kentucky bluegrass (7), zoysiagrass (19), and bermudagrass (2, 3, 4, 16).

Research at Michigan State University on Kentucky bluegrass demonstrated that a 10-year-old stand required less nitrogen to maintain turf (7). If annual rates of 5 lbs. N per 1,000 sq. ft. are continued for mature Kentucky bluegrass turf, then leachate will contain unacceptable amounts of nitrate-nitrogen. However, it is important to note that less than 1% of groundwater samples collected for 20 years from 44 golf courses exceeded nitrate-nitrogen maximum contaminant levels, as set by the U.S. Environmental Protection Agency (1).

Figure 1. Leachate nitrogen concentrations from a golf green at Coeur d'Alene, Idaho, 1998-2000 (11). Arrows indicate timing and amounts of nitrogen applications (lbs. of N per 1000 sq. ft.). Although nitrogen leaching increases 7 to 21 days following a fertilizer application on sand-based putting green, the amount of N leached poses little potential for groundwater contamination.

On newly constructed sand-based putting greens, research at Auburn University showed that nitrate leaching was greater in the first four months after construction but decreased substantially as the green matured and nitrogen fertilization was reduced to maintenance levels (8). During the first year after construction, nitrogen is sequestered in the surface organic layer of greens. Subsequently, an equilibrium is established between sequestering nitrogen and mineralization of nitrogen by microbes (16). Although research by Washington State University demonstrates that nitrogen leaching increases 7 to 21 days following fertilizer application on mature, sand-based greens (Figure 1), the amount of nitrogen leached poses little potential for groundwater contamination when healthy turfgrass is maintained (11).

Nitrogen runoff from fairways is a greater threat to water quality than drain outlets from greens and tees because of the increased acreage, greater slopes, and higher application rates for fairways (16). The USGA supported water-quality monitoring studies of fairway turfgrass, as well as golf course watershed studies, to provide a larger-scale perspective of potential nutrient loss (4, 12, 13, 19, 20).

At Oklahoma State University, normal rainfall caused 0.5% of the nitrogen applied to run off a bermudagrass golf course fairway with a 5% slope (Figure 2). During a season of near-record rainfall, this same fairway lost 1.3% of the nitrogen applied as fertilizer (3, 4). Nitrate-nitrogen concentration in runoff from a northern Minnesota golf course site during storm flow events was 3.3% of the applied nitrogen (12). Researchers noted, though, that nitrate-nitrogen concentrations and load transported through the subsurface drainage water

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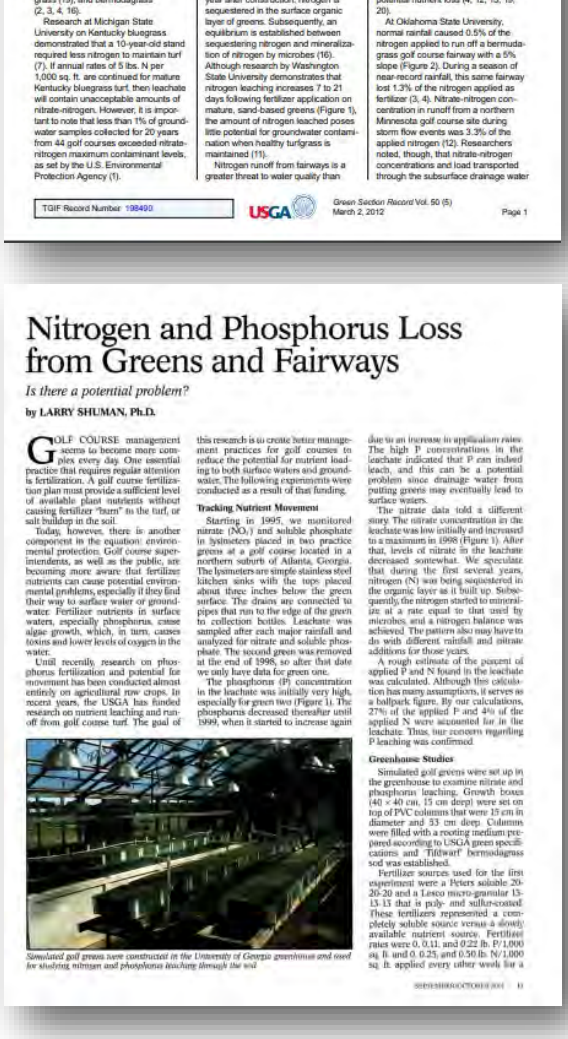

Nitrogen and Phosphorus Loss from Greens and Fairways

Is there a potential problem?

by LARRY SHUMAN, Ph.D.

GOLF COURSE management seems to become more complex every day. One essential practice that requires regular attention is fertilization. A golf course fertilization plan must provide a sufficient level of available plant nutrients without causing fertilizer "burn" to the turf, or salt buildup in the soil.

Today, however, there is another component in the equation: environmental protection. Golf course superintendents, as well as the public, are becoming more aware that fertilizer nutrients can cause potential environmental problems, especially if they find their way to surface water or groundwater. Fertilizer nutrients in surface waters, especially phosphorus, cause algae growth, which, in turn, causes toxins and lower levels of oxygen in the water.

Until recently, research on phosphorus fertilization and potential for movement has been conducted almost entirely on agricultural row crops. In recent years, the USGA has funded research on nutrient leaching and runoff from golf course turf. The goal of this research is to create better management practices for golf courses to reduce the potential for nutrient loading to both surface waters and groundwater. The following experiments were conducted as a result of that funding.

Tracking Nutrient Movement

Starting in 1995, we monitored nitrate (NO_3) and soluble phosphate in lysimeters placed in two practice greens at a golf course located in a northern suburb of Atlanta, Georgia. The lysimeters are simple stainless steel kitchen sinks with the tops placed about three inches below the green surface. The drains are connected to pipes that run to the edge of the green to collection bottles. Leachate was sampled after each major rainfall and analyzed for nitrate and soluble phosphate. The second green was removed at the end of 1998, so after that date we only have data for green one.

The phosphorus (P) concentration in the leachate was initially very high, especially for green two (Figure 1). The phosphorus decreased thereafter until 1999, when it started to increase again due to an increase in application rates. The high P concentrations in the leachate indicated that P can indeed leach, and this can be a potential problem since drainage water from putting greens may eventually lead to surface waters.

The nitrate data told a different story. The nitrate concentration in the leachate was low initially and increased to a maximum in 1998 (Figure 1). After that, levels of nitrate in the leachate decreased somewhat. We speculate that during the first several years, nitrogen (N) was being sequestered in the organic layer as it built up. Subsequently, the nitrogen started to mineralize at a rate equal to that used by microbes, and a nitrogen balance was achieved. The pattern also may have to do with different rainfall and nitrate additions for those years.

A rough estimate of the percent of applied P and N found in the leachate was calculated. Although this calculation has many assumptions, it serves as a ballpark figure. By our calculations, 27% of the applied P and 4% of the applied N were accounted for in the leachate. Thus, our concern regarding P leaching was confirmed.

Greenhouse Studies

Simulated golf greens were set up in the greenhouse to examine nitrate and phosphorus leaching. Growth boxes (40 × 40 cm, 15 cm deep) were set on top of PVC columns that were 15 cm in diameter and 53 cm deep. Columns were filled with a rooting medium prepared according to USGA green specifications and Tifdwarf® bermudagrass sod was established.

Fertilizer sources used for the first experiment were a Peters soluble 20-20-20 and a Lesco micro-granular 13-13-13 that is poly- and sulfur-coated. These fertilizers represented a completely soluble source versus a slowly available nutrient source. Fertilizer rates were 0, 0.11, and 0.22 lb. P/1,000 sq. ft. and 0, 0.25, and 0.50 lb. N/1,000 sq. ft. applied every other week for a

Simulated golf greens were constructed in the University of Georgia greenhouse and used for studying nitrogen and phosphorus leaching through the soil

SEPTEMBER/OCTOBER 2001 11

Potential Groundwater Contamination from Pesticides and Fertilizers Used on Golf Courses

by DR. BRUCE BRANHAM, DR. ERIC MILTNER* and DR. PAUL RIEKE
Michigan State University

THE environmental consequences of golf course construction and maintenance practices have captured much media attention over the last five years. Unfortunately, most of that attention has been negative. As scientists, the most galling aspect of the criticism from the media has been that it generally is based upon perceptions, hearsay, and innuendo. A few people have decided that golf courses are bad for the environment and have set out to make a case to the public, regardless of the facts about golf course management practices. It is against this backdrop that the USGA Green Section Research Committee wisely initiated a three-year research program to develop specific information concerning the effects of golf course management practices on the environment.

A review of the scientific literature provided just a handful of articles on pesticide or nutrient leaching from turfgrasses. In the design of the experiments conducted at Michigan State University (MSU), it was foremost in our experimental plan to make sure that our studies were realistic. Golf courses must be managed. Management is key to a sound, environmentally responsible system.

Turf is an excellent system to minimize leaching of pesticides and nutrients. However, a turfgrass system is highly managed, and even the best system can give poor results if poorly managed. Conversely, a poor system can often give good results when managed well. Researchers carry an important burden since the design of their research systems can dramatically influence the results obtained. It was our intent from the outset of these studies to design an experiment that would be realistic, using treatment levels that a reasonable golf course superintendent would employ.

Experimental Design

To study potential groundwater contamination, the best technique available is the use of a lysimeter, a bucket-like device to collect soil water and to monitor agrochemical movement. There are many types of lysimeters available that use various techniques for collecting soil water. At MSU, we constructed what we termed *soil monolith lysimeters*. Those lysimeters were constructed of stainless steel and had a diameter of 44.5 inches and a depth of 4 feet. They are termed monolith lysimeters to indicate that the cores are captured intact with undisturbed profiles of soil.

To construct these lysimeters, a steel cylinder, open at both ends, was pushed into the ground until filled with soil. The cylinder was then removed with the soil, inverted, and a base with a drain port was installed. We believed that by making the lysimeters 4 feet deep, whatever pesticide or fertilizer reached that point could potentially continue on and eventually reach groundwater. At a soil depth greater than 4 feet, the biological activity that can transform these products is greatly reduced.

The intent of our study was to gain an understanding of the leaching behavior of nitrogen, phosphorus, and some of the pesticides commonly used in turfgrass management.

Fate of Nitrogen in Turf

The most extensive portion of this research project examined the fate of nitrogen (N) in a Kentucky bluegrass turf grown on a sandy loam soil. It was designed to compare the fate of a single N application applied in the early spring (what we termed a *conventional N application timing*) to an application made in the fall (what is often called a *late fall or dormant N application*).

On April 26, 1991, urea was applied at a rate of 0.8 lb N/1000 ft² to the large lysimeters and to 40 smaller, open-ended cylinders that we called microplots. These 8"-diameter PVC pipes were installed in the soil near the large lysimeters, and were 24" deep. We had gone to extensive efforts to preserve the soil structure in the large lysimeter, and it did not seem reasonable then to dig into the soil in the lysimeter to take soil samples. Therefore, the microplots were treated exactly as the large lysimeters, and sets of four of these microplots were excavated periodically throughout the study to permit examination of the form and depth of the applied N, and transformations that were occurring. On November 7, 1991, a second set of lysimeters and microplots was treated with urea at a rate of 0.8 lb N/1000 ft². The seasonal nitrogen application schedule as well as the soil sampling schedule are displayed in Tables 1 and 2.

The two nitrogen regimes were designed to compare the impact of an early spring versus late fall N application on the fate and

Table 1
Seasonal Nitrogen Application Schedule During 1991*

Early Spring Schedule	Late Fall Schedule
April 26**	June 4
June 4	July 12
July 12	August 19
August 19	September 27
September 27	**November 8**

*Dates in **bold type** received nitrogen enriched in ^{15}N on those dates only.
**This schedule was followed in 1992 and 1993 without the ^{15}N applications.

Table 2
Soil Sampling Dates for Spring and Fall Treatments

Date	Treatment Sample
May 14, 1991	Spring
June 21, 1991	Spring
October, 1991	Spring
November 26, 1991	Spring, Fall
May 26, 1992	Spring, Fall
June 29, 1992	Fall
November 30, 1992	Spring, Fall
May 14, 1993	Spring, Fall
November 30, 1993	Fall

*Former research technician and graduate student; currently assistant professor, Utah State University.

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Mixing / Washing Station

Principle

Pesticide leaks or spills, if contained, will not percolate down through the soil into groundwater or run off the surface to contaminate streams, ditches, ponds, and other waterbodies. One of the best containment methods is the use of a properly designed and constructed chemical mixing center (CMC).

Best Management Practices

- Loading pesticides and mixing them with water or oil diluents should be done over an impermeable surface (such as lined or sealed concrete), so that spills can be collected and managed.
- Mixing station surface should provide for easy cleaning and the recovery of spilled materials.
- Pump the sump dry and clean it at the end of each day. Liquids and sediments should also be removed from the sump and the pad whenever pesticide materials are changed to an incompatible product (that is, one that cannot be legally applied to the same site).
- Apply liquids and sediments as you would a pesticide, strictly following label instructions.
- Absorbents such as cat litter or sand may be used to clean up small spills and then applied as a topdressing in accordance with the label rates, or disposed of as a waste.
- Sweep up solid materials and use as intended.

Audubon International

Fact Sheet

Inexpensive Wash Pad and Mix & Load Solutions

Whether you're running a golf course or just doing yard-work, cleaning and fueling up equipment are necessary tasks. Below we name some environmental safety hints for washing equipment and mixing chemical products that are useful to lawn and turf care professionals.

Wash Pads

Well maintained lawn and turf care equipment should be washed regularly to ensure a long and productive life. However, it is quite possible that something as seemingly innocuous as equipment maintenance can be causing lasting environmental harm. Let's take a moment and consider exactly what happens when you wash your equipment on your driveway or wash pad.

This wash pad was built for under $200, which included pouring the concrete, screen, and labor. Cinder blocks were reused from a past project and there is a double screen placed in the lower left corner. Water passes through the screen and out into tall vegetation, which acts as a filter.

What is in Rinsate and Where Does it Go?

First, consider exactly what you're washing off of your equipment: grass clippings, dirt, oil residue, fertilizer, and in some cases, even pesticides. Now consider where this water run-off is headed; it can flow into sewers, creeks, rivers, or even right back into the beautiful environment you've just landscaped. Not only can this be disastrous for your local environment, in many cases it is illegal. If you are washing a container that housed pesticides, like a spray tank, its runoff is legally considered pesticide waste and is subject to strict regulation. No matter what you're washing, there are ways to significantly reduce environmental harm.

For a small operation, like your Saturday morning car wash, the solution is often as simple as swapping out your traditional car-wash soap for one of the many biodegradable options on the market. Before you begin washing, observe where the run-off water will flow. Even biodegradable soap must avoid rivers, ponds and streams and storm drains. It requires soil to break down and should be directed into grass or gravel a safe distance from a stream or gutter.

Larger operations require significantly more care. Although exact regulations differ according to your location and circumstance, the chemicals and pesticides you'll be washing off your equipment should absolutely never go near any water source and should avoid even the ground. The best solution is a completely self contained system that captures run off and recycles the water. This both reduces water consumption and eliminates the concern about contamination. Unfortunately these set ups are often prohibitively expensive. Fortunately, however, there are effective, inexpensive options available.

To download this fact sheet and more, visit: www.audubonintenational.org

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Audubon International

GCM GCSAA

A low-cost wash pad solution

A New York club's self-contained system has slashed water use, curbed environmental impact, and provided a model for other businesses looking to better manage grey water.

Rick Slattery, the golf course superintendent at Locust Hill Country Club in Pittsford, N.Y., used to wash off his equipment like many of us — he had a wash pad with a drain that flowed into a septic tank.

Over the years, he noticed that a lot of water was used during the washing process. In addition, Slattery had occasionally noticed a foul odor when he wandered into a nearby forested area where the septic drains were directed.

Click for full article

Disposal

Principles

Wash water from pesticide application equipment must be managed properly, since it contains pesticide residues.

Best Management Practices

- Collect wash water (from both inside and outside the application equipment) and use it as a pesticide in accordance with the label instructions.
- The rinsate may be applied as a pesticide (preferred) or stored for use as makeup water for the next compatible application.

GCSAA RECYCLING ON GOLF COURSES

Today's world has placed a renewed emphasis on both voluntary and mandatory recycling. New technology has given many former waste products a second chance. GCSAA supports the recycling effort and encourages its members to conserve and recycle.

Recycling is a process that leads to the reuse of wastes. This process consists of collecting, transporting, sorting/grading, storing and processing. Golf course wastes that can be recycled include used motor oil, tires, batteries, cardboard, pesticide rinsate, grass and tree clippings, solvents and, in some states, pesticide containers.

Recycling makes economic and environmental sense. By reducing waste disposal, landfill space can be preserved. Some experts estimate that grass clippings and yard wastes make up 20 percent of all landfill wastes. In some states, this rate is almost as high as 50 percent. The Environmental Protection Agency projects that half of the country's 6,000 landfills will reach capacity and close by the late-1990s. Therefore, some states are passing recycling mandates and legislation banning yard wastes from landfills.

Golf course superintendents in many states are faced with legislation aimed at specific types of wastes generated by golf courses. Many superintendents voluntarily recycle even though there are no mandatory state laws requiring participation in recycling programs. As landfill disposal costs begin to rise, recycling may become the most economical method of waste disposal.

Whenever possible, superintendents recycle grass clippings.

Grass clippings can be recycled by spreading them along the rough and around trees. Composting the clippings is also an option. Compost is an excellent growing medium that promotes fast germination and can reduce fertilizer use. Recycling grass clippings provides valuable nutrients that improve the soil.

Whenever possible, superintendents recycle pesticide rinsate.

An alternative to disposal of pesticide waste is recycling pesticide rinsate in the field. According to an EPA research workshop, pesticide rinsate recycling is "economical, technically uncomplicated, provides total containment, may be adapted to specific site situations and minimizes the amount of wastewater that must be treated and disposed of." Superintendents who utilize this practice are encouraged to build a catchment and storage system for pesticide rinsate intended for reuse. This facility should be in compliance with state and local regulations.

Used tires and motor oil can be recycled.

Used tires and motor oil from golf course maintenance equipment and golf cars can also be recycled. Tire and oil distributors and local recycling companies should have information regarding recognized tire and motor oil recycling centers.

Trends in state waste reduction and recycling.

Legislation in effect in some states:

- Banning certain materials -- such as lead-acid batteries, oil, tires and yard wastes -- from landfills.
- Assessing advance disposal fees on the purchase of hard-to-dispose-of products.
- Encouraging or requiring composting of yard waste.
- Making the state a market for recycled goods by requiring or encouraging state agencies to buy products made from recycled materials, to use compost material whenever possible and to recycle their own wastepaper.
- Offering tax incentives to companies or organizations that buy recycling equipment.
- Providing funds for private research and development and low-interest loans to recycling companies.
- Requiring recycling instruction in schools.

Financing processing centers for recyclables.

You can work with your superintendent to start a community recycling program.

Information on setting up community programs can be obtained from the following organizations:

Solid Waste Association of North America,
P.O. Box 7219, Silver Spring, MD 20907-7219
Keep America Beautiful,
Mill River Plaza, 9 W. Broad St., Stamford, CT 06902

Personal Protective Equipment

Principles

Exposure to pesticides can be mitigated by practicing good work habits and adopting modern pesticide mix/load equipment (for example, closed-loading) that reduce potential exposure. Personal Protective Equipment (PPE) statements on pesticide labels provide the applicator with important information on protecting himself/herself.

Best Management Practices

- Provide adequate PPE for all employees who work with pesticides (including equipment technicians who service pesticide application equipment).
- Ensure that PPE is sized appropriately for each person using it.
- Make certain that PPE is appropriate for the chemicals used.
- Ensure that PPE meets rigorous testing standards and is not just the least expensive.
- Store PPE where it is easily accessible but not in the pesticide storage area.
- Forbid employees who apply pesticides from wearing facility uniforms home where they may come into contact with children.
- Provide laundering facilities or uniform service for employee uniforms.
- The federal Occupational Safety and Health Administration (OSHA) requires employers to fit test workers who must wear tight-fitting respirators.
- Meet requirements for OSHA 1910.134 Respiratory Protection Program.

UNITED STATES DEPARTMENT OF LABOR

Personal Protective Equipment

Overview

What is personal protective equipment?

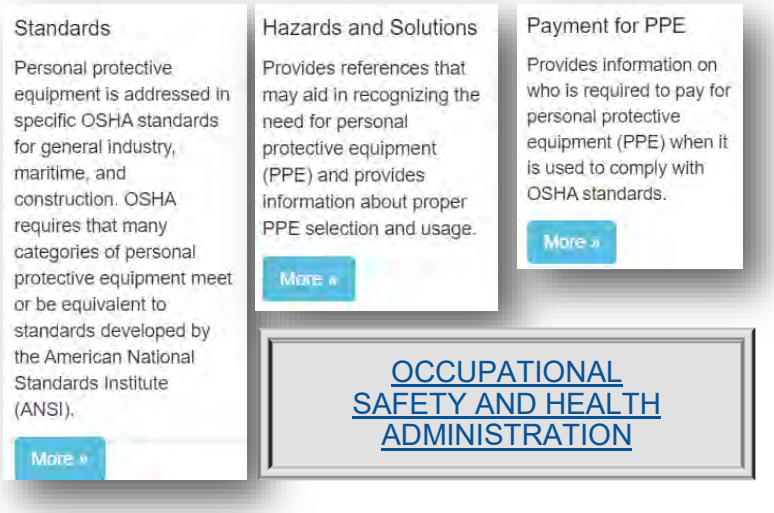
Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Personal protective equipment may include items such as gloves, safety glasses and shoes, earplugs or muffs, hard hats, respirators, or coveralls, vests and full body suits.

What can be done to ensure proper use of personal protective equipment?

All personal protective equipment should be safely designed and constructed, and should be maintained in a clean and reliable fashion. It should fit comfortably, encouraging worker use. If the personal protective equipment does not fit properly, it can make the difference between being safely covered or dangerously exposed. When engineering, work practice, and administrative controls are not feasible or do not provide sufficient protection, employers must provide personal protective equipment to their workers and ensure its proper use. Employers are also required to train each worker required to use personal protective equipment to know:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear and take it off
- The limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment

If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness.



Pesticide Container Management

Principle

The containers of some commonly used pesticides are classified as hazardous wastes if not properly rinsed, and as such, are subject to the many rules and regulations governing hazardous waste. The improper disposal of a hazardous waste can result in very high fines and/or criminal penalties. However, pesticide containers that have been properly rinsed can be handled and disposed of as nonhazardous solid waste. Federal law (FIFRA) and some state laws require pesticide applicators to rinse all empty pesticide containers before taking other container disposal steps. Under federal law (the Resource Conservation and Recovery Act, or RCRA), A PESTICIDE CONTAINER IS NOT EMPTY UNTIL IT HAS BEEN PROPERLY RINSED.

Best Management Practices

- Rinse pesticide containers immediately in order to remove the most residue.
- Rinse containers during the mixing and loading process and add rinsate water to the finished spray mix.
- Rinse emptied pesticide containers by either triple rinsing or pressure rinsing.
- Puncture empty and rinsed pesticide containers and dispose of according to the label..

EPA United States Environmental Protection Agency

Containers, Containment, Storage and Disposal of Pesticides

Pesticide Container Regulations

The pesticide container regulations establish standards for pesticide containers and repackaging as well as label instructions to ensure the safe use, reuse, disposal and adequate cleaning of the containers. Pesticide registrants and refillers (who are often distributors or retailers) must comply with the regulations, and pesticide users must follow the label instructions for cleaning and handling empty containers. Read more about pesticide container regulations.

Requirements for Containment when Storing Pesticides

Pesticide retailers who repackage pesticides, commercial applicators, and custom blenders must comply with the pesticide containment regulations if they handle agricultural pesticides and have a stationary container or pesticide dispensing area that is covered by the regulations. EPA has authorized 21 states to implement their state pesticide containment regulations instead of the federal regulations. Read more about containment requirements.

Storing Pesticides

This information is provided to help pesticide users such as farmers, golf course managers, pest control companies and others comply with requirements for pesticide storage. For pesticides in small portable containers, such as 55-gallon drums or smaller containers, EPA regulates pesticide storage through specific storage instructions on pesticide labels. Some states regulate the storage of pesticides in small portable containers. Read more about storing pesticides.

Disposal of Pesticides

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) governs the sale, distribution and use of pesticides in the United States. Pesticides are regulated under FIFRA until they are disposed, after which they are regulated under the Resource Conservation and Recovery Act (RCRA), which ensures responsible management of hazardous waste and non-hazardous solid waste.

Farmers and commercial pesticide users generally cannot dispose of pesticides in household hazardous waste programs. However, many states run pesticide disposal programs specifically for farmers and commercial pesticide users, which are often referred to as “Clean Sweep” programs. Read more about disposing of pesticides.

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 9

Pollinator Protection

Most flowering plants need pollination to reproduce and grow fruit. While some plants are pollinated by wind, many require assistance from insects and other animals. In the absence of pollinators, many plant species, including the fruits and vegetables we eat, would fail to survive.

The western honey bee (*Apis mellifera*) is one of the most important pollinators in the United States. Hundreds of other bee species, including the bumble bee (*Bombus* spp.), also serve as important pollinator species. Protecting bees and other pollinators is important to the sustainability of agriculture.

Pesticides are products designed to control pests (for example, insects, diseases, weeds, nematodes, etc.). Pesticides and other plant growth products, including plant growth regulators, surfactants, biostimulants, etc., are used in golf course management. The non-target effect of products used in golf course management is of increasing concern; therefore, pesticide applicators, including those on golf courses, need to be mindful of the impact that pesticides have on pollinator species and their habitat.

NEW MEXICO GAME & FISH

Conserving New Mexico's Wildlife for Future Generations

Pollinators and Other Wildlife

Following is a selected project highlight from the Share with Wildlife mission to assist all New Mexico wildlife in need, no matter what species.

Looking for a fun, educational family outing on a Saturday? Want to learn more about New Mexico's wildlife? Consider visiting the **New Mexico Wildlife Center (NMWC)** in Española. The Center has over 30 educational animals that you can see and learn about in self-guided tours. If you want more information about species habitats, adaptation, conservation, and biology, you can schedule a **Raptor or Native Wildlife Program** presentation for different age groups; all you have to do is call or email the Center. The Center also has a lovely native plant garden that they are continually working to expand and boasts many pollinator-friendly plants. Want to see a species of cholla cactus found only near Santa Fe? The Center has one!

Click for more information

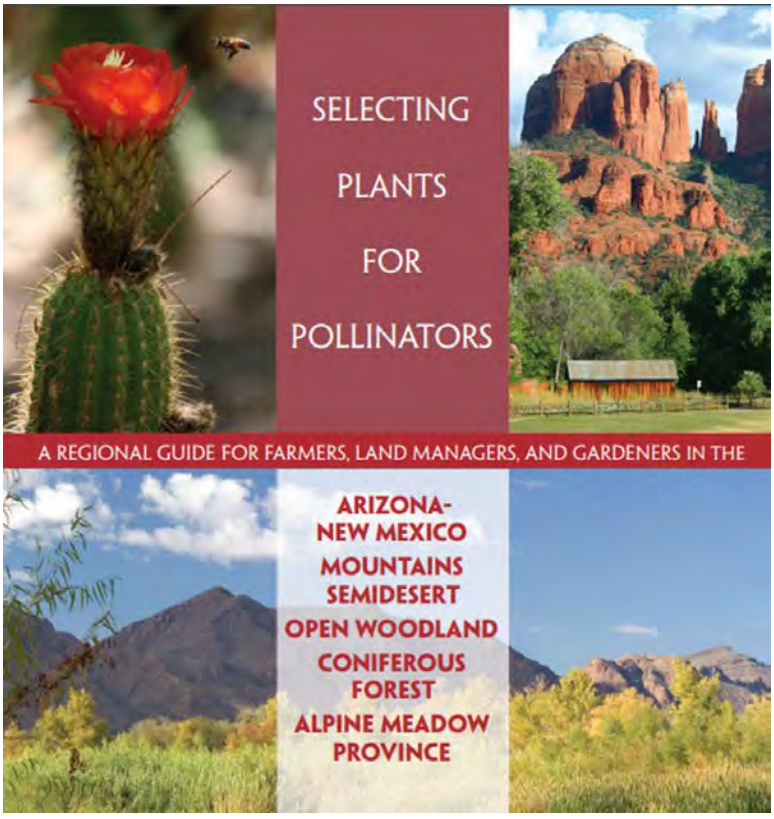
Regulatory Considerations

Principles

Pollinator-protection language is a label requirement found on pesticide labels; follow the label, it is the law.

Pesticide applicators must be aware of honey bee toxicity groups and able to understand precautionary statements.

Recordkeeping may be required by law in order to use some products. IPM principles suggest that you keep records of all pest control activity so that you may refer to information on past infestations or other problems to select the best course of action in the future.



Best Management Practices

- Proper records of all pesticide applications should be kept according to local, state, or federal requirements.
- Use records to establish proof of use and follow-up investigation of standard protocols regarding:
- Date and time of application
- Name of applicator
- Person directing or authorizing the application
- Weather conditions at the time of application
- Target pest
- Pesticide used (trade name, active ingredient, amount of formulation, amount of water)
- Adjuvant/surfactant and amount applied, if used
- Area treated (acres or square feet) and location
- Total amount of pesticide used
- Application equipment
- Additional remarks, such as the severity of the infestation or life stage of the pest
- Follow-up to check the effectiveness of the application
- Those applying pesticides, and who make decisions regarding their applications should be able to interpret pollinator protection label statements.
- Those applying pesticides should be aware of honey bee biology.
- Those applying pesticides should understand the various routes of exposure (outside the hive and inside the hive).
- Those applying pesticides should understand the effects of pesticides on bees.

NMBKA
New Mexico Beekeepers Association

The New Mexico Beekeepers Association is a non-profit organization of private beekeepers, commercial beekeepers, persons interested in promoting the importance of the honey bee in the environment, and businesses related to the honey industry. Representing all regions of New Mexico, the Association maintains a close affiliation with the State of New Mexico's Department of Agriculture. Membership in the Association is open to all interested persons.

Pocket Guide to the Native Bees of New Mexico

Tessa R. Grasswitz, New Mexico State University, Agricultural Science Center, Los Lunas, NM
David R. Dreesen, Natural Resources Conservation Service Plant Materials Center, Los Lunas, NM

Introduction

Honeybees and wild native bees pollinate approximately 75% of the fruits and vegetables grown in the US. In recent years, however, honeybee populations have declined in many parts of the world due to the phenomenon known as Colony Collapse Disorder. Research indicates that native bees can often fill the 'pollination gap' when honeybees are scarce, and there is increasing interest in growing flowering plants to help sustain our native bees, honeybees, and other beneficial insects. New Mexico State University and the Natural Resources Conservation Service's NM Plant Materials Center are collaborating in testing more than 200 species of (mostly native) plants for their survival, ease of cultivation, and ability to attract and sustain pollinators and other beneficial insects. This publication, funded by the Western Integrated Pest Management Center, is intended as an introductory guide to the main groups of native bees that you might expect to see visiting such plants. Information on techniques for enhancing bee habitat is also included.

Native bees and how they differ from honeybees

The familiar European honeybee (*Apis mellifera*), as its name suggests, is not native to the US, but is a semi-domesticated species introduced to provide honey and pollinate crops. Large-scale fruit and nut growers often rent hives of honeybees to ensure pollination of their plants, and the fact that honeybees can form large 'social' colonies makes them well-adapted to transport and intensive management of this type. Most native bees, in contrast, are either 'solitary' species that nest and raise their brood alone or form only relatively small colonies (e.g., bumble bees (*Bombus* spp.)). Some species show intermediate, 'gregarious' nesting behavior, whereby each female forms their own nest but in close proximity to the nests of other females of the same species.

Habitat enhancement for bees

Any garden can be made more inviting for bees and other beneficial insects. Remember that even organically approved insecticides can be toxic to such species, so minimize their impact by practicing integrated pest management (IPM) and by not spraying flowering plants when pollinators are active. Some systemic insecticides (e.g., imidacloprid) can move within the plant and reach damaging concentrations in nectar, so try to avoid such products.

Provide a source of clean water, for example by filling a shallow plant saucer with pebbles and adding water until they are partly submerged. The exposed parts of the pebbles provide landing sites for bees and other insects. To avoid encouraging mosquitoes, empty the container every few days and allow it to dry out for several hours before refilling.

Principal bee families of New Mexico

More than 4,000 species of native bees occur in the US, classified into 6 major families (although there are more elsewhere). Representatives of most of the US families are found in New Mexico, although the species are so diverse in size and appearance that it is sometimes difficult for non-specialists to discern the basis on which they are assigned to different families.

Click for more information

Pollinator Habitat Protection

Principles

It is important to minimize the impacts of pesticides on bees and beneficial arthropods. Pesticide applicators must use appropriate tools to help manage pests while safeguarding pollinators, the environment, and humans.

Be mindful of pollinators; when applying pesticides, focus on minimizing exposure to non-target pollinators in play and non-play course areas.

Pollinators require a diversity of flowering species to complete their life cycle. Pollinator habitat contains a diversity of wildflower species of different colors and heights, with blossoms throughout the entire growing season

Best Management Practices

- Follow label information directing the application of pesticide when the plant may be in bloom. Avoid applying pesticides during bloom season.
- Stay on target by using coarse-droplet nozzles, and monitoring wind to reduce drift.
- Do not apply pesticides when pollinators are active.
- Before applying a pesticide, scout/inspect the area for both harmful and beneficial insect populations, and use pesticides only when a threshold of damage has been indicated.
- Mow flowering plants (weeds) before insecticide application.
- If flowering weeds are prevalent, control them before applying insecticides.
- Use insecticides that have a lower impact on pollinators.
- Use the latest spray technologies, such as drift-reduction nozzles to prevent off-site (target) translocation of pesticide.
- Avoid applications during unusually low temperatures or when dew is forecast.
- Use granular formulations of pesticides that are known to be less hazardous to bees.
- Consider lures, baits, and pheromones as alternatives to insecticides for pest management.
- Develop new pollinator habitat and/or enhance existing habitat.

Blueberry Bee, Osmia ribifloris on berberry. Photo courtesy Dr. Suzanne Batra, USDA ARS

The New Mexico Native Bee Pollinator Project

Sponsored by Pollinator Paradise

Read about the 2008 New Mexico Initiative for Bee Habitat Corridors

More Information

AlbuquerqueJournal

Get the buzz on pollinators

ALBUQUERQUE, N.M. — The ABQ BioPark has opened its "Butterflies and Bees" exhibit at the Botanic Garden that will eventually feature 40 species of butterflies and moths, as well as other important pollinators.

"This innovative new exhibit combines the serenity of a butterfly house with eye-opening displays about our native pollinators and host plants," said Jason Schaller, ABQ BioPark curator of entomology, in a news release.

"One of the main focuses will be native bee ecology, which is poorly understood, yet immensely important to the environment," he said. "It will take a while for this part of the exhibit to really blossom as we learn more about these intriguing creatures and their husbandry."

The exhibit also features:

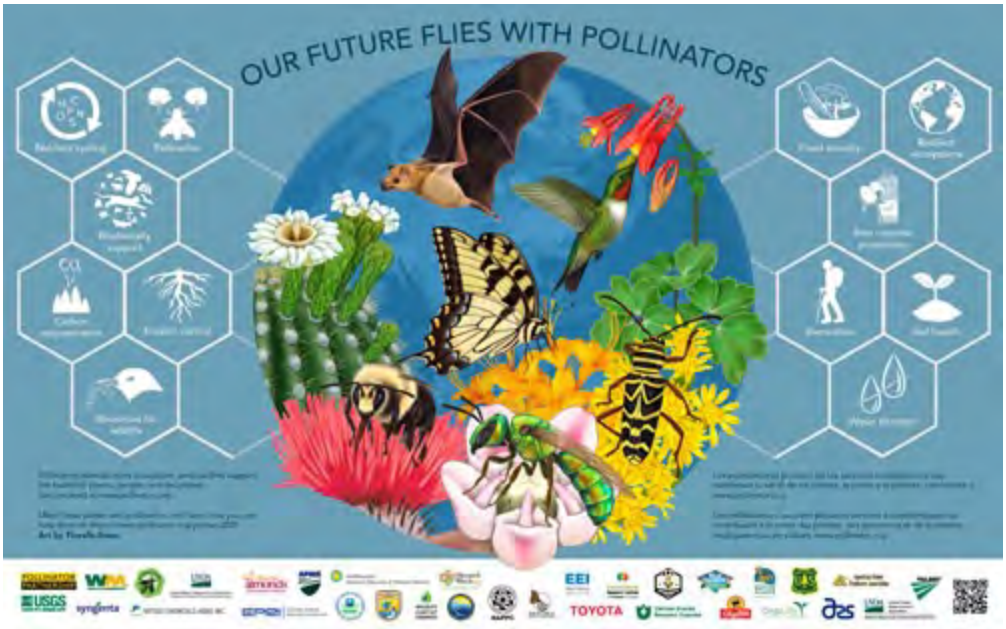
- A variety of native pollinator-friendly plants;
- Education panels on the pollinators' role in helping us grow the food we eat;
- How to create pollinator-friendly backyards; and
- A chance to interact with BioPark staff and participate in hands-on learning.

The exhibit, in the old "Butterfly Pavilion" at the garden, focuses on New Mexico-native species. The pavilion will no longer house exotic butterflies, but has added other pollinators, such as nonstinging bees and fig beetles.

Pollinators will not be active in winter, but visitors can view displays about how pollinators spend that season, organizers said in a news release.

U.S. Fish & Wildlife Service

Pollinators



The southwestern United States is a haven for pollinators. From moist riverside areas, to the Texas coast and marshes, to the semitropical borderlands with Mexico, to the Chihuahuan and Sonoran deserts, on into the grasslands, and among mountain ranges and valleys, the landscape diversity provides a wide array of homes to insect pollinators, as well as birds and bats

Click for more information

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 10

Maintenance Operations

Equipment maintenance, fueling, and chemical storage can have an impact on water quality on-site and off-site both during construction and during the maintenance of existing golf courses.

Regulatory Considerations

Local and state regulations may be in place in your location. Early engagement among developers, designers, local community groups and permitting agencies is essential to designing and constructing a golf maintenance and storage facility that minimizes environmental impact and meets the needs for the approval process.

Storage and Handling of Chemicals

Principles

- Proper handling and storage of pesticides and petroleum-based products is important to reduce risk of serious injury or death of an operator or bystander. Fires or environmental contamination may result in large fines, cleanup costs, and civil lawsuits if these chemicals are not managed properly.
- Check federal, state, and local regulations for specific requirements related to storage of pesticides.

Best Management Practices

- Storage buildings should have appropriate warning signs and placards.
- Follow all personal protective equipment (PPE) statements on pesticide labels.
- Store PPE away from pesticide storage areas in an area that is easily accessible.
- Develop an emergency response plan and educate all golf course personnel regarding emergency procedures on a regular basis.
- Individuals conducting emergency chemical cleanups should be properly trained under requirements of federal Occupational Safety and Health Administration (OSHA).
- Continued on Next Page

Use shelving to keep areas free of clutter, reduce the potential for contamination and protect investments.

USGA

Proper pesticide storage not only reduces the likelihood of accidental spills but also improves operational efficiency during the mixing and loading process. A pesticide storage area should create a suitable environment for pesticides to retain their performance abilities while also protecting the environment.

Click for full article

Best Management Practices

Storage and Handling of Chemicals - Continued

- Store pesticides in a lockable concrete or metal building.
- Locate pesticide storage away from other buildings, especially fertilizer storage facilities.
- Floors of chemical storage buildings should be impervious and sealed with chemical-resistant paint.
- Floors of chemical storage buildings should have a continuous sill to contain spills and should not have a drain. A sump is acceptable.
- Shelving should be fabricated from plastic or reinforced metal. Metal shelving should be painted to avoid corrosion. Wood shelving should never be used because of its ability to absorb spilled pesticides.
- Automatic exhaust fans and an emergency wash area should be provided
- Explosion-proof lighting may be required. Locate fan and light switches outside the entrance to the building to facilitate ventilation of building before entrance of staff.

Continued on Next Page

BE BOLD. Shape the Future.
New Mexico State University

General Chemical Storage Guidelines

- Storage cabinets and shelving must be made of materials compatible with the chemicals being stored.
- Use of compatible, corrosion-resistant storage trays (i.e. polypropylene) is recommended as secondary containment to catch spills, leaks, or drips from primary storage containers.
- Leaking storage containers must be replaced and the chemical transferred to a new container or over-packed into a secondary container.
- Avoid storing chemicals on top of cabinets or on shelves higher than 5 feet (1.5 m). Use a step stool when retrieving materials stored above on overhead shelves.
- Maintain at least 18 inches of clearance from area fire sprinkler heads to allow for proper functioning of the sprinkler system in the event of a fire. [NFPA Standard 13].
- Store heavy materials on lower shelves.
- Keep exits, passageways and areas near emergency equipment clear of clutter to allow for quick egress from the area and access to essential equipment in case of emergency.
- Label all hazardous chemical storage containers (see NMSU Chemical Container Labeling procedures).
- Provide a definite storage place for each chemical and return the chemical to that location after each use to assist in maintaining a clean work environment and to ensure that segregation of incompatible chemicals is maintained.
- Avoid storing chemicals on benchtops or in fume hoods, except for chemicals being actively used, to avoid clutter.
- Avoid storing chemicals in chemical hoods, except for those chemicals being actively used, to avoid clutter and to maintain adequate airflow in the hood.
- Provide ventilated storage near or beneath laboratory chemical fume hoods and store volatile toxic or odoriferous chemicals in ventilated cabinets.
- Ensure storage containers of corrosive, flammable, or toxic chemicals are sealed to minimize the vapors escaping.
- Chemicals that do not require ventilated storage cabinets should be stored inside closable cabinets or on shelves with a lip designed to prevent containers from sliding off in the event of a fire, accident, or earthquake.
- Do not stored chemicals close to a heat source or in direct sunlight.
- Store chemicals in a secure area or lockable storage to prevent unauthorized access to the materials.

Best Management Practices

Storage and Handling of Chemicals - Continued

- Maintain detailed records of current pesticide inventory in the storage facility. Safety Data Sheets (SDS) for the chemicals stored on-site should be stored separate from the storage room, but readily accessible on-site.
- Do not store large quantities of pesticides or chemicals for long periods of time. Follow a "first in, first out" principle to rotate products into use to ensure products do not expire.
- Store chemicals in original containers. Never store them in containers that might be mistaken as packaging for food or drink.
- Arrange containers so the labels are clearly visible. Securely fasten loose labels to ensure containers and associated labels are kept together.
- Damaged labels should be replaced immediately.
- Store flammable pesticides separate from those that are nonflammable.
- Store liquid materials below dry materials to prevent leaks from contaminating dry products.
- Ensure that oil containers and small fuel containers (service containers) are properly labeled and stored within the facility.

BE BOLD. Shape the Future.
New Mexico State University

Systemic Storage of Hazardous Chemicals

A system for storing chemicals according to chemical compatibility is recommended by EH&S. Separation and segregation of incompatible chemicals reduces the risk of accidental mixing in case of container breakage, fire, earthquake, or response to a laboratory emergency. One example of a detailed classification system for the storage of chemicals grouped by compatibility, developed by Stanford University and recommended by the National Research Council (in Prudent Practices in the Laboratory, 2011) is described below.

Compatible Chemical Storage Group Classification System

Chemical Compatibility Storage Groups for Selected Chemicals

This system classifies chemicals into 11 Storage Groups. Each group should be separated by secondary containment (e.g., plastic trays) or, ideally, stored in separate storage cabinets or shelves. Storage Groups B (compatible pyrophoric and water-reactive chemicals) and X (incompatible with all other storage groups) are the most important to segregate from other chemicals. If possible, these two groups of chemicals should be stored in separate cabinets or shelves.

Other chemical storage systems may also be used. Whatever system is used, it should be based on the concept of keeping the chemical groups listed below separated by using secondary containment, cabinets, separate shelves or distance:

- Oxidizers, including peroxides
- Corrosives—inorganic bases
- Corrosives—inorganic acids, not including oxidizers or combustibles
- Flammable materials
- Reproductive toxins
- Select carcinogens
- Chemicals with a high degree of acute toxicity.

Each laboratory needs to develop a chemical storage system that works for their individual lab operations. No matter what system is used be sure to follow any storage information on chemical container labels and in the chemical Safety Data Sheets.

BE BOLD. Shape the Future.
New Mexico State University

Storing Hazardous Chemicals

- Proper chemical storage minimizes the health and physical hazards posed by hazardous chemicals found in the laboratory. Good chemical storage technique will:
- Segregate incompatible chemicals to prevent accidental mixing
- Keep flammable materials away from sources of ignition
- Prevent hazardous vapors and gasses from entering common workplace air
- Minimize worker exposure to health and physical hazards from chemicals that are not being used.

The basic requirements and guidance for the safe storage of the wide variety of hazardous chemicals found in laboratories at NMSU can be found here.

General Chemical Storage Guidance

System for Storing Hazardous Chemicals

BE BOLD. Shape the Future.
New Mexico State University

Chemical Container Labeling Procedures

Per the NMSU Hazard Communication Program, all containers of hazardous chemicals in the workplace must be properly labeled. There is specific information that must be included on original (manufacturer) and on workplace (secondary) container labels.

Original Container Labeling

Under the new Globally Harmonized System of Classification and Labeling of Chemicals (GHS), all new containers shipped to NMSU will have labels with the following information:

The original manufacturer label must remain legible at all times. If the original label is damaged, removed or defaced the label must be replaced immediately with a new label containing the same information.

Workplace (Secondary) Container Labeling

During routine laboratory or shop operations, hazardous chemicals are frequently transferred from the original container into a secondary container. Unless it is intended for immediate use by the employee who performs the transfer, a workplace label is required on these secondary containers.

At a minimum, the workplace container label must include the following:

Product identifier

Specific information concerning the physical and health hazards of the chemical. The hazards may be identified by using words, pictures, symbols or a combination thereof.

EH&S recommends that workplace containers be labeled with the same information that is on the original manufacturer label (using all of the elements shown in the sample label above), or an alternate labeling system, such as NFPA.

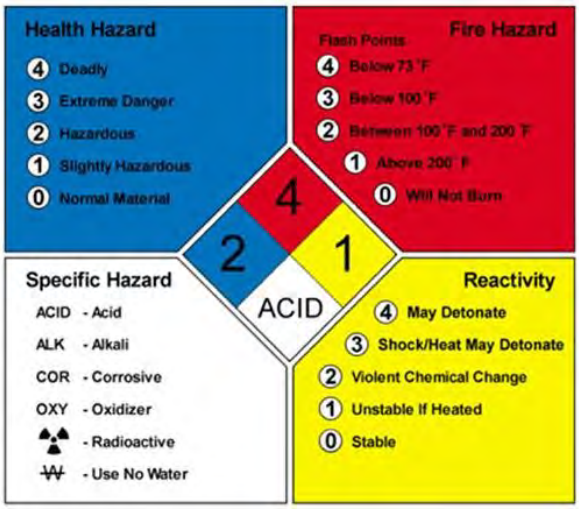
In addition, workers must have quick access to the appropriate chemical Safety Data Sheets (SDS) which provide a complete description of the chemical constituents and detailed hazard information.

EH&S highly recommends using the National Fire Protection Association (NFPA) 704 labeling system for workplace labels.

Summary of NFPA 704 Hazard Information System

The National Fire Protection Association (NFPA 704) system uses a diamond-shaped diagram of symbols and numbers to indicate the degree of hazard associated with a particular chemical or material. These diamond-shaped symbols are placed on containers of chemicals or materials to identify the degree of hazard associated with the chemical or material.

The diagram identifies three color-coded categories of hazard for each material:



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Each category is divided in five levels of hazard potential ranging from 0 – 4, with (0) used to indicate no special hazards and (4) for severe or extreme hazard potential.

The degrees of hazard in each of these categories are given as follows:

Health – The degree of health hazard of a chemical or material is based on the form or condition of the material, and its inherent properties. The degree of health hazard of a material should indicate the degree of personal protective equipment required for working safety with the material:

A rating of 1 is for slightly hazardous or toxic material which requires only minimal protection (e.g. safety glasses and gloves) in addition to normal work clothing.

A rating of 2 is for moderately toxic or hazardous material which requires additional PPE or equipment (e.g. chemical goggles, lab/work smock, and local ventilation) in addition to that required for less toxic material. Consult the SDS for specific health hazard and proper PPE to use with this material.

A rating of 3 or 4 is for highly to extremely toxic material and any carcinogen, mutagen, or teratogen. These materials will require specialized equipment (e.g. respirator or exhaust hood, full face shield, rubber apron, specialized glove, or handling tongs) beyond that required for moderately toxic material. The SDS and any other safety information must be consulted to determine the hazard and the proper PPE and engineering controls to safely use this material.

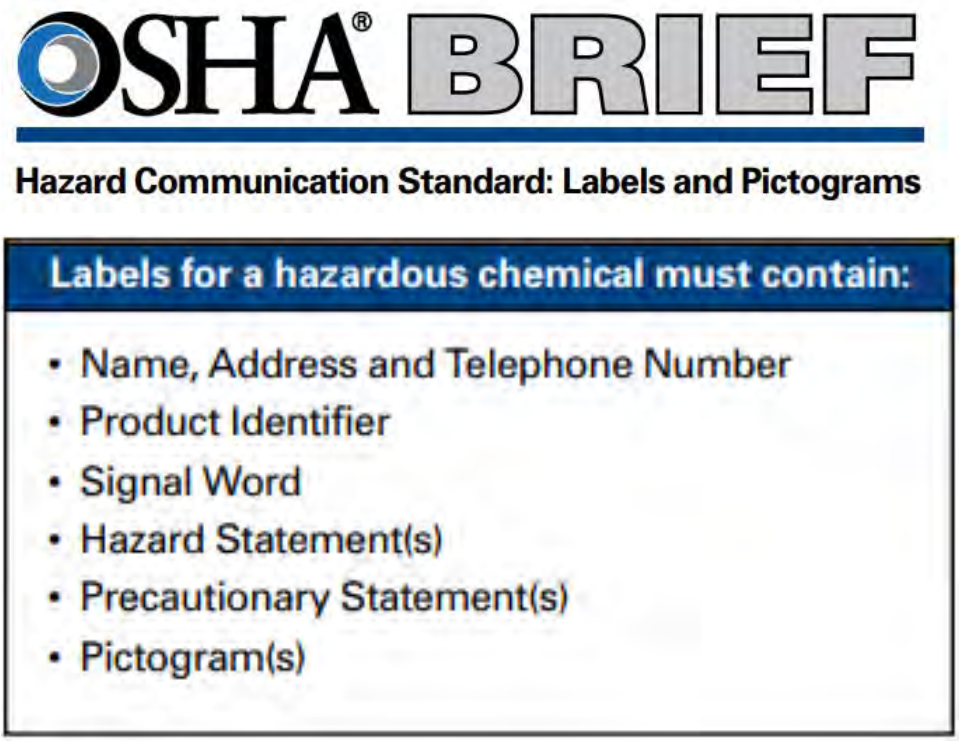
Flammability – The flammability hazards deal with the degree of susceptibility of the material to ignite and burn. The form or condition of the materials, as well as their properties, affects the extent of the hazard. Many hazardous materials such as acetone and gasoline have a flash point, far below freezing and will readily ignite with a spark if the vapor concentration is sufficient. A low rating of 1 is for material with a flash point above 200F, while more hazardous ratings of 2, 3, and 4 are for materials with respective flash point below 200, 100 and 73 F.

Reactivity – The reactivity hazards deal with the potential of a material or chemical to release energy. Some materials are capable of rapid release of energy without any catalyst, while others can undergo violent eruptive or explosive reactions if they come in contact with water or other materials. Generally this rating is used to indicate the potential to react if the material is heated, jarred, or shocked. A low rating of 1 indicates a material that is normally stable but may be reactive if heated. The more hazardous ratings of 2, 3, and 4 indicate a material is capable of violent reaction, shock/rapid heating and detonation respectively.

Other Hazard Information – An open space at the bottom of the NFPA diagram can be used to indicate additional information about the chemical or material. This information may include the chemical or material's radioactivity, proper fire extinguishing agent, skin hazard, its use in pressurized containers, protective equipment required, or unusual reactivity with water. For example, the usual signal to indicate reactivity with water is this symbol "W". Similarly, the words ACID, COR (corrosive), RAD (radiation), OXY (oxidizer), Rad (radioactive), CARC (carcinogen) or other abbreviations may be used.

Use the following link to download a PDF copy: NMSU Chemical Labeling Procedure

For detailed information regarding GHS Labeling please view this OSHA Brief.



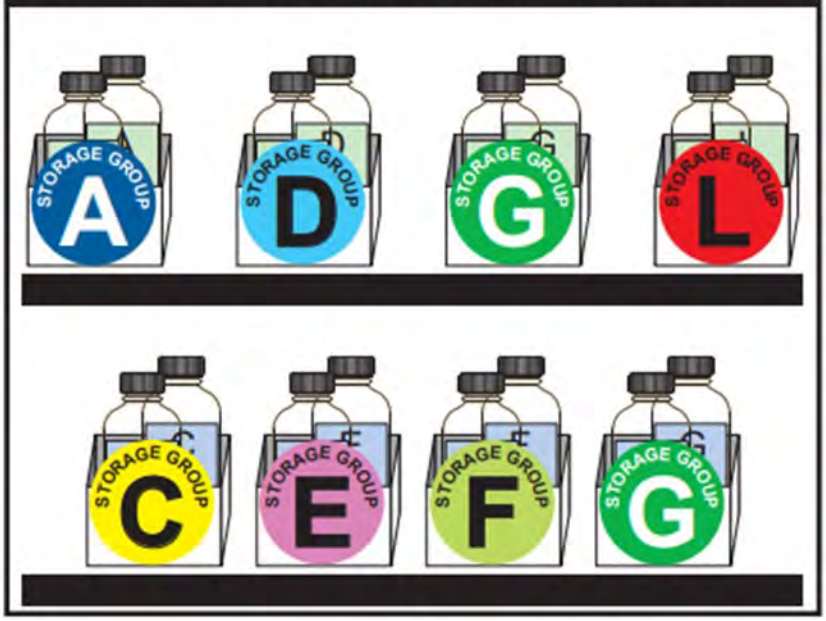
STORAGE GROUPS

Store chemicals in separate secondary containment and cabinets

A	Compatible Organic Bases
B	Compatible Pyrophoric & Water Reactive Materials
C	Compatible Inorganic Bases
D	Compatible Organic Acids
E	Compatible Oxidizers including Peroxides
F	Compatible Inorganic Acids not including Oxidizers or Combustible
G	Not Intrinsically Reactive or Flammable or Combustible
J*	Poison Compressed Gases
K*	Compatible Explosive or other highly Unstable Material
L	Non-Reactive Flammable and Combustible, including solvents
X*	Incompatible with ALL other storage groups

***Storage Groups J, K and X: Consult EHS Department**
For specific storage - consult manufacturer's MSDS

If space does not allow Storage Groups to be kept in separate cabinets the following scheme can be used with extra care taken to provide stable, uncrowded, and carefully monitored conditions.



Storage Group X must be segregated from all other chemicals.

Storage Group B is not compatible with any other storage group.

Pesticide Environmental Stewardship

Pesticide Storage

Storing pesticides properly protects human and animal health, safeguards wells and surface waters, and prevents unauthorized access to hazardous chemicals. Proper pesticide storage and inventory practices will prolong the shelf-life of pesticides and make it easier to track your pesticide usage so that you can plan purchases for future years.

Reducing the amount of pesticide you store lowers the risk of chemical fires, explosions, or spills that contaminate well water, surface water or the soil. Make every effort to limit storage by buying only the amount of pesticide that you need for a specific job or for the current growing season. Where available, purchase pesticides in refillable containers that can be returned to your pesticide dealership.

The pesticide label is the best guide to storage requirements for every product. The Material Safety Data Sheet (MSDS) provides additional information on normal appearance and odor as well as flash point, fire control recommendations, boiling point, and solubility. Labels and Material Safety Data Sheets for most pesticides are available on-line at http://www.cdms.net and http://www.greenbook.net

Equipment Storage and Maintenance

Principle

Storing and maintaining equipment properly will extend useful life and reduce repairs.

Best Management Practices

- Store and maintain equipment in a covered area complete with a sealed impervious surface to limit risk of fluid leaks contaminating the environment and to facilitate the early detection of small leaks that may require repair before causing significant damage to the turf or the environment.
- Seal floor drains unless they are connected to a holding tank or sanitary sewer with permission from the local wastewater treatment plant.
- Store pesticide and fertilizer application equipment in areas protected from rainfall. Rain can wash pesticide and fertilizer residues from the exterior of the equipment and possibly contaminate soil or water.
- Store solvents and degreasers in lockable metal cabinets away from ignition sources in a well-ventilated area. These products are generally toxic and highly flammable. Never store them with fertilizers or in areas where smoking is permitted.
- Keep an inventory of solvents and SDS for those materials on-site but in a different location where they will be easily accessible in case of an emergency.
- Keep basins of solvent baths covered to reduce emissions of volatile organic compounds (VOC).
- When possible, replace solvent baths with recirculating aqueous washing units. Soap and water or other aqueous cleaners are often as effective as solvent-based products and present a lower risk to the environment.
- Always use appropriate PPE when working with solvents.
- Never allow solvents or degreasers to drain onto pavement or soil, or discharge into waterbodies, wetlands, storm drains, sewers, or septic systems.
- Collect used solvents and degreasers in containers clearly marked with contents and date; schedule collection by a commercial service.
- Blow off all equipment with compressed air to reduce damage to hydraulic seals.

A clean, well-maintained maintenance facility sets a positive tone for employees and helps lengthen the lifespan of equipment.

USGA

The maintenance facility is the hub of the golf course agronomy team. It is where maintenance staff report for work, have breaks and eat lunch. It's also where the agronomic team holds meetings and where hundreds of thousands, perhaps even millions of dollars in turf care equipment is housed.

Click for full article

Waste Handling

Principles

- Proper disposal of waste materials is critical for protection of water and natural resources. State or local laws and regulations related to disposal of hazardous waste products may vary. Be sure to familiarize yourself with all state and local laws related to disposal/recycling of these waste materials.
- Identify and implement waste-reduction practices.
- Look for ways to increase recycling efforts and programs.
- Purchase environmentally preferred products in bulk packaging when possible.

New Mexico Environment Department

Waste Management




Waste is something all of us create, in varying amounts, throughout our daily lives. It is often unavoidable, but can be a challenge to deal with. NMED has many programs that work with businesses, organizations, and communities to reduce and manage our waste here in New Mexico.

Waste can be addressed in many different ways through proper disposal, recycling, storage, or reducing the amount created in the first place (source reduction).

The types of waste we deal with in New Mexico include Solid Waste, Hazardous Waste, Liquid Waste, Wastewater, and other types such as radioactive waste.

Proper management of these wastes will help protect our air, land, ground water, surface waters, and public health.

NMED is responsible for monitoring and controlling the generation, storage, transportation, and disposal of wastes in New Mexico.

Report a Waste Complaint

(For illegal dumping, spills, or other waste management concerns)

Waste Permits & Registrations INFO

Waste Cleanups & Remediation of Contaminated Areas

NMED Waste Management Programs:

Solid Waste Bureau

Hazardous Waste Bureau

Petroleum Storage Tank Bureau

Ground Water Pollution Prevention
(Ground Water Quality Bureau)

Point Source Discharge Regulation
(Surface Water Quality Bureau)

Wastewater Operator Certification Program
(Surface Water Quality Bureau)

Construction Programs Bureau
for water, wastewater, & solid waste infrastructure)

Liquid Waste Bureau

Best Management Practices

Waste Handling

- Pesticides that have been mixed for application must be disposed of as waste and may be classified as hazardous waste depending on the materials involved. Contact local authorities for guidance regarding proper disposal.
- Collect used oil, oil filters, and antifreeze in separate marked containers and recycle them as directed by local and state authorities.
- Antifreeze may be considered hazardous waste by state or local laws and should be handled accordingly. Commercial services are available to collect and recycle antifreeze.
- Lead-acid batteries are classified as hazardous waste unless they are properly recycled.
- Store old batteries on impervious services where they are protected from rainfall and recycle as soon as possible.
- Recycle used tires.
- Recycle or dispose of fluorescent tubes and other lights according to state requirements.

RECYCLING & WASTE DIVERSION

Recycling is the process of transforming waste materials into usable resources. It is preferable to treatment and disposal because it helps conserve energy and reduce waste.

Waste diversion refers to the act of keeping waste out of the landfill through processes such as reuse, repair, and recycling.

Although the state has no mandated waste diversion goal, pollution prevention and recycling are supported and encouraged through NMED public education and outreach activities.

NMED also works closely with the New Mexico Recycling Coalition to plan and implement recycling initiatives in the state. The NMRC is a valuable source of information for all types of recycling in New Mexico.

For more on recycling, waste diversion, and waste reduction:

NMED Solid Waste Bureau

New Mexico Recycling Coalition

SOLID WASTE

Solid Waste (non-hazardous waste) can be broadly defined as any material no longer used for its intended purpose. It is what most of us think of as "trash" or "garbage".

More specifically, the EPA defines solid waste as any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. Nearly everything we do leaves behind some kind of waste.

Two common types of Solid Waste:

- Municipal Solid Waste – "everyday" waste from homes, offices, and schools. More @ EPA.gov
- Industrial Waste – variety of materials resulting from the production of goods & products (ex: construction & demolition, special waste, medical waste, CO2 streams). More @ EPA.gov

NMED manages and monitors activities regarding solid waste in New Mexico. We do this through permits, enforcement of regulations, and outreach.

Permits, Registrations, & Enforcement actions apply to:

Landfills	solid waste haulers
transfer stations	air curtain incinerators
transformation facilities	infection treatment processes

We also approve such activities as: closure plans, ground water and methane monitoring plans reports, and oversees landfill liner and cap, and well installations.

- NMED operates under multiple statutes, rules, memorials, and executive orders for solid waste listed HERE.
- We have jurisdiction in Mew Mexico to regulate the management of solid waste at permitted and registered solid waste facilities but NOT on public lands or most private lands
- NM has been granted Primacy to implement federal (EPA) solid waste regulations within the state.
- Our managing program is the Solid Waste Bureau.

Equipment Washing

Principle

Wash water generated from equipment-washing facilities can be a source of both surface-water and groundwater pollution. Steps should be taken to prevent pollution.

Best Management Practices

- Equipment washing areas should drain to an oil/water separator before draining to a sanitary sewer or holding tank.
- Consider the use of a closed-loop wash-water recycling system.
- Grass-covered equipment should be brushed or blown off with compressed air before being washed.
- Wash equipment with a bucket of water and a rag to minimize the amount of water used and use only the minimal amount of water required to rinse the machine.
- Spring-operated shut-off nozzles should be used.
- Do not allow any wastewater to flow directly into surface waters or storm drains.

WASTEWATER

Wastewater management encompasses a broad range of efforts that promote effective and responsible water use, treatment, and disposal and encourage the protection and restoration of our nation's watersheds.

Within NMED there are multiple programs working with businesses, communities, individuals, and the EPA to manage different types of wastewater. NMED regulates municipal and industrial operations discharging water to surface or groundwater.

Discharges to Ground Water

NMED monitors and issues Ground Water Discharge Permits to address a wide variety of discharges including:

- Commercial land farms (contaminated soil treatment)
- Ground water remediation systems
- Commercial laundries (not served by sanitary sewers)
- Industrial discharges
- Dairies
- Large capacity septic tank leachfields
- Domestic wastewater facilities
- Power generating plants
- Food processing plants
- Reclaimed wastewater reuse

See the Ground Water Quality Bureau's Pollution Prevention Section for more information.

Discharges to Surface Water

NMED monitors and inspects all point source discharges in the state to assure compliance and compatibility with applicable state and federal laws. Our activities include:

- Assisting the EPA in implementing its National Pollutant Discharge Elimination System (NPDES) permitting program.
- Conducting and maintaining a comprehensive monitoring program for the regulated community of industrial and municipal effluent dischargers.
- Reviewing federal NPDES permits for municipal wastewater treatment plants, electrical generating stations, fish hatcheries, mines, etc.

Wastewater also includes stormwater. NMED is responsible for the protection of surface water quality through the State by regulating point source discharges of pollutants to surface watercourses.

New Mexico Environment Department

Fueling Facilities

Principle

Safe storage of fuel, including use of above-ground tanks and containment facilities, is critical to the protection of the environment. State or local laws and regulations related to storage of fuel may vary.

Best Management Practices

- Locate fueling facilities on roofed areas with a concrete (not asphalt) pavement. Areas should be equipped with spill-containment and recovery facilities.
- Use of above ground fuel tanks is preferred.

STORAGE TANKS (UNDERGROUND AND ABOVE GROUND)

Storage tanks are used to store petroleum or certain other hazardous liquids. Leaking tanks can pose a serious environmental threat if the stored contents seep into the soil and contaminates ground water, the source of much of New Mexico's drinking water.

NMED regulates:

Underground Storage Tanks (UST) larger than 110 gallons.

Above ground storage tanks larger than 1320 gallons but less than 55,000 gallons.

The regulations apply to owners and operators of storage tanks containing petroleum products and other regulated substances.

NMED has Primacy from EPA, which recognizes that the New Mexico regulations are at least as protective as the federal rules and regulations.

Our activities include:

- Maintaining a registry of all storage tanks and storage tank facilities in the State.
- Inspecting every tank at every facility at least once every three years to ensure compliance with all rules and regulations.
- Collecting annual tank fees and penalties associated with notices of violations issued to tank owners an operators
- Overseeing corrective action conducted at facilities that have released regulated substances into the environment.
- Managing a Corrective Action Fund to reimburse tank owner and operators the costs of conducting corrective actions at their facilities, if they are in substantial operational compliance with the Rules and regulations.

PETROLEUM STORAGE TANK BUREAU

Petroleum Storage Tank Bureau

Leaks, Spills, and Incident Reports

Delivery Prohibition

Forms

New Mexico Petroleum Storage Tank Regulations

Public Outreach, Reports and Lists

Prevention and Inspection Program

Tank Registration, Certified Installers, Operator Training, Qualified Tester

Remedial Action Program

Reimbursement Section (Corrective Action Fund)

Storage Tank Committee

GoNM

Petroleum Storage Tank Bureau Staff

PST Regulations (current)

New Mexico Environment Department

Pollution Prevention

Principles

- Plan appropriately to minimize the possibility of an elicit discharge and need for disposal. Monitor the water to be discharged for contamination; never discharge to the environment any contaminated water. If the water is not contaminated, it can be reused or discharged to a permitted stormwater treatment system.

- Pesticide leaks or spills, if contained, will not percolate down through the soil into groundwater or run off the surface to contaminate streams, ditches, ponds, and other water bodies.

- Wash water from pesticide application equipment must be managed properly, since it contains pesticide residues. This applies to wash water from both the inside and the outside of the application equipment. Material should be collected and used as a pesticide in accordance with the label instructions for that pesticide.

- An equipment-washing facility can be a source of both surface water and groundwater pollution, if the wash water generated is not properly handled. All equipment used in the maintenance of golf courses and associated developments should be designed, used, maintained, and stored in a way that eliminates or minimizes the potential for pollution.

- One of the key principles of pollution prevention is to reduce the unnecessary use of potential pollutants. Over time, the routine discharge of even small amounts of solvents can result in serious environmental and liability consequences, because of the accumulation of contaminants in soil or groundwater.

- The proper handling and storage of pesticides is important. Failure to do so correctly may lead to the serious injury or death of an operator or bystander, fires, environmental contamination that may result in large fines and cleanup costs, civil lawsuits, the destruction of the turf you are trying to protect, and wasted pesticide product.

- Generating as little as 25 gallons per month of used solvents for disposal can qualify you as a “small-quantity generator” of hazardous waste, triggering EPA and state reporting requirements.

- Pesticides that have been mixed so they cannot be legally applied to a site in accordance with the label must be disposed of as a waste. Depending on the materials involved, they may be classified as hazardous waste.

- Provide adequate protection from the weather. Rain can wash pesticide and fertilizer residues from the exterior of the equipment, and these residues can contaminate soil or water.

- Never allow solvents to drain onto pavement or soil, or discharge into water bodies, wetlands, storm drains, sewers, or septic systems, even in small amounts.

- Office paper, recyclable plastics, glass, and aluminum should be recycled. Place containers for recycling aluminum cans and glass or plastic soft drink bottles at convenient locations on the golf course.

POLLUTION PREVENTION SECTION

The Ground Water Pollution Prevention Section (GWPPS) reviews and approves ground water Discharge Permits for discharges that have the potential to impact ground water quality pursuant to Subparts III and V of the Water Quality Control Commission (WQCC) regulations (20.6.2 NMAC). Ground water Discharge Permits address a wide variety of discharges including:

- Domestic wastewater facilities
- Large capacity septic tank leachfields
- Reclaimed wastewater reuse
- Power generating plants
- Commercial laundries (when not served by sanitary sewers)
- Commercial land farms for treatment of contaminated soil
- Industrial discharges
- Ground Water remediation systems

A Discharge Permit application for PPS sites can be found here. Discharge Permits for dairies and non-dairy agricultural facilities, such as cheese plants and chile processors, are managed by the Agriculture Compliance Section. To access dairy specific forms, please visit the Agricultural Compliance Section

Spill Reporting

This program also addresses unauthorized discharges, such as spills, for facilities that it regulates. Please review 20.6.2.1203 NMAC for instructions on how to proceed with notifying the Pollution Prevention Section if you have a spill.

Current List of Discharge Permits - Updated November 18, 2019

Permits are issued for 5 year terms and must be renewed to provide continuous coverage. This list (PDF or Excel) will be updated regularly as more permits are finalized. Currently the PPS manages approximately 420 active permits.

HAZARDOUS WASTE

Hazardous Waste is waste that is dangerous or potentially harmful to our health or the environment.

Hazardous wastes can be liquids, solids, gases, or sludges. They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes.

Types of Hazardous Waste:

Listed waste – some specific wastes determined to be hazardous by the EPA and published in lists as such. More @ EPA.gov

Characteristic waste – wastes not specifically listed but exhibits one of 4 hazardous characteristics (Ignitability, Corrosivity, Reactivity, Toxicity). More @ EPA.gov

Universal waste – specific, federally designated wastes falling under a streamlined system for management (includes: batteries, pesticides, Mercury-containing equipment, light bulbs). More @ EPA.gov

Who generates hazardous waste? Many types of businesses and institutions. If your business or institution generates hazardous waste, you must comply with certain requirements, depending on the quantity of hazardous waste you generate during any given month.

Hazardous waste generator categories:

1) Large Quantity Generators (LQGs)

2) Small Quantity Generators (SQGs)

3) Conditionally Exempt Small Quantity Generators (CESQGs)

NMED operates under the New Mexico Hazardous Waste Act [HWA; Chapter 74, Article 4 NMSA 1978] and regulations promulgated under the Act.

*NMED does NOT regulate household hazardous waste.

Our managing program is the Hazardous Waste Bureau.

Pollution Prevention
Best Management Practices

- Pesticides should be stored in a lockable concrete or metal building.
- Pesticide storage and mixing facility floors should be impervious and sealed with a chemical-resistant paint. Floors should have a continuous sill to retain spilled materials and no drains, although a sump may be included.
- For valuable information about constructing chemical mixing facilities, reference the Midwest Plan Service book, Designing Facilities for Pesticide and Fertilizer Containment (revised 1995); the Tennessee Valley Authority (TVA) publication, Coating Concrete Secondary Containment Structures Exposed to Agrichemicals (Broder and Nguyen, 1995); and USDA–NRCS Code 703.
- Use a chemical mixing center (CMC) as a place for performing all operations where pesticides are likely to be spilled in concentrated form—or where even dilute formulations may be repeatedly spilled in the same area—over an impermeable surface. (A CMC is a concrete pad treated with a sealant and sloped to a liquid-tight sump where all of the spilled liquids can be recovered.)
- Flush wash pad with clean water after the equipment is washed. Captured wash water can be used as a dilute pesticide per labeled site, or it may be pumped into a rinsate storage tank for use in the next application.
- FIFRA, Section 2(ee), allows the applicator to apply a pesticide at less than the labeled rate.
- The sump should then be cleaned of any sediment before another type of pesticide is handled.
- Discharge to a treatment system that is permitted under industrial wastewater rules.
- Never discharge to a sanitary sewer system without written permission from the utility.
- Never discharge to a septic tank.
- Use a closed-loop wash-water recycling system and follow appropriate BMP.
- Use non-containment wash water for field irrigation.
- Do not discharge non-contaminated wastewater during or immediately after a rainstorm, since the added flow may cause the permitted storage volume of the stormwater system to be exceeded.
- Whenever practical, replace solvent baths with recirculating aqueous washing units (which resemble heavy-duty dishwashers).
- Use soap and water or other aqueous cleaners; these products are often as effective as solvent-based ones.
- Blowing off equipment with compressed air instead of washing with water is often easier on hydraulic seals and can lead to fewer oil leaks.

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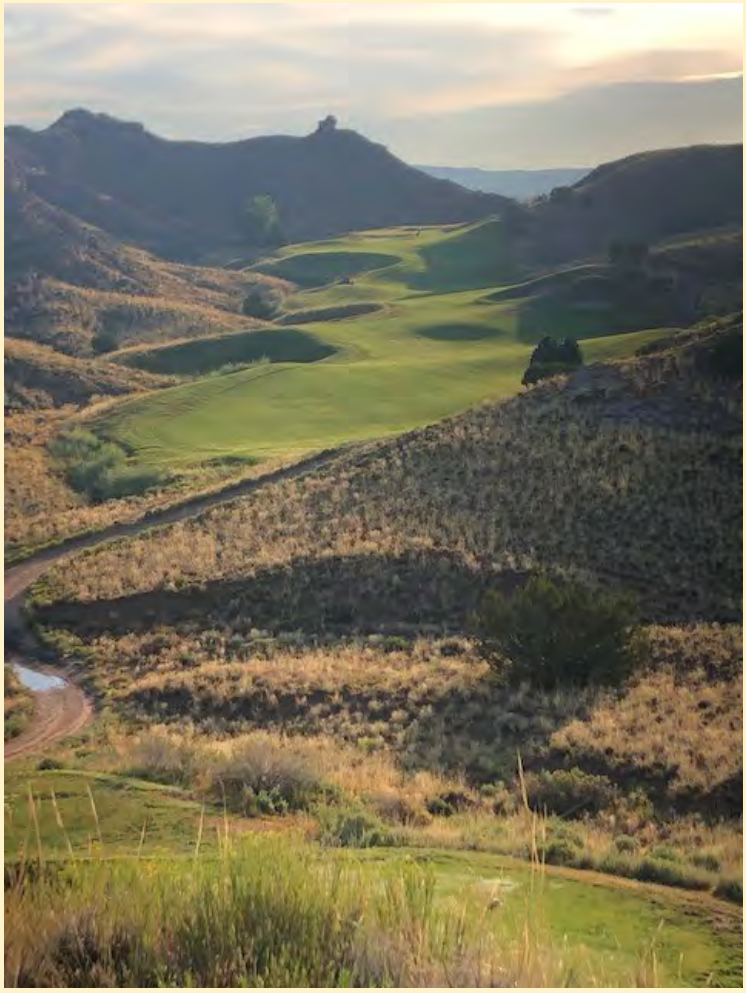


Pollution Prevention (Cont.)

Best Management Practices

- Grass-covered equipment should be brushed or blown with compressed air before being washed. Dry material is much easier to handle and store or dispose of than wet clippings.
- It is best to wash equipment with a bucket of water and a rag, using only a minimal amount of water to rinse the machine.
- Clean up spills as soon as possible.
- Keep spill cleanup equipment available when handling pesticides or their containers.
- If a spill occurs of a pesticide covered by certain state and federal laws, you may need to report any accidental release if the spill quantity exceeds the "reportable quantity" of active ingredient specified in the law.
- Large spills or uncontained spills involving hazardous materials may best be remediated by hazardous material cleanup professionals.
- For emergency (only) information on hazards or actions to take in the event of a spill, call CHEMTREC, at (800)424–9300. CHEMTREC is a service of the Chemical Manufacturers Association. Continued on next page
- For information on whether a spilled chemical requires reporting, call the CERCLA/RCRA help line at (800) 424–9346.
- Do not allow any wash water to flow directly into surface waters or storm drains.
- Avoid washing equipment in the vicinity of wells or surface water bodies.
- Wash equipment over a concrete or asphalt pad that allows the water to be collected. After the residue dries on the pad, collect, compost, or spread in the field.
- If applicable, allow runoff onto a grassed area to soak into the ground, but never into a surface water body or canal.
- Use compressed air to blow off equipment. This is less harmful to the equipment's hydraulic seals, eliminates wastewater, and produces dry material that is easier to handle.
- Handle clippings and dust separately. After the residue dries on the pad, it can be collected and composted or spread in the field.
- Minimize the use of detergents. Use only biodegradable non-phosphate detergents.
- Minimize the amount of water used to clean equipment. This can be done by using spray nozzles that generate high-pressure streams of water at low volumes.
- Do not discharge wash water to surface water or groundwater either directly or indirectly through ditches, storm drains, or canals.
- Do not conduct equipment wash operations on a pesticide mixing and loading pad. (This keeps grass clippings and other debris from becoming contaminated with pesticide).
- Solvents and degreasers should be used over a collection basin or pad that collects all used material.
- Oil/water separators can be used but must be managed properly to avoid problems. Do not wash equipment used to apply pesticides on pads with oil/water separators
- Collect used solvents and degreasers, place them into containers marked with the contents and the date, and then have them picked up by a service tha properly recycles or disposes of them. Never mix used oil or other liquid material with the used solvents.
- Collect used oil, oil filters, and antifreeze in separate marked containers and recycle them. Arrange pickup of used oil, or deliver to a hazardous waste collection site.
- Do not mix used oil with used antifreeze or sludge from used solvents. Antifreeze must be recycled or disposed of as a hazardous waste.

Continued on next page

Pollution Prevention (Cont.)

Best Management Practices

- Store batteries on an impervious surface and preferably under cover. Remember, spent lead-acid batteries must be recycled if they are to be exempt from strict hazardous waste regulations.
- Lead-acid storage batteries are classified as hazardous wastes unless they are recycled. All lead-acid battery retailers in Florida are required by law to accept returned batteries for recycling.
- Spent lead-acid batteries must be recycled if they are to be exempt from strict hazardous waste regulations.
- Equipment used to apply pesticides and fertilizers should be stored in areas protected from rainfall.
- Pesticide application equipment can be stored in the chemical mixing center (CMC), but fertilizer application equipment should be stored separately.
- Blow or wash loose debris off equipment to prevent dirt from getting on the CMC pad, where it could become contaminated with pesticides.
- Ensure that all containers are sealed, secured, and properly labeled. Use only regulatory agency-approved, licensed contractors for disposal.
- Rinse pesticide containers as soon as they are empty. Pressure rinse or triple-rinse containers, and add the rinse water to the sprayer. Continued on next page
- Shake or tap non-rinseable containers, such as bags or boxes, so that all dust and material fall into the application equipment.
- After cleaning them, puncture the pesticide containers to prevent reuse (except glass and refillable mini-bulk containers).
- Keep the rinsed containers in a clean area, out of the weather, for disposal or recycling.
- Storing the containers in large plastic bags/tubs to protect the containers from collecting rainwater.
- Recycle rinsed containers in counties where an applicable program is available, or take them to a landfill for disposal. Check with your local landfill before taking containers for disposal, as not all landfills will accept them.

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 11

Landscape

Landscape (non-play) areas are an essential part of the overall course design, providing enhanced course aesthetics, wildlife habitat, external sound/noise abatement, and natural cooling and freeze protection.

An environmental landscape design approach addresses environmentally safe and energy-saving practices; therefore, environmentally sound landscape management is also economically important. Non-play areas require a mix of sun and shade, optimal soil conditions and adequate canopy air movement to sustain growth and function.

Species Selection and Size Considerations

Principles

♦ The fundamental principle for the environmentally sound management of landscapes is "right plant, right place." The ideal plant from an environmental standpoint is the one that nature and evolution placed there. It has adapted specifically to the soil, microclimate, rainfall, and light patterns, insects, and other pests, and endemic nutrient levels over thousands of years.

♦ Know the ultimate sizes and growth rates of trees, shrubs, and ground covers. This reduces the need for pruning and debris removal and lowers maintenance costs.

♦ The addition of proper soil amendments can improve soil's physical and chemical properties, increase its water-holding capacity, and reduce the leaching of fertilizers. Amendments may be organic or inorganic; however, soil microorganisms rapidly decompose organic amendments such as peat or compost.

♦ The goal of species-selection BMP is to maintain as close to a natural ecosystem as practical, while meeting the needs of a golf course.

♦ Landscape areas should be fundamentally designed to facilitate rapid plant establishment to conserve water and lower nutritional input requirements once mature. Plants within areas that are not in play or are not critical to the design of the course may be removed and replanted with native plant material that requires little to no maintenance after establishment. Additionally, 50% to 70% of the non-play areas should remain in natural cover. As much natural vegetation as possible should be retained and enhanced through the supplemental planting of native trees, shrubs, and herbaceous vegetation to provide wildlife habitat in non-play areas, along water sources to support fish and other water-dependent species. By leaving dead trees (snags) where they do not pose a hazard, a well-developed understory (brush and young trees), and native grasses, the amount of work needed to prepare a course is reduced while habitat for wildlife survival is maintained.

Best Management Practices

- Base plant selection as close to a natural ecosystem as practical, while meeting the needs of the golf course. It has adapted specifically to the soil, microclimate, rainfall, light patterns, insects and other pests, and endemic nutrient levels over many years.
- Select trees, plants, and grass species to attract birds seeking wild fruits, herbs, seeds, and insects.
- Know the ultimate sizes and growth rates of trees, shrubs, and ground covers.
- Use plants that are adapted for the site based on the United States Department of Agriculture (USDA) cold-hardiness map.
- Select stress-tolerant species or cultivars to manage periodic dry/wet conditions.
- Choose the most stress-tolerant species or cultivar for a particular area.

Design and Function

Principles

- Aesthetic gardens, window boxes, and container gardens should include a variety of plants of different heights that provide nectar for hummingbirds and butterflies. Again, “right plant, right place” is the key to success.
- When integrating turf areas into the landscape around the clubhouse, entries, and other areas, design them for ease of maintenance and keep in mind that turfgrasses grow best in sunny areas. Consider the effect that tree canopy and other design features may have on the health and function of the turf.
- Garden plants, shrubbery, ground covers, or native plants may provide a pleasing a view and also provide useful food, cover, or other environmental benefits to wildlife; they may also require reduced maintenance.
- Trees and shrubs along streams provide temperature moderation through shade, which lowers water temperature in summer and increases it in winter.

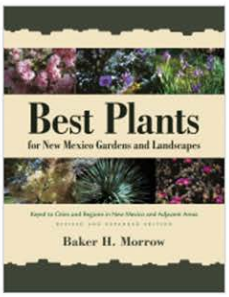
Best Management Practices

- Well-designed forested buffers should contain a mixture of fast- and slow-growing native trees, shrubs, and grasses to provide a diverse habitat for wildlife.
- Use forested buffers to trap and remove upland sources of sediments, nutrients, and chemicals.
- Use forested buffers to protect fish and wildlife by supplying food, cover, and shade.
- Use forested buffers to maintain a healthy riparian ecosystem and stable stream channel.
- Leave dead tree snags whenever possible for nesting and food source to wildlife. However, make sure that these snags are a safe distance away from playing surfaces should they get blown over.
- Use turf as a landscape element where needed.

Native Plant Society of New Mexico

Our Mission

The Native Plant Society of New Mexico (NPSNM) is a non-profit organization that strives to educate the public about native plants by promoting knowledge of plant identification, ecology, and uses; fostering plant conservation and the preservation of natural habitats; supporting botanical research; and encouraging the appropriate use of native plants to conserve water, land, and wildlife. Click for more information



Best Plants for New Mexico Gardens and Landscapes: Keyed to Cities and Regions in New Mexico and Adjacent Areas. Revised and Expanded Edition.

Baker H. Morrow
2016
Book
Published by: University of New Mexico Press
View | Save

First published in 1995, this invaluable guide to the trees, shrubs, ground covers, and smaller plants that thrive in New Mexico's many life zones and growing areas is now available in a long-awaited new edition. Landscape architect Baker H. Morrow considers the significant factors that impact planting in New Mexico--including soil conditions, altitude, drought, urban expansion, climate change, and ultraviolet radiation--to provide the tools for successful gardens and landscapes in the state. Added photographs and sketches identify the forms and uses of plants, including many new species that have become widely available in the region since the 1990s. The latest recommendations for specific cities and towns include more photos for ease of reference, and botanical names have also been updated. With ingenuity and efficient water management, Morrow demonstrates how to create landscapes that provide shade, color, oxygen, soil protection, windscreening, and outdoor enjoyment.

Planting Methods

Principles

♦ The ideal plant from an environmental standpoint is the one that nature and evolution placed there. It has adapted specifically to the soil, microclimate, rainfall, light patterns, insects, and other pests, and endemic nutrient levels over hundreds or thousands of generations. Where these factors have changed, the challenge is finding other suitable plants. A BMP goal is to maintain as close to a natural ecosystem as practical, while meeting the needs of the golf course.

♦ The use of organic mulches in gardens and aesthetic areas increases the moisture-holding capacity of plantings and prevents weed growth when applied in sufficient depth. Organic amendments are decomposed by soil microorganisms and add to soil tilth.

♦ Keep mulch 2 to 3 inches away from plants, to prevent fungal growth from excess dampness.

♦ Excess mulch or compacted mulch may be detrimental, causing water to shed away from the root zone and encourage overwatering. Compaction or excessive mulch buildup should be avoided, especially when annual remulching is performed.

Best Management Practices

♦ The plant palette and irrigation system should be appropriate for site conditions, taking into account that, in some cases, soil improvement can enhance water-use efficiency.

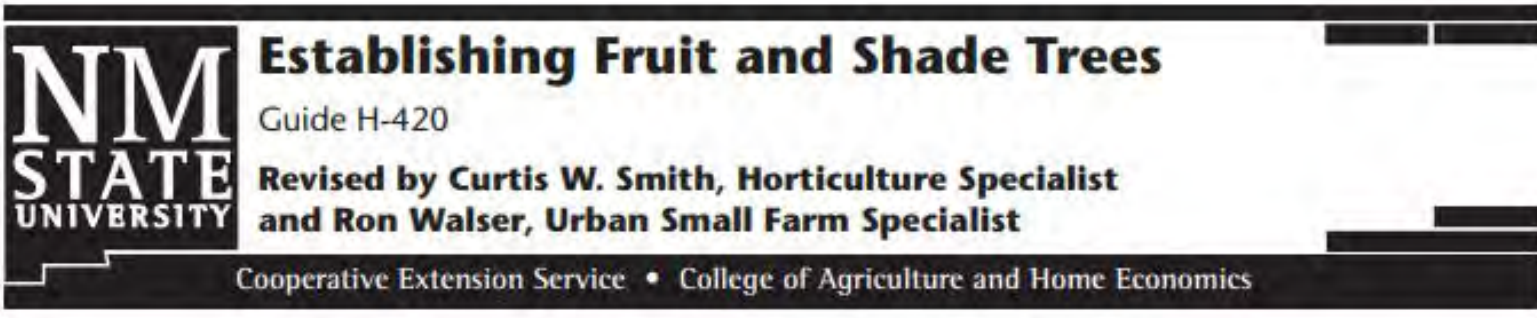
♦ Plants should be grouped together based on irrigation demand.

♦ The percentage of landscaped area in irrigated high-water-use hydrozones should be minimized. Local government ordinances should address the percentage of irrigated landscaped area that may be included in high-water-use hydrozones. These high water-use limits should not apply to landscaped areas requiring large amounts of turf for their primary functions (for example, ball fields and playgrounds).

♦ In most instances, established, drought-tolerant landscape plants have a root system substantial enough to keep them alive with little or no supplemental irrigation.

♦ Pruning and fertilizing will also benefit landscape plants while they are becoming established.

♦ Add proper soil amendments in garden areas to improve the soil's physical and chemical properties, increase its water-holding capacity, and reduce the leaching of fertilizers.



Getting off to a good start is essential to growing a healthy, long-lived tree. A stunted tree seldom develops into a desirable one. Weak growth and poor foliage let the sun burn the trunk and branches, making the tree more susceptible to attacks by insects and diseases. Good cultural practices lead to improved success in establishing trees.

Click for full article

BE BOLD. Shape the Future.
New Mexico State University
College of Agricultural, Consumer, and Environmental Sciences

Shade Trees for New Mexico

Guide H-426 Revised by Curtis Smith College of Agricultural, Consumer and Environmental Sciences, New Mexico State University

Author: Extension Horticulture Specialist, Department of Extension Plant Sciences and Agricultural Science Center at Los Lunas, New Mexico State University (Print Friendly PDF)

Less than one-third of New Mexico is naturally forested. The rest of the state is natural grassland or desert, with small areas of tundra. Thus, trees planted in our cities and around our homes must grow under climatic conditions and in soil that does not naturally support tree growth. Yet trees are valuable in our environment, making our surroundings more pleasant and ameliorating the effects of development and other human activity. They cool our cities, cleanse the air, and absorb noise. New Mexicans need tree species that can tolerate the soil and environmental conditions of an arid or semi-arid region. Also, because many trees are not native to our state, they require special care.

Selecting a Tree

There are a number of factors to consider when selecting a tree for landscaping, including tree size, water requirements, temperature and other weather conditions, and potential problems. All trees listed in Table 1 will grow in New Mexico. This table does not represent an exhaustive list of all potential trees for New Mexico, but it does provide good selections for a variety of situations. A tree should never outgrow its site, yet it must be large enough to fulfill the purpose for which it was planted. Become familiar with the mature size of a tree in New Mexico before deciding to plant that species. (Table 1 lists the height of various tree species. Consult your county agent for more information on tree size.) Species native to areas with acid soil may be 15–20% smaller in New Mexico than in their native environments.

Trees grow at different rates. As a general rule, the faster a tree grows, the weaker its wood and the more likely it is to be attacked by insect pests and diseases. Slow-growing trees, on the other hand, are difficult to transplant and take years to reach salable size. Therefore, large, slow-growing trees are hard to find in nurseries. The best choices are to select a tree with a medium growth rate, or to select a fast-growing tree and plant a slow-growing tree nearby to replace it when the fast-growing tree dies.

Other features to look for when selecting a tree are the texture or apparent coarseness of the tree (both in leaf and without leaves), leaf color, presence of flowers and fruit, whether there is any fruit drop, and whether the pollen presents a potential allergy problem. In the case of dioecious trees (trees that have male and female blossoms on different plants), a male tree may present a pollen problem while a female does not. Trees with attractive flowers do not generally have high allergy potential. For many trees listed in Table 1, information on pollen allergy potential is unavailable, either because the tree has not been extensively studied or because the pollen allergy potential is so low that medical references do not consider it worth mentioning.

Following the contours of a fairway when root pruning is a great way to prevent distracting, straight lines.

USGA

TREE ROOT TURMOIL
BY JOHN DANIELS
AGRONOMIST, CENTRAL REGION

Tree roots can cause significant moisture and nutrient stress to turf. As such, many golf course superintendents sever troublesome feeder roots from trees at appropriate intervals to minimize stress to putting greens, tees, fairways and other key areas of the course. A variety of implements can be used to prune tree roots, many of which are described in the USGA article, Getting to the Root of the Problem.

When pruning tree roots, follow these two tips to ensure that your efforts result in the greatest success:

1. Avoid pruning too close to trees – This is not for fear of injuring the trees or damaging your equipment but to prevent unsatisfactory results. Tree roots that cause the bulk of turf stress are not close to the base of trees.

2. Follow the contours of the hole. – Although cutting perfectly straight lines may be the most time-efficient procedure for root pruning, it is not the most desired.

Click here for full article

Turfgrass Establishment

Guide H-509

Revised by Bernd Leinauer[1]

Cooperative Extension Service • College of Agricultural, Consumer and Environmental Sciences

An important part of obtaining a good turfgrass stand is the selection of species and varieties that are best adapted to the specific location. Most turf problems encountered during the first or second year can be related directly to mistakes or omissions made prior to or during turf establishment. A new turfgrass site should always be prepared to correct existing problems and avoid potential problems.

Turfgrass Selection

The first step in turfgrass establishment is selecting a grass that is adapted to the area and suits the future use of the turf. Turf characteristics, such as climate adaptation, water use, traffic tolerance, color, quality, maintenance requirements, and available resources, need to be considered when selecting a turf species. Climatic adaptation and traffic tolerance, which largely determine the future use of the turf area, are the two most important factors. For more information about selecting the right turfgrass for your area, please see NMSU Extension Guide H-508, Turfgrasses for New Mexico (http://aces.nmsu.edu/ pubs/_h/H508.pdf).

Site Preparation

Site preparation is of utmost importance because it affects the management, appearance, and life of the turf area. It includes various operations such as clearing, tilling, grading, fertilizing, modifying soil, controlling weeds, and installing an irrigation system. The absolute minimum soil depth for a lawn is 4 inches. However, for deep root penetration and the benefits that come from an extensive and deep root system, a depth of 6 inches or more is recommended. Loams and sandy loams with a pH of 6.0 to 7.0 are the very best soils for producing a beautiful lawn. Unfortunately, this ideal soil is seldom found on any property in New Mexico, and soil modification and/or the addition of topsoil may be necessary. Have your existing soil tested and consult your local county Extension agent (http://aces.nmsu.edu/county/) about soil suitability as well as preplant fertilization. For more information on how to take a soil test, see NMSU Extension Guide A-114, Test Your Garden Soil (http://aces. nmsu.edu/pubs/_a/A114.pdf).

Preplant Weed Control

If an existing turf area has an undesirable plant cover and needs to be replanted entirely, a nonselective, systemic herbicide should be applied before cultivating and grading the area. Glyphosate eliminates most of the undesirable weedy grasses and broadleaved weeds. Glyphosate moves down, or translocates, in plants to also kill underground portions. Two applications 4 to 8 weeks apart may be necessary for deep-rooted perennial grasses. Directions for application rates and other instructions on the label must be followed. A waiting period of 7 days after glyphosate application may be necessary before tilling or disturbing the sod. Do not use preemergent or residual type herbicides during this phase.

Clearing and Grading

Around newly constructed buildings, clear the site of all building materials (wood, cement, and bricks), as well as any buried stumps, rocks, stones larger than 2–3 inches in diameter, or other debris. This important measure is often overlooked. If not done thoroughly, these materials can affect irrigation and turf establishment. Grade the entire area to eliminate any possible drainage problems on the property. This includes sloping the grade away from building foundations and filling low-lying areas. For large areas, a tractor-mounted blade and/or box is most often used for rough grading. Hand tools, drags, and rototillers perform well on areas that are smaller in size. The grading will probably uncover more debris that should be removed and not buried.

Soil Modification

If the minimum soil depth cannot be achieved (for example if a caliche layer is close to the surface) or if the soil test shows that the existing soil is unsuitable for turfgrass growth, topsoil and/or soil amendments should be added. Add topsoil (loamy sand, sandy loam, or other soil suitable for the area) and organic matter to achieve a total topsoil depth of 4–6 inches after firming. A more shallow soil can negatively affect turf appearance and can lead to increased water use. If peat or compost is recommended to be incorporated into the topsoil, use a rate of 50 to 100 pounds per 100 square feet. Depending on soil test results, additional soil amendments and preplant fertilizer can be added at this point.

Bernd Leinauer *is a professor and Extension Turfgrass Specialist in the Department of Extension Plant Sciences. He received his M.S. and Ph.D. degrees in crop and soil science from Hohenheim University in Stuttgart, Germany. His Extension and research program focuses on developing water management strategies for turf areas to reduce the amount of water used for irrigation.*

Click for full article

BE BOLD. Shape the Future.
New Mexico State University
College of Agricultural, Consumer, and Environmental Sciences

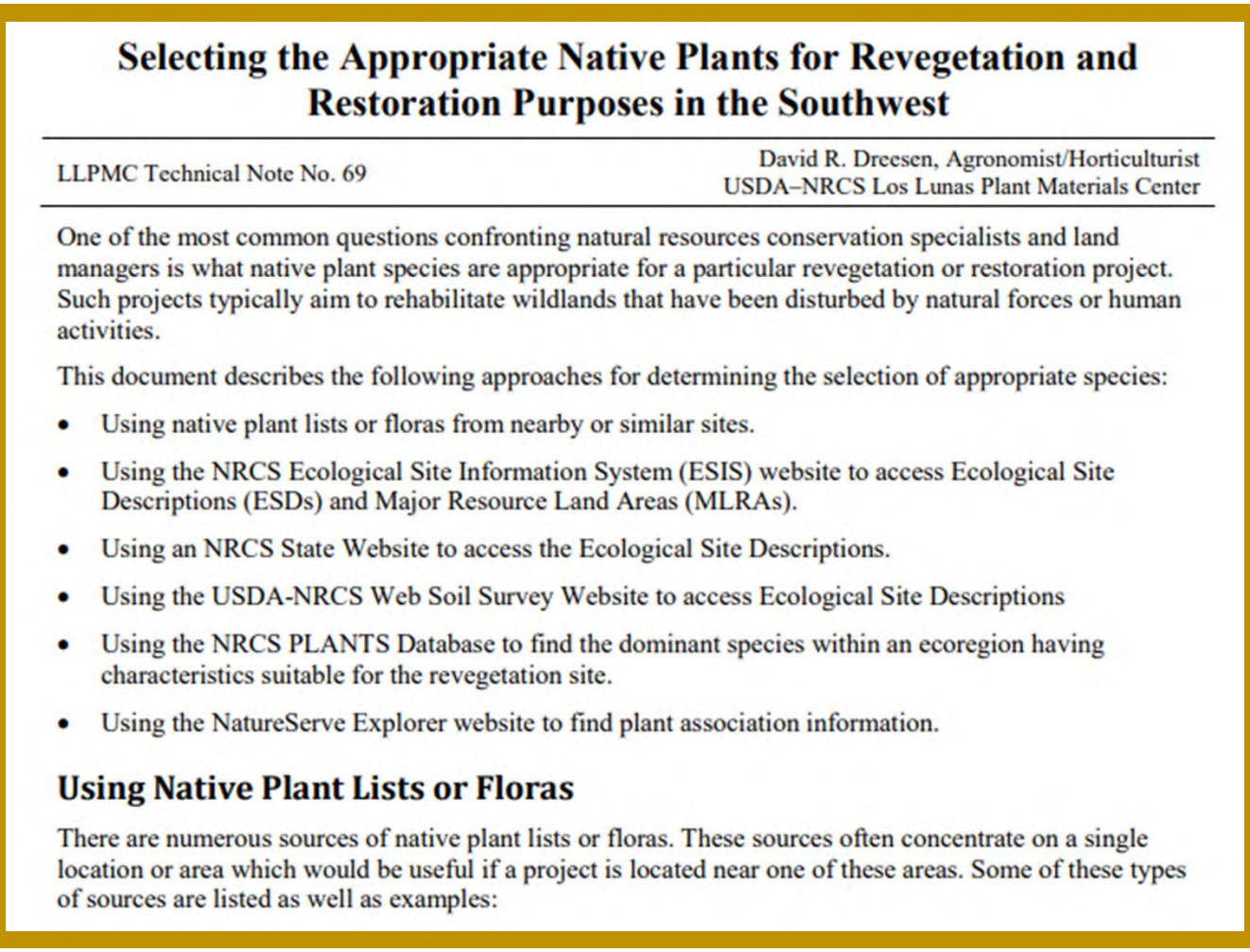
Selecting Ornamental Trees for New Mexico

Trees provide many benefits to us and our environment. They cool our cities, cleanse the air, recycle oxygen and reduce noise levels. In addition, trees enhance our quality of life by providing habitat for desirable wildlife and creating a restful environment. However, with New Mexico's varied landscape, where less than one-third of the state covered with native forests, selecting trees that will thrive in this environment is challenging. Trees planted in our cities and around our homes grow under climatic and soil conditions that may not naturally support tree growth. Nevertheless, New Mexicans need trees that tolerate our soils and climate. The purpose of this publication is to provide a description of trees that are adapted to New Mexico. While, many of the trees recommended in this publication are not native to New Mexico, they will adapt and thrive with appropriate care.

SELECTING A TREE

An important consideration when selecting a tree should be the planned function of the tree in the landscape. This planned function will determine which tree is chosen and where it is planted. Trees may be chosen for their shade, flowers, seasonal leaf color, fruit (presence or absence), wildlife habitat, size and architectural form. Growth rate also is a consideration, but often not be the primary reason for selecting a tree. Trees that grow rapidly tend to have a short life and create hazards, because they often have weak wood and increased disease and insect problems. Trees should be considered a long-term investment as a well-placed, attractive part of the landscape that can substantially enhance the property value. When choosing a tree for the landscape, consider the location in which the tree will be planted. Mature tree height and spread should be considered when selecting a site. Distance from structures, roads, walkways, walls and other paved areas are factors that must be considered. For example, if planted under power lines, trees eventually will interfere with power line maintenance and create electrical hazards. Poor site selection eventually could lead to structural damage, necessitating removal of the tree or pruning that could decrease the tree's form, function and value. Potential problems can be avoided by matching the tree to the site. If you desire a specific tree, be sure to find a site appropriate for that tree. If your concern is a specific site, select a tree appropriate for that site. Many tree problems in New Mexico result from a failure to match trees and sites. An unseen potential problem is the root system of an actively growing tree. As a tree grows, the root system expands beyond the tree's drip line. (The drip line is the area of soil beneath the ends of the tree's branches.) Trees planted close to walkways or other pavement can cause of the pavement to lift up due to root growth creating a hazard to foot traffic.

Click for full article



Selecting the Appropriate Native Plants for Revegetation and Restoration Purposes in the Southwest

LLPMC Technical Note No. 69

David R. Dreesen, Agronomist/Horticulturist
USDA–NRCS Los Lunas Plant Materials Center

One of the most common questions confronting natural resources conservation specialists and land managers is what native plant species are appropriate for a particular revegetation or restoration project. Such projects typically aim to rehabilitate wildlands that have been disturbed by natural forces or human activities.

This document describes the following approaches for determining the selection of appropriate species:

- Using native plant lists or floras from nearby or similar sites.
- Using the NRCS Ecological Site Information System (ESIS) website to access Ecological Site Descriptions (ESDs) and Major Resource Land Areas (MLRAs).
- Using an NRCS State Website to access the Ecological Site Descriptions.
- Using the USDA-NRCS Web Soil Survey Website to access Ecological Site Descriptions
- Using the NRCS PLANTS Database to find the dominant species within an ecoregion having characteristics suitable for the revegetation site.
- Using the NatureServe Explorer website to find plant association information.

Using Native Plant Lists or Floras

There are numerous sources of native plant lists or floras. These sources often concentrate on a single location or area which would be useful if a project is located near one of these areas. Some of these types of sources are listed as well as examples:

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Section 12

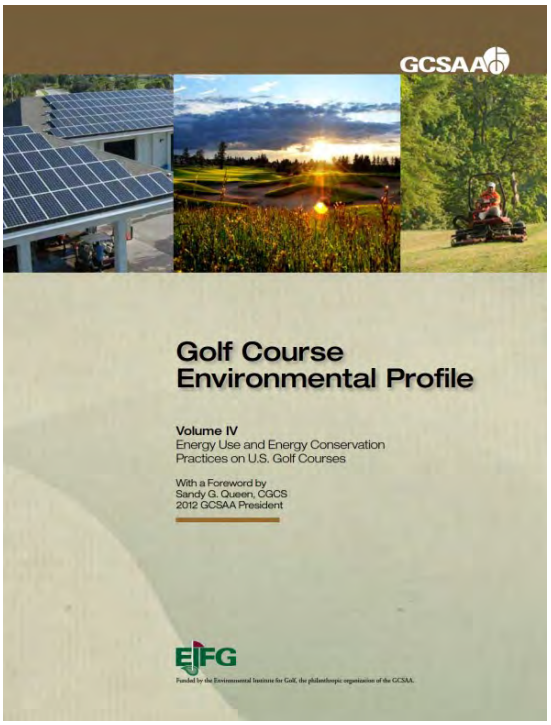
Energy

According to the GCSAA Golf Course Environmental Profile, Vol. IV (GCSAA 2012), six major energy sources were identified for golf course use: electricity, gasoline, diesel, natural gas, propane and heating oil. In addition, operational uses were segmented to meet irrigation, turf maintenance, buildings, clubhouse operations, swimming pools and various amenity needs.

The overall conclusion of the study suggests that golf facility managers must take steps toward identifying options for conservation, efficiency, and cost savings.

To address current needs and future energy reduction opportunities, managers should evaluate current energy conservation performance practices based on the following categories:

- **General energy conservation position statements on policy and planning**
- **Buildings and amenities statements –buildings, infrastructure and facility amenities such as the clubhouse, swimming pool, restaurant, parking lot, kitchen, offices, maintenance building(s), tennis courts, etc.**
- **Golf course statements – the golf course and surrounding landscapes, pump station, irrigation system and related agronomic operations (playing surfaces, equipment, turfgrass maintenance etc.)**



GOLF COURSE ENVIRONMENTAL PROFILE

Growing awareness about the environmental impact of golf courses.

Energy Use and Energy Conservation Practices on U.S. Golf Courses

Volume IV
With a Forward by
Sandy G. Queen, CGCS
2012 GCSAA President

Click graphic for Profile Report

Phase II, Volume V

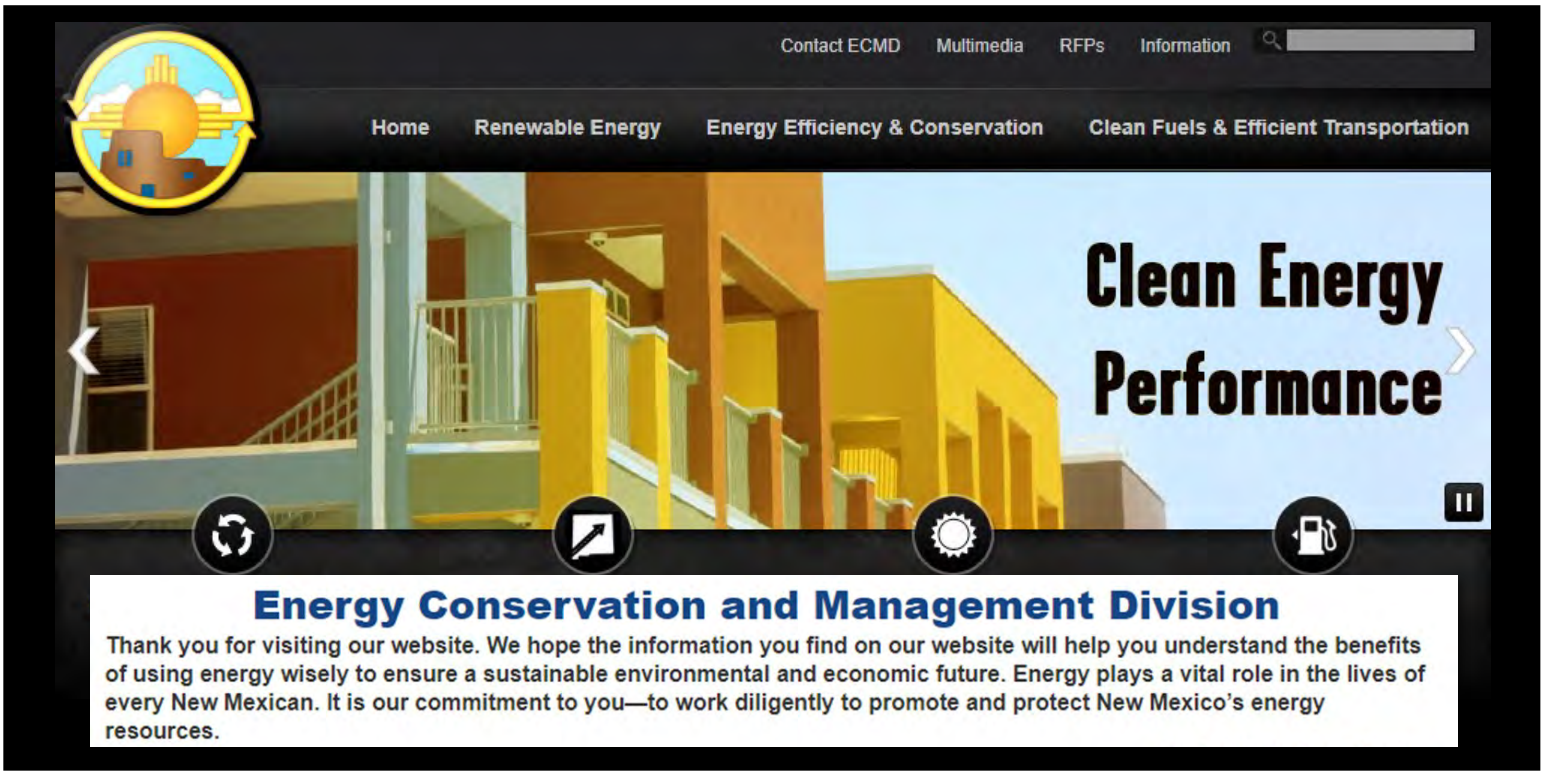
Energy Conservation

Principles

- Determine goals and establish an energy policy that is part of the facility's overall environmental plan.
- Establish an energy management plan for the facility based on current energy use baselines to optimize efficiency.
- Communicate policy to all staff regarding use patterns and management practices to effect change.
- Relate the policy to the entire facility, including the services the facility provides to its customers and community.
- Incorporate quality management elements for continual improvement (plan, do, check, and act) to reduce environmental and economic impacts.
- Understand that the irrigation pump is the largest user of energy. A well-engineered pump station is critical to reducing energy consumption.

Best Management Practices

- Conduct an energy audit.
- Conduct a lighting audit.
- Conduct a carbon footprint analysis.
- Add insulation where needed.
- Use non-demand electrical hour rates: charge golf carts, and use pumps to acquire water, charge maintenance equipment, and other items later in the day or early in the morning.
- Limit high-consumption activities during periods when demand is high.
- Use alternative energy from natural sources, such as solar, geothermal and wind energy generation.
- Upgrade or install National Electrical Manufacturers Association's (NEMA) premium efficiency-rated pump motors.
- Seek output reduction by watering less area, apply target golf goals.
- Install LED lighting and/or retrofit devices.
- Install motion sensors for lights where appropriate.
- Install a programmable thermostat.
- Install solar/Geo Thermal pumps for pools and spa.



Energy Conservation and Management Division

Thank you for visiting our website. We hope the information you find on our website will help you understand the benefits of using energy wisely to ensure a sustainable environmental and economic future. Energy plays a vital role in the lives of every New Mexican. It is our commitment to you—to work diligently to promote and protect New Mexico's energy resources.

Louise N. Martinez, Director

The Energy Conservation and Management Division (ECMD) develops and implements effective clean energy programs — renewable energy, energy efficiency, alternative fuels, and safe transportation of radioactive waste — to promote economic growth, environmental sustainability, and wise stewardship of our natural resources while protecting public health and safety for New Mexico and its citizens.

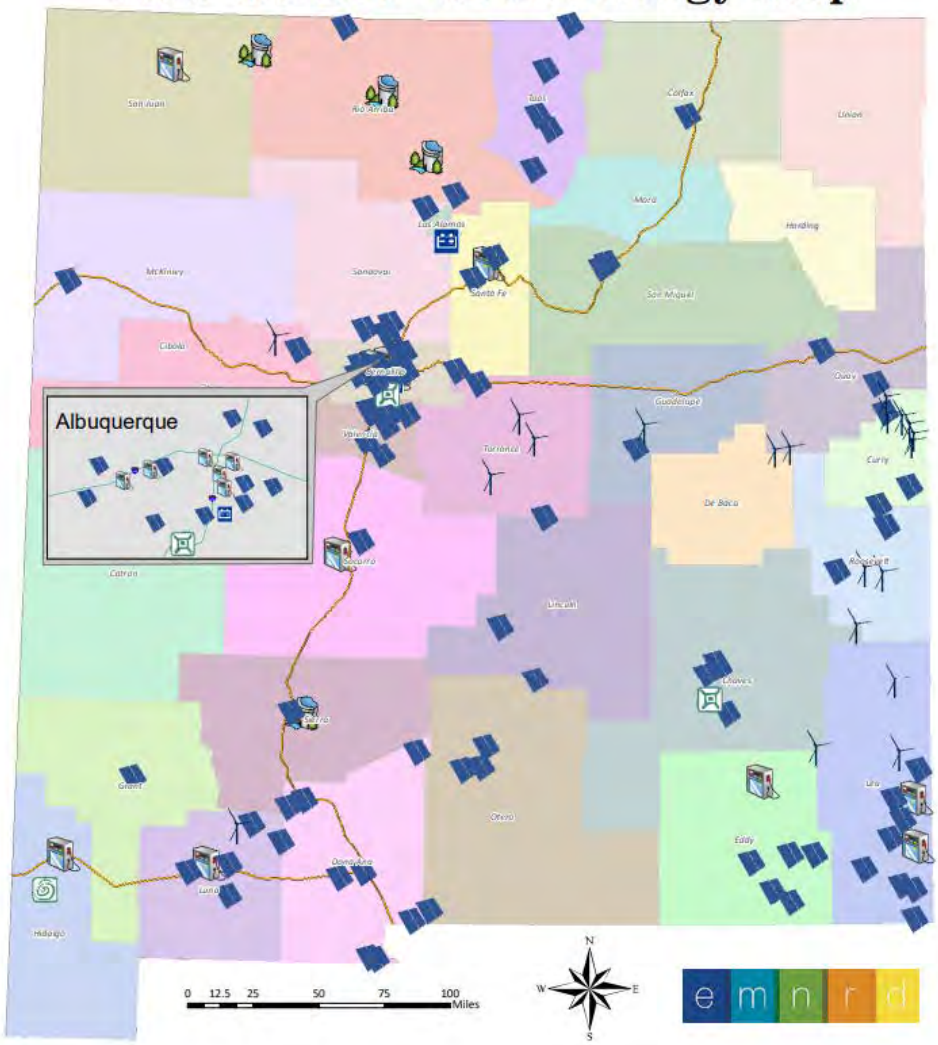
Mission

ECMD develops and implements effective clean energy programs — renewable energy, energy efficiency, alternative fuels, and safe transportation of radioactive waste — to promote economic growth, environmental sustainability, and wise stewardship of our natural resources while protecting public health and safety for New Mexico and its citizens.

Technical Assistance

The Energy Conservation and Management Division is your State Energy Office. We provide technical assistance on energy efficiency, renewable energy, alternative fuels and transportation.

New Mexico Clean Energy Map



Legend

- Energy Storage
- Geothermal
- Compressed Nat Gas
- Hydro
- Solar
- Waste to Energy
- Wind

3590 MW Total Clean Energy Capacity (includes planned projects)

Wind > 1 MW: 1109 MW operating + 1023 MW planned

Solar > 1 MW: 254 MW operating + 1103 MW planned

Residential Solar: 40 MW distributed on 7107 homes, farms and small businesses

The Energy Conservation and Management Division (ECMD) develops and implements effective clean energy programs — renewable energy, energy efficiency, alternative fuels, and safe transportation of radioactive waste — to promote economic growth, environmental sustainability, and wise stewardship of our natural resources while protecting public health and safety for New Mexico and its citizens.

Energy, Minerals and Natural Resources Department
Energy Conservation and Management Division
1220 South Saint Francis Drive
Santa Fe, NM 87505

505-476-3310

www CleanEnergyNM.org

January 2017

Evaluation

Principles

- Continually track and measure energy use at the facility based on energy assessment units, for example, kilowatt hour.
- Benchmark practices to evaluate existing facility consumption with other local golf facilities of similar size.

Efficiency

Principles

- Evaluate energy efficiency performance.
- Evaluate electric equipment/operations and ensure proper selection, operation, charging, and maintenance.

Best Management Practices

- Monitor energy use: track data, evaluate billing meters.
- Install adequate meters, gauges, etc.
- Develop an equipment inventory incorporating individual equipment's energy use, use / traffic patterns, etc. (maintenance records, operation hours, etc.).
- Establish a baseline for performance parameters to optimize irrigation pumps.
- Consider benchmarking performance against similar-sized facilities.

Best Management Practices

- Evaluate all energy providers (electricity, natural gas and liquid petroleum fuels) for costs, efficiency/ assistance programs, and incentives.
- Identify and categorize operations for energy efficiency opportunity and conservation analysis.
- Perform assessments of all the facility's infrastructure and operations.
- Perform appropriate audits throughout the facility depending on operation, infrastructure, and planning stage.
- Identify efficiency and conservation elements of infrastructure/hard items and behavioral/process-oriented items.
- Consider alternative equipment, products, and practices.

The Energy Conservation and Management Division (ECMD) develops and implements effective clean energy programs — renewable energy, energy efficiency, alternative fuels, and safe transportation of radioactive waste — to promote economic growth, environmental sustainability, and wise stewardship of our natural resources while protecting public health and safety for New Mexico and its citizens.

Click for more information

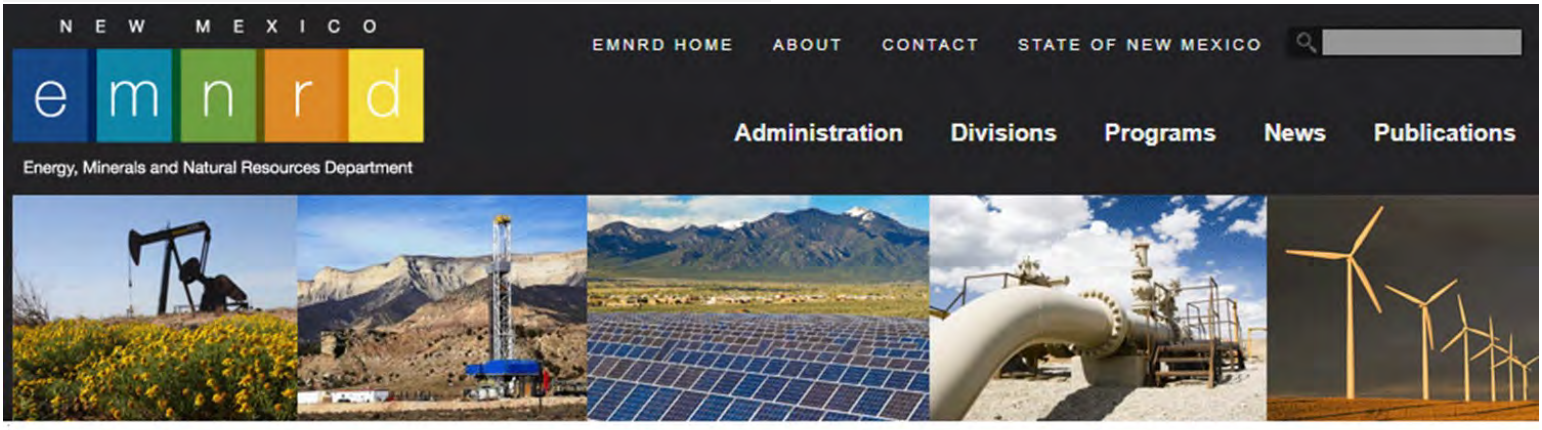
Design and Renovation

Principles

- Incorporate an analysis of the assessments, audits, and data.
- Incorporate first cost consideration (initial investment and long-term gain).
- Redesign – evaluate future projects with a priority for energy conservation.
- According to system and compliance standards, communicate with utility provider, insurance company, and any state or local regulatory officials.

Best Management Practices

- Identify buildings, amenities, and operations including existing, new construction, or renovation activities where energy efficiency enhancements are needed.
- Identify the golf course, course infrastructure, and related agronomic operations including existing and future developments or renovations that would benefit from energy efficiency improvements.



Implementation Plan

Principles

- Set goals for buildings/amenities and the golf course operation; develop an implementation plan.
- Set energy-use goals according to efficiency/ conservation of the building, infrastructure and equipment efficiency.

Best Management Practices

- Evaluate effectiveness of upgrades according to efficiency/conservation goals for energy use.
- Continue to identify future energy needs and maintain good record keeping.
- Prioritize energy consumption as part of purchase/ decision-making process for HVAC, food service, laundry, swimming pools, etc.
- Consider other devices as part of the plan; do research on building, pumps, and power generation.

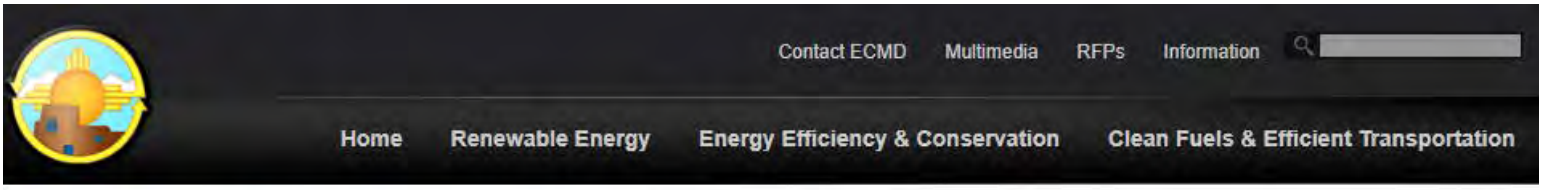
Infrastructure

Principles

- Ensure efficient building/facility/amenities and related infrastructure.
- Consider the materials: used insulation and color selection.
- Ensure efficient lighting in both interior and exterior areas.

Best Management Practices

- Maximize use of space.
- Inspect and repair leaks/maintenance.
- Monitor temperature/environmental settings (heat loss, etc.).
- Evaluate building automation systems, monitoring systems, etc.
- Incorporate technology and up-to-date equipment (lights, controls, switches, etc.).
- Implement schedules/controlled use.
- Evaluate off-grid pole lighting and similar technology.



New Mexico Energy Roadmap Project 2017-2027

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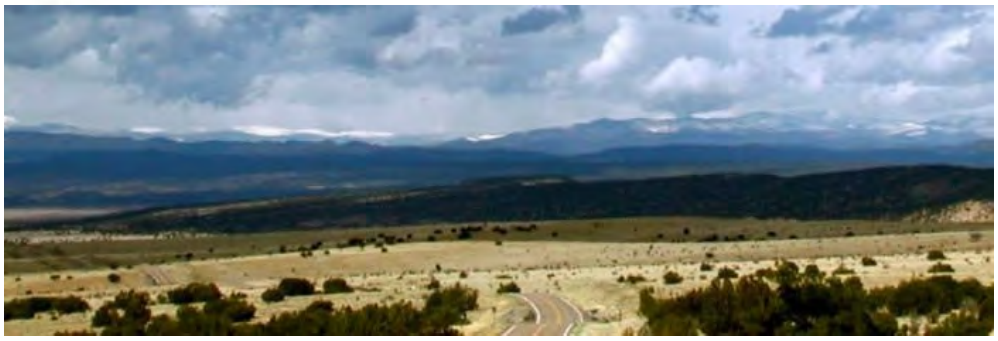
Gail Cooke (505) 476-3496
NMenergy.roadmap@state.nm.us



Purpose: To Strengthen and Diversify a New Mexico Energy Economy that is Resilient to Global Changes

Project Summary: Following the release of the 2015 New Mexico State Energy Policy and Implementation Plan, staff at the Energy Minerals and Natural Resources Department's (EMNRD) Energy Conservation and Management Division (ECMD) began to look for ways to enact specific objectives called out in the plan. However, the 2015 plan lacked clear strategies and direction for reaching the desired objectives. Therefore, in 2016, the ECMD applied for and received financial support from the U.S. Department of Energy to fund the development of an Energy Roadmap that defines a direction and sequence of strategies required to strengthen and diversify a New Mexico energy economy that is resilient to global changes.

To create such a roadmap, the ECMD assembled a steering committee made up of energy stakeholders that represented energy producers, large energy users, regulators, transportation interests, local and regional governments and energy advocates. In all more than 50 energy stakeholders, each bringing with them expertise in specific energy disciplines, engaged in networking, information sharing, debate and compromise to develop the New Mexico Energy Roadmap.

Development of the Energy Roadmap is only the beginning of a decade long process of implementing changes to energy policies and practices at both the public and private level. The strategies and goals of the Energy Roadmap recognize and aim to address on common reality; the way the state produces, and uses energy must preemptively adapt to global energy developments.

Click for full article

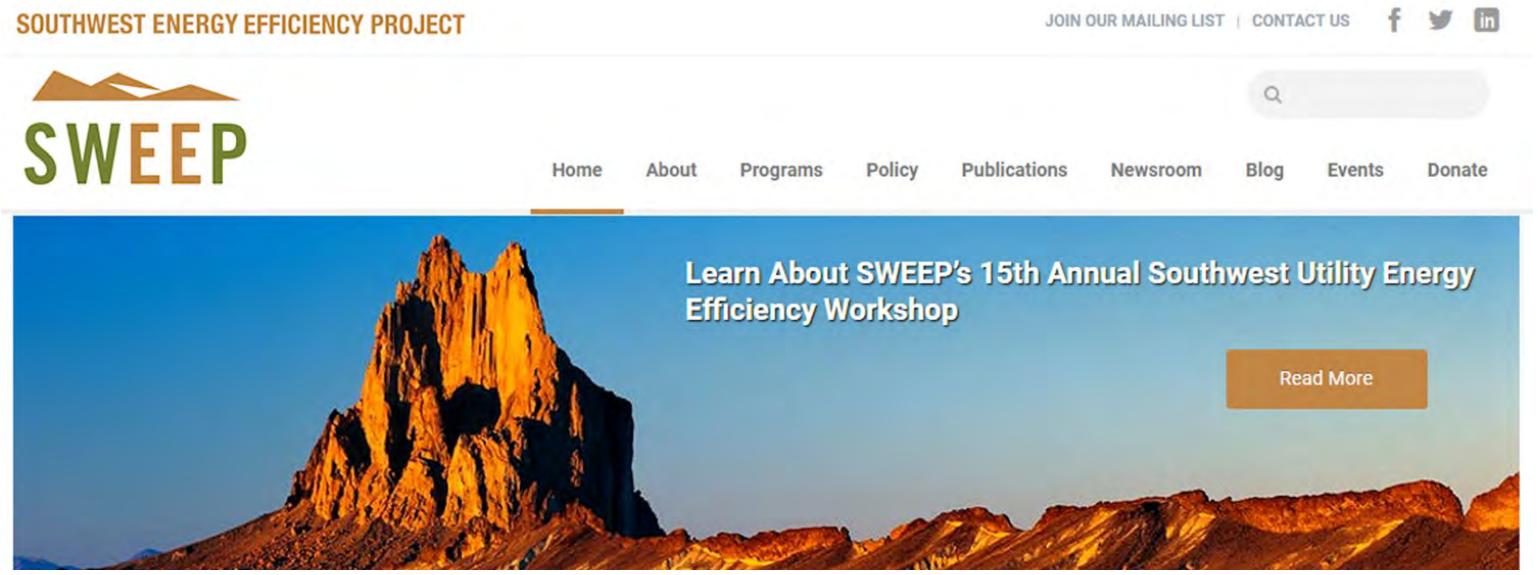
Alternative products, operations, and practices

Principles

- Educate and motivate employees, guests, etc.
- Educate, train, and motivate employees on energy efficiency practices pertaining to golf course operations.
- Identify incentives and programs from energy providers.
- Identify state/local programs and certification.
- Consider U.S. Green Building Council's LEED program.
- Consider EPA's EnergyStar, Portfolio Manager, etc.
- Consider energy management software, services, etc.
- Consider national and local programs and programs like the EPA's WaterSense program as it relates to buildings (see Water Conservation BMP).

Best Management Practices

- Evaluate alternative transportation.
- Evaluate cleaning practices (dry vs. wet).
- Consider local vs. distant purchases, product selection, etc.
- Evaluate energy acquisition and energy coming into the facility.
- Evaluate golf car equipment/operations and ensure proper selection, operation, charging, and maintenance.
- Incorporate training for employees.
- Incorporate the use of incentives.



Energy efficiency means reducing the amount of energy that you need to perform a particular task.

When you practice energy efficiency, you increase or maintain your level of service, but you decrease the energy used to provide that service through efficient technologies. Examples include ENERGY STAR appliances, compact fluorescent and LED light bulbs, better insulation for buildings, more efficient windows, high efficiency air conditioning equipment, and vehicles with higher miles per gallon (mpg). Another distinct strategy is energy conservation, which means that you change your behavior or lifestyle to reduce energy use. Examples include carpooling, using mass transit, turning thermostats down in the winter and up in summer, and other behavioral changes.

Improving energy efficiency is a "win-win" strategy— it saves money for consumers and businesses, reduces the need for costly and controversial new power plants, increases the reliability of energy supply, cuts pollution and greenhouse gas emissions, and lowers energy imports. There is vast potential for improving the energy efficiency of homes, appliances, businesses, and vehicles throughout New Mexico.

Click for more information

Course Management Plan

Principles

- Set energy-use goals for efficiency/conservation including infrastructure, equipment, behavior and agronomic practices.
- Ensure proper selection (type, size, etc.), operation, and equipment maintenance.
- Ensure efficient design, selection, operation, and maintenance of irrigation pumps, irrigation controls and other irrigation components.
- Implement energy source selection, management, and efficiency/conservation practices.

SWEEP

NEW MEXICO ENERGY FACT SHEET

Energy Efficiency & Energy Consumption

October 2018

Quick Facts:

• Population, 2016:	2,085,432
• Population growth rate, 2008-2016:	0.46% per year
• Number of households, 2016:	912,445

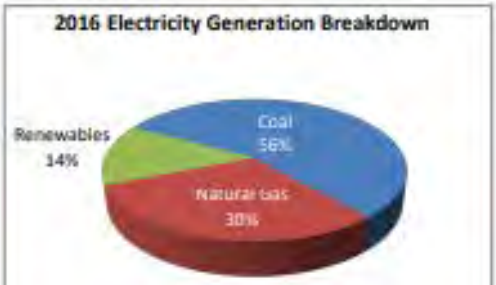
Primary Energy Consumption (2016)

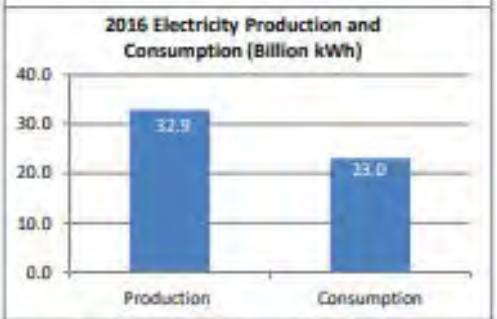
• Primary energy consumption:	667.8 trillion Btu
• Growth rate, 2008-2016:	-0.19% per year
• Primary energy consumption per capita:	320 million Btu
• Ranking, energy consumption per capita:	21
• Ranking, total energy consumption:	38
• Ratio of consumption to production:	0.26

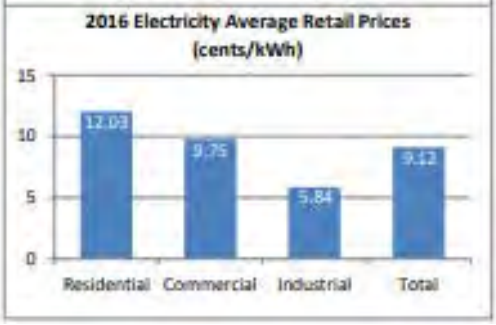
Energy Expenditures (2016)

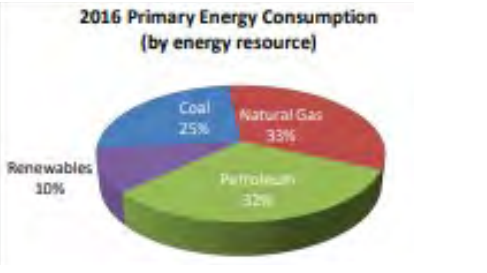
• Total energy expenditures:	$6.44 billion
• Ranking, energy expenditures:	38
• Energy expenditures per capita:	$3,089
• Ranking, energy expenditures per capita:	34

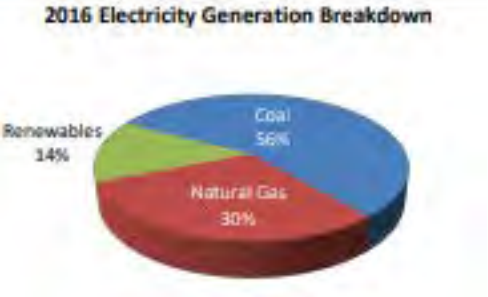
Source: *U.S. Energy Information Administration, State Energy Data System, June 2018.*

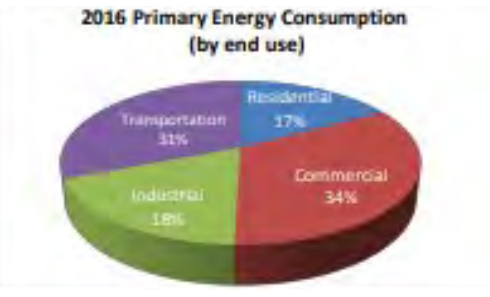












Best Management Practices

- Work with energy providers and evaluate existing programs, resources, etc.
- Consider long-term costs in addition to acquisitions.
- Schedule reviews to evaluate future technology and fuel types.
- Evaluate upgrades.
- Evaluate use of alternative energy/fuels.
- Identify future energy needs.
- Prioritize energy consumption as part of selection.
- Optimize equipment use data including hours operated, use patterns, etc.
- Incorporate new technology and upgrades when feasible.
- Consider alternative equipment, products, and practices.

Irrigation

Principles

- Ensure efficient design, selection, operation, and maintenance of irrigation pumps, irrigation controls, and other irrigation components.
- Assess irrigation pump efficiency; consider alternative equipment, products, and practices; use energy efficiently to maximize the output of the pump station.

Best Management Practices

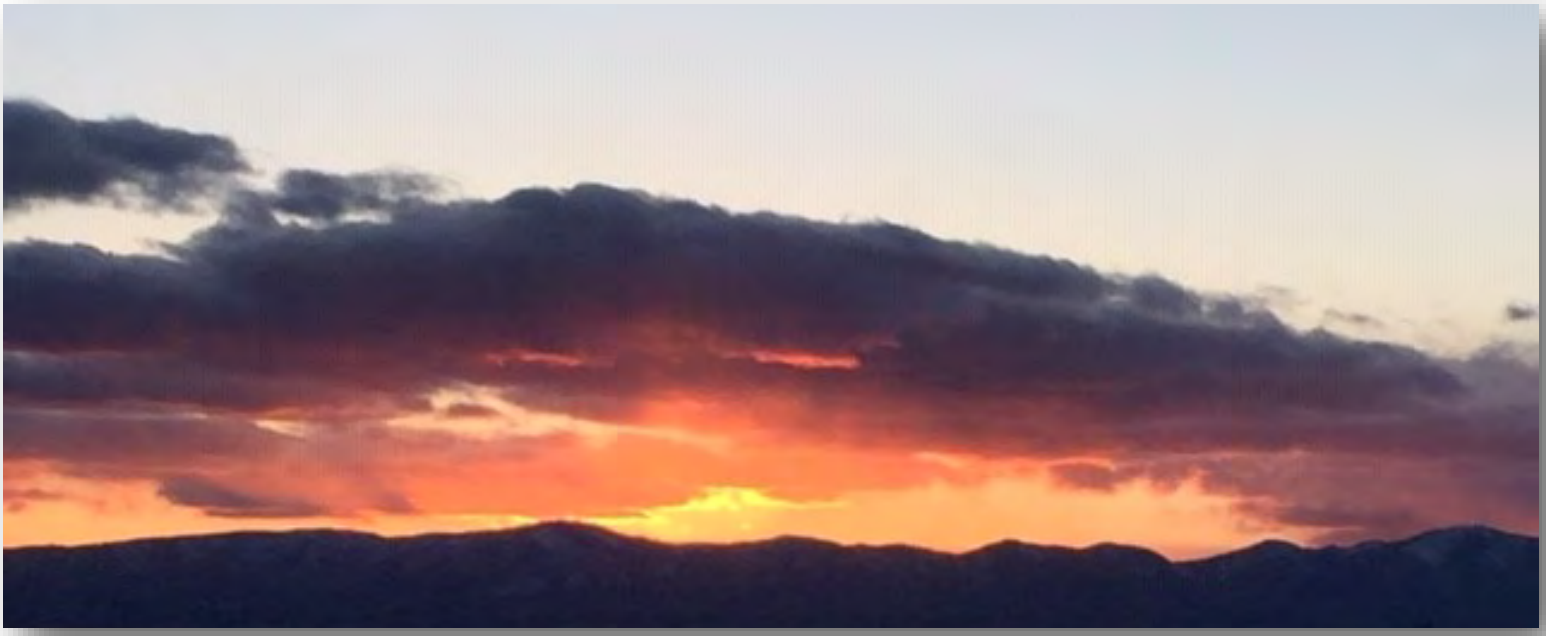
- Audit irrigation system (see Water Conservation BMP).
- Schedule and operate pumps and irrigation in an efficient manner.
- Identify and implement infrastructure and behavioral changes.
- Evaluate technology and upgrades; implement when feasible.

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Full Content List

BMP Best Management Practices



Section 1

Planning, Design and Construction *5*

Rio Grande Chapter GCSAA Golf Course Superintendents Association of America

Best Management Practices

Full Content List

BMP Best Management Practices

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Section 5

Section 6

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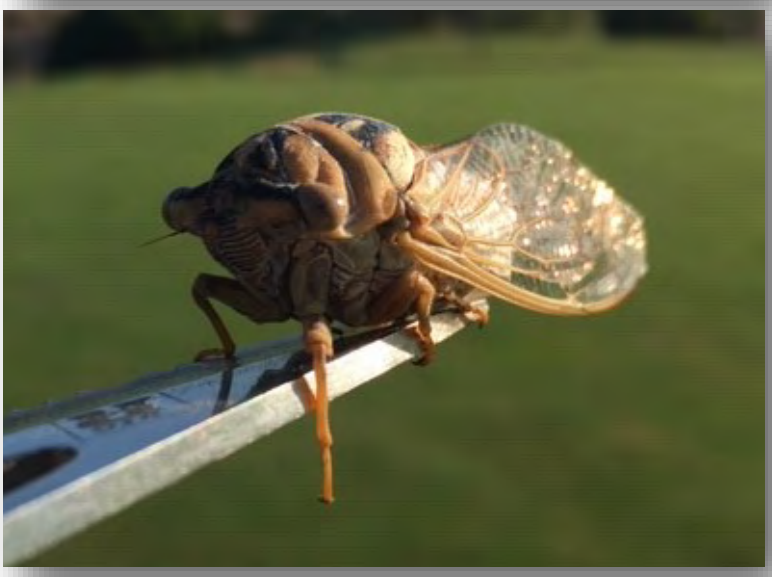
Section 7



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Section 8

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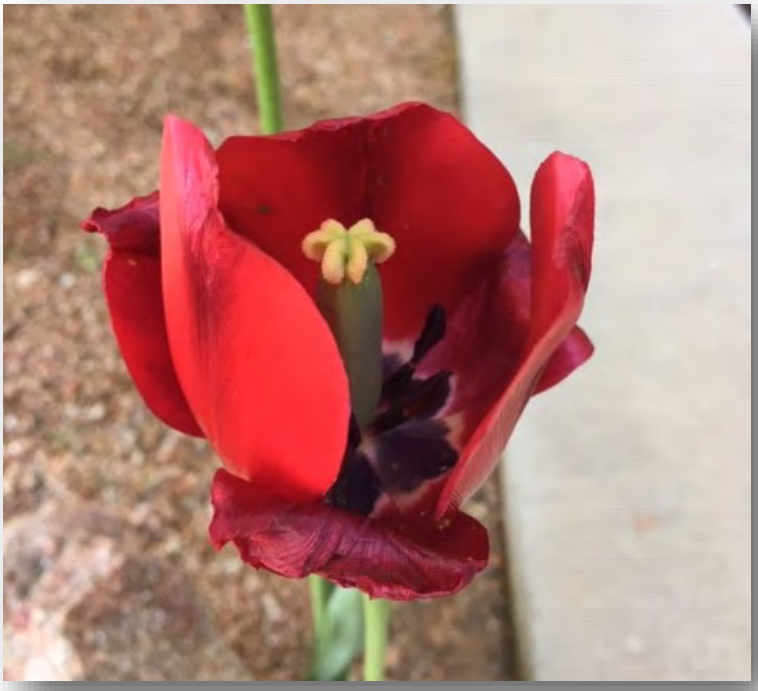
Section 8 Continued

Section 9



Section 10

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