



ENVIRONMENTAL PERFORMANCE REPORT 2014

Annual Site Environmental Report per the
U.S. Department of Energy Order 231.1B

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Cover Photo: Aerial view of the National Wind Technology Center (NWTC) and surrounding property.

Photo by Dennis Schroeder, NREL 30775

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ACKNOWLEDGEMENTS

This report requires a tremendous amount of data, collaboration, and review. Thank you to all who contributed their time and effort to this publication.

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Frank Rukavina and the Sustainable NREL team provided the report's sustainability content. Lissa Myers provided content for the Traffic Management section of the report.

Adrienne Elmore and Kathryn Ruckman with NREL's Communications and Public Affairs Office provided project support and editing.

Lori Gray, Laura Margason, Lisa Jorgensen, Robert Smith, and Robin Sweeney, with the U.S. Department of Energy Golden Field Office, worked closely with staff of the Alliance for Sustainable Energy, LLC, to continuously improve the report and conducted the review and approval process.

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NREL Environmental Performance Report 2014

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The 1 MW solar array at the National Wind Technology Center. It was installed in February of 2010. *Photo by Dennis Schroeder, NREL 18660*



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NOMENCLATURE

APCD – Air Pollution Control Division of CDPHE
APEN – Air Pollutant Emission Notice
AST – Aboveground Storage Tank

CCR – Colorado Code of Regulations
CDLE – Colorado Department of Labor and Employment
CDPHE – Colorado Department of Public Health and Environment
CFR – Code of Federal Regulations
CGI – Controllable Grid Interface
CGP – Construction General Permit
CO₂ – Carbon Dioxide
CO₂e – Carbon Dioxide Equivalent
CRS – Colorado Revised Statute
CWA – Clean Water Act
CX – Categorical Exclusion

DERTF – Distributed Energy Research Test Facility
DOE – U.S. Department of Energy
DOE Order – Department of Energy Order
DOPS – Division of Oil and Public Safety of the Colorado Department of Labor and Employment
DWOP – Denver West Office Park

EA – Environmental Assessment
EERE – Energy Efficiency and Renewable Energy
EHS – Environment, Health, and Safety
EIS – Environmental Impact Statement
EMS – Environmental management system
EPA – U.S. Environmental Protection Agency
EPCRA – Emergency Planning and Community Right-to-Know Act
ESA – Endangered Species Act
ESIF – Energy Systems Integration Facility
EO – Executive Order

FTLB – Field Test Laboratory Building
FY – Fiscal Year

IBRF – Integrated Biorefinery Research Facility
ISO – International Organization for Standardization

MBTA – Migratory Bird Treaty Act
mrem – Millirem
MW – Megawatt

NEPA – National Environmental Policy Act
NREL – National Renewable Energy Laboratory
NWTC – National Wind Technology Center

ODS – Ozone Depleting Substances
OTF – Outdoor Test Facility

PM – Particulate Matter

RFHP – Renewable Fuel Heating Plant
RSF – Research Support Facility
RTD – Regional Transportation District

SDS – Safety Data Sheet
SERF – Solar Energy Research Facility
SPCC – Spill Prevention Control and Countermeasures
SRRRL – Solar Radiation Research Laboratory
SSP – Site Sustainability Plan
SSPP – Strategic Sustainability Performance Plan
S&TF – Science and Technology Facility
STL – Structural Testing Laboratory
STM – South Table Mountain

TTF – Thermal Test Facility

USACE – U.S. Army Corps of Engineers
USFWS – U.S. Fish and Wildlife Service

VTIF – Vehicle Testing and Integration Facility

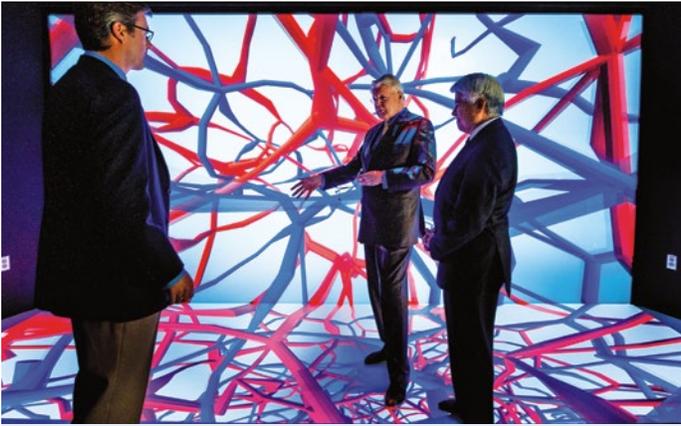
WQCD – Water Quality Control Division of CDPHE

ABOUT NREL

NREL is the principal research laboratory for DOE's Office of Energy Efficiency and Renewable Energy. The laboratory also conducts research for the Office of Science and the Office of Electricity Delivery and Energy Reliability. The laboratory is managed for the Office of Energy Efficiency and Renewable Energy by the Alliance for Sustainable Energy, LLC, a partnership between MRIGlobal and the Battelle Memorial Institute.

NREL is the only national laboratory solely dedicated to advancing renewable energy and energy efficiency technologies from concept to commercial application. The laboratory's innovations, analysis, and expertise have enabled the emergence of a U.S. clean energy industry and led to numerous success stories from across the laboratory. NREL's two campuses, the 327-acre South Table Mountain main campus in Golden, Colorado, and the 305-acre National Wind Technology Center in northern Jefferson County, are living models of sustainable energy integration.

NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the nation's energy and environmental goals. The laboratory's research and development achievements have helped shape clean-energy alternatives for powering our homes and businesses, and the nation's transportation infrastructure. NREL's science and technology teams span the full spectrum of innovation, from fundamental science and market-relevant research, to systems integration and testing and validation.



EXECUTIVE SUMMARY

PURPOSE

The National Renewable Energy Laboratory's (NREL's) Environmental Performance Report provides a description of the laboratory's environmental management activities for 2014, including information on environmental and sustainability performance, environmental compliance activities and status, and environmental protection programs, highlights, and successes.

The purpose of this report is to ensure that the U.S. Department of Energy (DOE) and the public receive timely, accurate information about events that have affected or could adversely affect the health, safety, and security of the public or workers, the environment, or the operations of DOE facilities. This report meets the DOE requirements of the Annual Site Environmental Report and has been prepared in accordance with the DOE Order 231.1B Chg 1, *Environment, Safety and Health Reporting*.

ENVIRONMENTAL AND SUSTAINABILITY PERFORMANCE

The laboratory is committed to environmental stewardship, pollution prevention, compliance with environmental requirements, and continual improvement in environmental protection and sustainability performance. NREL's Environmental Management System implements a framework of policies, procedures, and programs that integrates environmental protection into daily work practices. The Environmental Management System is structured based on a plan-do-check-act continual improvement management model and is implemented as part of an Integrated Safety Management System.

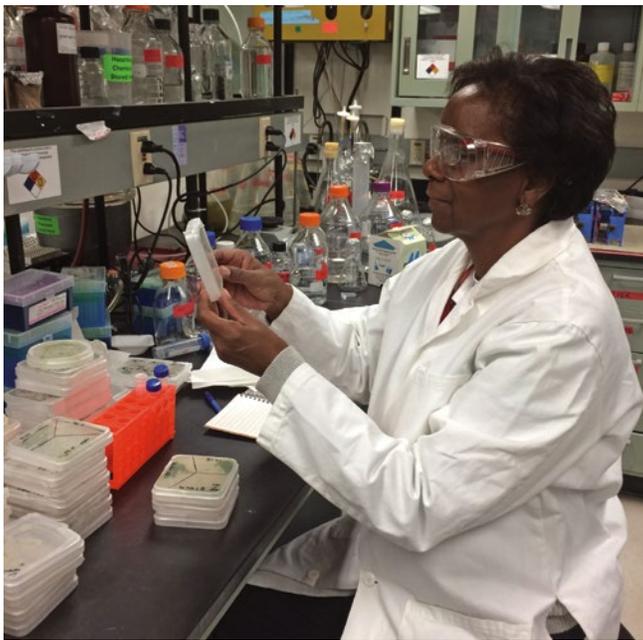
NREL hosts dignitaries from many countries. Here, President of Iceland Olafur Grimsson (middle) experiences the Insight Collaboration Laboratory in the Energy Systems Integration Facility. *Photo by Dennis Schroeder, NREL 24989*

Each year, the laboratory sets measurable objectives and targets for environmental improvement through the NREL Environmental Management System planning process. Goals are established through the Performance Evaluation Measurement Plan and the Site Sustainability Plan. Progress of all goals is tracked throughout the year using an online software tracking system. A summary is prepared annually for the DOE Golden Field Office on Performance Evaluation Measurement Plan results and for DOE Headquarters on Site Sustainability Plan results.

Sustainability is integral to both NREL's research and operations, and the laboratory is committed to demonstrating federal leadership in sustainability and continuously improving performance. Sustainable NREL, an interdisciplinary initiative involving staff from across the organization, fosters environmental and social responsibility, working to establish NREL as a global model for sustainability.

Each year, Sustainable NREL develops a Site Sustainability Plan to report on steps taken to meet the national and DOE sustainability objectives and to outline plans for the upcoming year. The laboratory has currently identified 20 objectives to enhance sustainability and continues to make significant progress toward these objectives.

During 2014, NREL continued its excellent record of environmental leadership and sustainability performance. The following are some of the laboratory's key accomplishments:



NREL researchers are using algae to develop alternative renewable fuels, capable of greatly decreasing greenhouse gas emissions. *Photo by Christy Eschenfeldt, NREL 33208*

- Achieved key short-term internal environmental and sustainability goals, and made progress toward long-term goals (For more details, see sections 3 and 4.)
- Received several awards and recognitions for environmental and sustainability accomplishments (see sidebar page 7)
- Maintained International Organization for Standardization 14001:2004 environmental management system certification
- Maintained Colorado Environmental Leadership Program Gold-Level Leader status, the highest level awarded by the state-sponsored program
- Reduced the total area of impervious surfaces at the South Table Mountain campus by removing approximately 15,000 square feet of asphalt parking lot, increasing stormwater infiltration
- Initiated climate resilience planning by identifying risks to NREL's operations and mission as a result of climate change, and subsequently developed a method to analyze, compare, and rank those risks
- Completed Site-Wide Environmental Assessments for both the South Table Mountain and National Wind Technology Center campuses that identify potential impacts to the human and natural environment relative to future master plans, thus allowing DOE to make informed campus management decisions as the laboratory continues to grow
- Completed a validation of accuracy of the site chemical inventory tracking system
- Added a window film visible to birds in order to prevent collisions with glass at the Energy Systems Integration Facility; shared the laboratory's experience in reducing impacts to migratory birds within DOE and among other federal agencies
- Partnered with industry in developing a prototype radar system capable of detecting large birds; ultimately this system is intended to provide wind operators with a means of early detection of avian species from which operational modifications can be made to reduce bird-turbine strikes
- Reduced impacts of employee commuting by supporting alternative work schedules, telecommuting, and alternative commuting options such as access to mass transit, vanpool discounts, preferred parking for carpool/vanpool vehicles, ride-share coordination, and bicycle and pedestrian infrastructure.



New blades are being installed for testing on a 3MW wind turbine at NREL's National Wind Technology Center. *Photo by Lee Jay Fingersh, NREL 33210*

ENVIRONMENTAL COMPLIANCE AND MONITORING

NREL is subject to many federal, state, and local environmental laws and regulations, as well as executive orders, DOE requirements, and agreements with government agencies. Unlike many other DOE facilities, NREL does not conduct work involving nuclear materials and does not have legacy radiological or other contamination issues associated with past nuclear weapons production or research activities; therefore, continuous radiation or radiological contamination monitoring is not conducted.

The laboratory continued its excellent record of environmental compliance in 2014. No violation notices were received from any regulatory agency and all required permits were received or renewed; required registrations were completed; and required notifications and reports were submitted. Actions were taken in two instances to correct circumstances that could lead to a violation.

NREL is committed to protecting wildlife on campus and workers are encouraged to notify staff biologists of

Prestigious Environmental Sustainability Awards Received

NREL received several important recognitions in 2014 for its environmental and sustainability accomplishments including:

- A DOE Green Buy Program Gold Award for purchasing 13 products in six different categories, achieving DOE's Green Buy leadership goal
- Environmental Protection Agency Federal Green Challenge recognition both nationally and in Region 8 for green purchasing
- A DOE Sustainability Award for Green IT Stewardship, for exemplary performance related to power management, sustainable electronics acquisition, and data center sustainability.

situations that could impact wildlife. Reports of birds colliding with building windows at the Energy Systems Integration Facility resulted in retrofitting select windows with bird-visible markers. Inspections and feedback received during the three months following installation indicate no additional collisions have occurred.

Environmental Management Programs

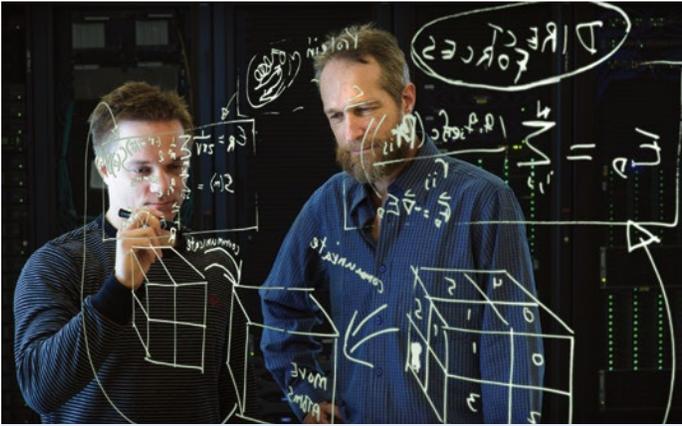
The laboratory continues to meet or exceed compliance requirements and strives to make continual improvements in environmental management. Major environmental program areas include:

- Air quality protection, including air permitting, ozone depleting substance management, and greenhouse gas emissions monitoring
- Water quality protection, including construction stormwater management, drinking water monitoring, and preventing unallowable sanitary sewer system discharges
- Hazardous materials and waste management, including pollution prevention, spill response, proper storage, use, and disposal of hazardous chemicals and materials, as well as planning, permitting, and reporting regarding use and emissions of such materials
- National Environmental Policy Act reviews
- Natural and cultural resources protection, including wildlife, vegetation, protected species, wetlands, and cultural resources management.

NREL's Continued International Organization for Standardization 14001 Certification Demonstrates Commitment to Environmental Leadership

In 2014, the laboratory maintained International Organization for Standardization 14001:2004 certification of its environmental management system. A team of external auditors conducted an independent assessment of the policies, procedures, tools, and roles and responsibilities used in environmental management. The assessment verified that the laboratory continues to meet the requirements of the International Organization for Standardization 14001 standard and demonstrates the laboratory's commitment to environmental stewardship.

The laboratory continued to improve its environmental management and performance in 2014. This was demonstrated by a track record of excellent compliance with regulatory requirements and established leadership in environmental and sustainability management.



1

INTRODUCTION

1.1 PURPOSE

This report presents a summary of the National Renewable Energy Laboratory's (NREL's) 2014 environmental management activities, including:

- Environmental protection programs
- Environmental and sustainability performance
- Environmental compliance activities and status
- Environmental management highlights and successes.

This report incorporates the U.S. Department of Energy's (DOE's) most recent guidelines for the Annual Site Environmental Report, as required by DOE Order 231.1B Admin. Chg. 1, *Environment, Safety, and Health Reporting*.

1.2 OUR MISSION

NREL's mission is focused on advancing the energy goals of DOE and our nation. This focus is captured in the mission statement:

NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the nation's energy and environmental goals.

NREL fulfills its mission through technology portfolios. A brief description of each major technology area follows.

- **Basic science**—Fundamental research is conducted in the sciences that underlie renewable energy and energy efficient technologies.

NREL scientists have enhanced a software tool used to simulate the motions of thousands of atoms. The research has led to a greater understanding of how molecular models work to further advance biofuels technology.
Photo by Dennis Schroeder, NREL 24348



An NREL process engineer stirs a 1,450-liter fermentation vessel as part of biofuels research being conducted at the Integrated Biorefinery Research Facility. *Photo by Dennis Schroeder, NREL 31690*



Energy Systems Integration Facility researchers inspect the vanadium redox flow energy storage system, which is being tested to assess its ability to provide uninterrupted power supply from renewable energy sources. *Photo by Dennis Schroeder, NREL 31367*

- **Bioenergy**—NREL currently has major programs in biomass-derived fuels (biofuels) and biomass-derived electricity (biopower), and projects in biomass-derived chemicals and materials.
- **Building energy**—NREL supports research and development of technologies and practices for energy efficiency, working closely with the building industry and manufacturers; promotes energy and money-saving opportunities to builders and consumers; and works with state and local regulatory groups to improve building codes and appliance standards.
- **Computational sciences**—This area includes basic and applied research using high-performance computing and applied mathematics.



Research being conducted at NREL's Automated Home Energy Laboratory, housed at the Thermal Test Facility, seeks to identify the complex interactions of multiple household appliances with the power distribution grid, and ultimately determine convenient means for homeowners to save energy and money. *Photo by Dennis Schroeder, NREL 20162*

- **Distributed power**—Distributed power draws upon small-scale power generation sources (e.g., photovoltaic cells/arrays and wind turbines) located close to where the electricity is used (e.g., a home or business) and therefore provides an alternative to or an enhancement of the traditional electric power grid. NREL participates in the development of technologies, market structures, and policies that affect the incorporation of renewable and energy efficiency technologies in distributed power systems.
- **Electricity technologies**—Research is conducted to support electricity technologies that include renewable energy, hydrogen, and superconductivity technologies, as well as utility resources.
- **Energy analysis**—Energy analysis at NREL is performed to inform policy and investment decisions as energy-efficient and renewable energy technologies advance from concept to commercial application to market penetration.
- **Hydrogen**—NREL is a leader in renewable hydrogen production technologies and the development of codes, standards, and advanced storage and sensors. Basic and applied research and material development using biology, physics, and chemistry enable and support the development of hydrogen production, storage, and end-use systems.
- **Measurements and testing**—NREL laboratories and facilities allow state-of-the-art testing on photovoltaic cells, building technologies, and wind turbines.
- **Photovoltaics**—Photovoltaic cells enable the direct conversion of sunlight to electricity using solid-state materials. The National Center for Photovoltaics

develops and deploys photovoltaic technology for the generation of electric power.

- **Renewable energy resources**—Researchers develop resource information for solar, wind, biomass, and geothermal energy applications.
- **Renewable thermal technologies**—Research is conducted in thermal technologies, including concentrating solar power, solar water heating, and geothermal heat and power, which generate power from heat or utilize heat from renewable resources.
- **Transportation**—NREL works with industry experts to develop advanced vehicles and transportation systems. NREL also works with energy companies and manufacturers of vehicles and engines to develop advanced motor vehicle fuels for improved energy and environmental performance.
- **Wind energy**—Through the National Wind Technology Center, NREL develops, improves, and demonstrates the viability of wind technology for electricity generation and facilitates its utilization throughout the world.



An NREL employee works in the hub of the wind turbine rotor installed on the Controls Advanced Research Turbine at the National Wind Technology Center. *Photo by Lee Jay Fingersh, NREL 14902*

1.3 SITE AND FACILITY DESCRIPTION

NREL facilities occupy four separate locations in Jefferson County, Colorado, and one location in the City and County of Denver. These include:

- National Wind Technology Center (NWTC)

- South Table Mountain (STM)
- Denver West Office Park
- Joyce Street Facility
- Renewable Fuels and Lubricants Research Laboratory.

The STM and NWTC campuses are the two main sites where research operations are conducted; these will be addressed separately in the discussion of environmental features. The Denver West Office Park is leased space used primarily for administrative functions and limited research activities. The leased Joyce Street Facility space is primarily used for storage. The Renewable Fuels and Lubricants Research Laboratory facility is a leased research space that consists of a single vehicle high bay and small office area housed within the Regional Transportation District's District Shops and Operations Center facility in Denver.

Laboratory staff also conduct work at additional locations as needed; for example, at the Solar Technology Acceleration Center described below.

Climate

The climate for the geographic region of NREL operations is classified as semi-arid, typified by limited precipitation, low relative humidity, abundant sunshine, and large daily and seasonal temperature variations.

The area experiences moderate precipitation, with an average annual rainfall of less than 20 inches (50 centimeters [cm]). Almost half of the annual precipitation occurs from March to June. Summer showers contribute 33% of the annual precipitation total. Precipitation begins to decrease significantly in the fall, reaching the minimum during winter. Winter is the driest season, contributing less than 10% of the annual precipitation, primarily in the form of snowfall.

Spring is a season of unstable air masses with strong winds along the foothills and the Front Range. The highest average snowfall occurs in March, and the STM campus can generally expect to experience at least one heavy snowstorm with totals exceeding 6 to 10 inches (15 to 25 cm).

The solar radiation (sunlight energy) of the region is excellent for outdoor research and testing of solar energy conversion devices and systems. Sunshine is abundant throughout the year and remarkably consistent from month to month and season to season.



NREL's South Table Mountain campus. Photo by Dennis Schroeder, NREL 30709

South Table Mountain Campus

The STM campus is the main research center for NREL—nearly 80% of the laboratory's staff have their offices and laboratories there. The STM campus is approximately two miles (3.2 kilometers [km]) east of Golden and 12 miles (19.3 km) west of central Denver.

Land Use

The STM campus is a roughly triangular parcel of land occupying portions of the top, sides, and lower south-facing slopes of South Table Mountain, a mesa that stands approximately 492 feet (150 meters) above the adjacent lowlands. South Table Mountain is composed of sedimentary rocks below a basalt lava cap, which is quite resistant to erosion.

The STM site is a 327-acre (132 hectares) area predominantly bordered by open grassland zoned for recreation and light-commercial activity. Portions of the community of Pleasant View are located immediately to the south and west. Pleasant View has constructed a recreational park immediately south of the STM campus. Offices, shops, and a tree nursery owned by the Colorado State Forest Service are located at the far western edge. Undeveloped state land and a Colorado State Highway Patrol pursuit driver-training track are located along the northwestern boundary of the STM campus on top of the mesa. Jefferson County open space wraps around the northern and eastern edges of the site. Portions of the Denver West Office Park and apartment homes lie to the east.

More than half of the STM campus (177 acres / 72 hectares) has been set aside in a conservation easement. No development is allowed on that land, with the exception of some existing utility easements and recreational trails to be established by Jefferson County Open Space. (For more details, see section 11, Conservation Easement Lands.)

Geology, Soils, and Hydrogeology

The mesa was formed as weak sedimentary rocks surrounding the lava were eroded away, leaving the lava-capped mesa in relief. Below the lava caprock, the sedimentary rocks are part of the Denver Formation that consists of layers and lenses of claystone, sandstone, and conglomerate. Sedimentary rocks of the Arapahoe Formation underlie the Denver Formation.

Both the Arapahoe and Denver Formations are considered to be aquifers in portions of the Denver Basin. The Denver Formation underlies the areas on which most NREL construction has taken place. Groundwater on the STM campus occurs primarily in the weathered and fractured silts and sands of the Denver Formation. There may also be some groundwater in the form of perched aquifers below the basaltic lava cap on South Table Mountain, and within the materials above the Denver Formation, which are largely the result of stream deposits. Groundwater flow on the site is in a southeasterly direction.

The soil covering the top of South Table Mountain is lavina loam. Loam is composed of a mixture of clay, sand,

silt, and organic matter. The loam on the mesa top is a shallow, well-drained clayey soil. Soil on the upper side slopes of South Table Mountain is also a loam consisting of extremely stony soils with significant amounts of clay. Much of the remainder of the site, including the area designated for major development, has a deep, well-drained soil referred to as Denver clay loam. It consists of clayey material containing some calcium carbonate. There are also two smaller soil areas on the southwestern portion of the site, both of similar character to other site soils—cobble clay loam and very stony clay loam.

Surface Water

About 90% of the surface drainage from the site, both from the mesa top and across the lower portions of the site, flows in a southerly direction toward Lena Gulch (a tributary of Clear Creek). While there is no permanent stream flow on the STM campus, occasional flow from extended periods of precipitation, usually during the late winter and early spring, is found in the drainage channels, with seasonal springs evident along some of the mesa slopes. There is one seep on the mesa top that is often active throughout much of the year, but the water infiltrates and evaporates quickly during the dry season.

Vegetation

Two primary vegetation types are present on the STM campus: grasslands and shrublands. The most common plant communities on the STM campus are mixed grasslands, comprising more than 80% of the vegetation on the site. These communities are generally dominated by short- and mid-grass species. Two primary upland shrub communities occur on the STM campus: mountain mahogany shrublands, found on the shallow soils of the mesa, and upland shrublands, occurring in drainages lacking active channels as well as drainages with associated wetlands. Field surveys have identified limited wetland and riparian areas along drainages. The wetland communities identified on the STM campus are a minor component of the total vegetation cover, accounting for less than 1% of the vegetation over an area of less than 0.3 hectares (0.75 acres). Riparian shrub communities also occur adjacent to the emergent wetlands. A vegetation survey of the STM campus was conducted in 2010. (For more details, see section 10.3, Vegetation Management.)

Wildlife

Several comprehensive wildlife surveys have been conducted on the site, starting with the original study in 1987. Additional surveys were done in 1999 of the conservation easement property. Surveys to update



Red-tailed hawk soaring over the South Table Mountain campus.
Photo by Tom Ryon, NREL 33065

existing data were completed in 2005 and in 2011. (For more details, see section 10.1, Wildlife Management.)

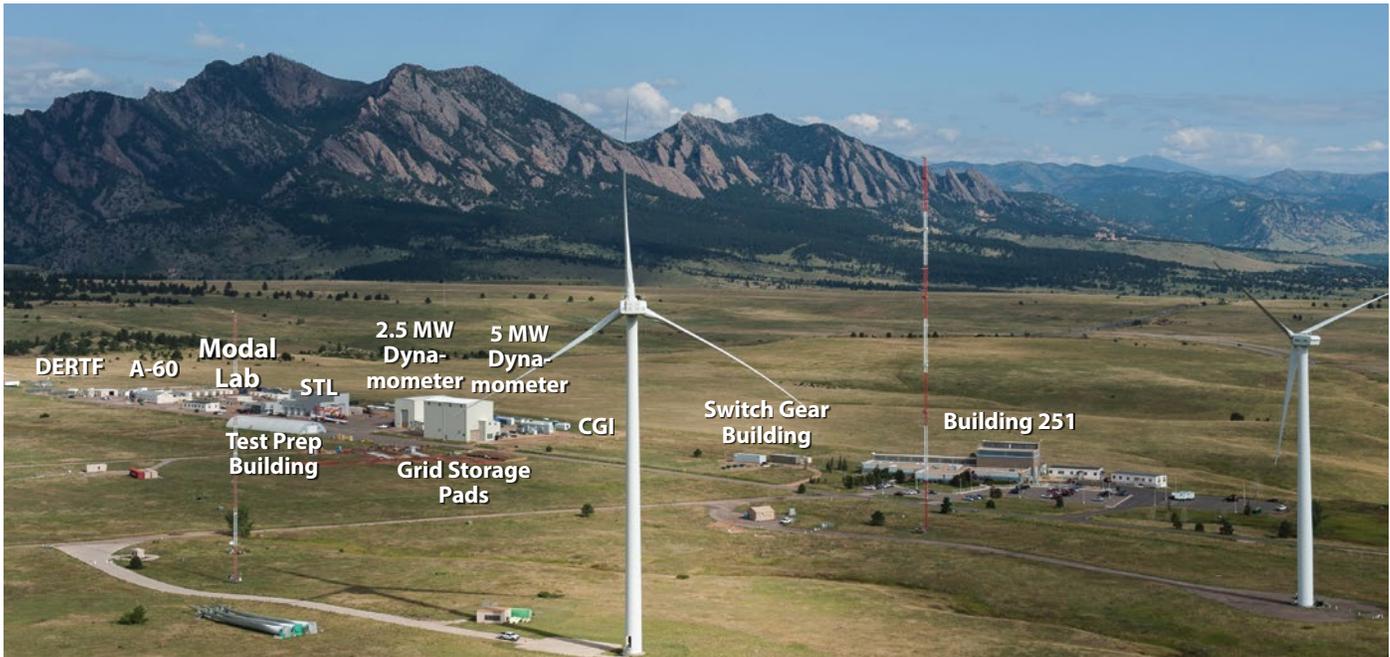
Mammals identified during the surveys included mule deer, coyotes, gray foxes, red foxes, raccoons, long-tailed weasels, striped and spotted skunks, badgers, bobcats, mountain lions, rabbits, yellow-bellied marmots, and various smaller mammals. More than 50 species of birds have been recorded on the STM campus by the formal wildlife surveys and supplemental employee observations. A number of raptor species have been recorded at or above the STM campus, especially during spring migration. Two raptor species are resident at the site: American kestrel (*Falco sparverius*) and red-tailed hawk (*Buteo jamaicensis*). Reptiles and amphibians inhabit the area as well. Most notably, the western rattlesnake is routinely encountered around the campus area.

National Wind Technology Center

The NWTC is the main facility for NREL's wind turbine technology research. Located on the Jefferson-Boulder County border just east of the foothills of the Rocky Mountains, the NWTC has abundant wind resources that are critical for the variety of projects conducted at the site. The NWTC is located near the intersection of Highways 93 and 128, between Boulder and Golden, and is approximately 15 miles (24.2 km) north of the STM campus.

Land Use

The NWTC facility occupies a 305-acre (124-hectares) area surrounded largely by open space and grazing land. The Rocky Flats National Wildlife Refuge borders the NWTC to the southeast, and a sand and gravel mining and processing operation is located along the southern and western boundaries of the site. A blasting company also has a small installation along the western site boundary.



NREL's National Wind Technology Center campus. Photo by Dennis Schroeder, NREL 30766

State Highway 128 borders the NWTC to the north; Boulder County open space lies to the north of the highway.

Geology, Soils, and Hydrogeology

The NWTC campus is located on a plain formed by stream deposits. The uppermost geological layer beneath the site is known as the Rocky Flats Alluvium. It is composed of cobbles, coarse gravel, sand, and gravelly clay. Below the Rocky Flats Alluvium are the Laramie Formation, Fox Hills Sandstone, and Pierre Shale. These rock formations consist primarily of claystones with some siltstones. Unconfined groundwater flow occurs in the Rocky Flats Alluvium toward the east/southeast, and small perched zones are common. Groundwater occurs as confined aquifers in the deeper bedrock formations.¹

The NWTC has a strongly developed soil defined as a very cobbly, sandy loam. The soil is characterized by a large amount of cobble and gravel in the soil volume, and subsoil dominated by clay.

Surface Water

The area surrounding the NWTC campus is drained by five streams: Rock Creek, North Walnut Creek, South Walnut Creek, Woman Creek, and Coal Creek. Rock Creek flows eastward and is located southeast of the NWTC. North Walnut Creek and South Walnut Creek flow eastward into

the Great Western Reservoir. Woman Creek drains eastward into Standley Lake. Coal Creek flows in a northeasterly direction across the City of Boulder Open Space north of the NWTC.

The majority of the NWTC drains into a tributary to Rock Creek. Some of the northern portions of the site drain into Coal Creek or its tributaries.

Vegetation

The NWTC is located in the transition area between the Great Plains and the Rocky Mountains.² This location results in a flora that contains elements from both mountain and prairie ecosystems, and associations that represent residual tallgrass prairie, shortgrass plains, ponderosa pine woodland, and foothill ravine flora.³

Vegetation surveys conducted at the site have identified 271 vascular plant species and defined five major habitat types on the NWTC campus, including xeric mixed grasslands, pine woodlands, shrublands, wetlands, and disturbed areas.

Along the northwestern ridge is a ponderosa pine woodland area. Vegetation found in this area includes woody species with an understory of grasses, forbs, and shrubs. The most recent vegetation survey was completed in 2011. (For more details, see section 10.3, Vegetation Management.)

¹ EG&G Rocky Flats, Inc. (1992). Rocky Flats Plant Site Environmental Report, January Through December 1992. Golden, Colorado.

² Plantae Consulting Services (2000). Vegetation Survey, NREL National Wind Technology Center. Boulder, Colorado.

³ Ibid.

Wildlife

Prior to 1975, livestock heavily grazed the NWTC campus, damaging a majority of the native vegetation. DOE prepared a biological characterization inventory in 1992 for the entire Rocky Flats plant, including the NWTC campus, which was part of the no-activity buffer zone of the Rocky Flats plant at the time. Signs or tracks of bears and mountain lions were identified. Other mammals known to feed at the site are mule deer, coyotes, desert cottontail rabbits, white-tailed jackrabbits, black-tailed jackrabbits, deer mice, prairie voles, and thirteen-lined ground squirrels. Approximately 20 different species of birds were sighted at or near the site. Raptor surveys were conducted at the NWTC in 1994 and 1995, and identified seven raptor species on or in the vicinity of the site. An avian survey was also completed in 2002 and updated in 2011. (For more details, see section 10.1, Wildlife Management.) Although seldom seen, rattlesnakes, bull snakes, racers, and several other reptilian and amphibian species are known to occupy the area.

Denver West Office Park

The Denver West Office Park, located within the City of Lakewood approximately two miles (3.2 km) east of Golden and 12 miles (19.3 km) west of central Denver, is a relatively flat, landscaped office complex occupied by a number of four-story buildings, parking lots, and common areas. NREL-leased facilities at this location are situated approximately in the geographic center of the development. The Denver West Office Park is bordered on the south by commercial areas (West Colfax strip), and on the west by the Pleasant View residential area, Camp George West facility, and the STM campus. In addition to office spaces, activities at the Denver West Office Park include



NREL researchers analyze micro-grid synchronization wave forms at the NWTC's Distributed Energy Resources Test Facility to facilitate interconnection and grid integration of renewable energy sources. Photo by Dennis Schroeder, NREL 21937

low-risk research related to fuel and battery characterization, thermal analyses of vehicle cooling loops, vehicle electrical systems analysis, and photo-electrochemical hydrogen production.

Joyce Street Facility

The Joyce Street Facility is located in a commercial area surrounded by agricultural land, residential neighborhoods, and small businesses. It is currently used by NREL primarily as warehouse space; there are no staff offices at this location. The Joyce Street Facility is located at 6800 Joyce Street, about 5.5 miles (8.9 km) north of Denver West Office Park and the STM campus.

Renewable Fuel and Lubricants Research Laboratory

The Renewable Fuels and Lubricants Research Laboratory is used for research, testing, and support activities related to advanced fuels, engines, and vehicles to objectively evaluate performance, emissions, and energy efficiency impacts, including the evaluation and development of heavy-duty hybrid vehicles. The laboratory consists of a single vehicle high bay and small office area housed within the Regional Transportation District's District Shops and Operations Center located at 1900 31st Street, Denver, approximately 12 miles (20 km) east of the STM campus. The District's Shops and Operations Center facility occupies approximately 22 acres (9 hectares) of land and serves as the primary maintenance facility for the Regional Transportation System's bus and light rail train systems. The area around the facility consists of commercial and light industrial development.

The site lies on relatively flat terrain with a slight gradient to the northwest. The general area is highly developed with concentrated industrial and commercial activities. Very little natural vegetated habitat exists on-site or in the immediate vicinity. There are trees and shrubs lining the South Platte River adjacent to the site's southern, eastern, and northeastern borders.

Additional Locations

- Laboratory staff also conducts work at additional locations as needed. One such location is the Solar Technology Acceleration Center, operated by MRIGlobal, located near Denver International Airport, northeast of the intersection of East 26th Avenue and North Hudson Road in Aurora, Colorado. The Solar Technology Acceleration Center is a partnership of solar equipment manufacturers, research organizations, and electric utilities that want to make use of a real-world outdoor site to develop, test, validate, and showcase

solar products. Approximately 33 miles (54 km) east of the STM campus, the 74-acre (30-hectare) facility provides users with readily accessible land and all the necessary infrastructure and resources needed to rapidly and economically install their technologies. NREL currently leases several acres at the site. The primary projects currently being conducted by NREL include:

- **Concentrating Photovoltaics Demonstration** – This project, which was terminated in late 2014, demonstrated and quantitatively compared performance of concentrating photovoltaic systems installed in Japan and the United States.
- **Thermal Energy Storage Test Facility** – NREL used this facility to provide a pilot-scale demonstration project related to thermal storage. This facility has since been transferred to MRIGlobal, and NREL will have no further involvement.



An NREL engineer monitors data from a test run on a chassis dynamometer in the control room at the Renewable Fuels and Lubricants Research Laboratory. *Photo by Dennis Schroeder, NREL 22761*



2

SIGNIFICANT SITE ACTIVITIES IN 2014

In 2014, numerous minor construction projects were either begun, continued, or completed. From concept to design to completion, environmental and sustainable stewardship are integrated into the management of infrastructure and building projects.

2.1 CONSTRUCTION PROJECTS

A brief description of the significant projects undertaken on NREL campuses in 2014 is as follows:

STM Campus

- The 15 megawatt (MW) electrical upgrade to the campus-wide electrical system was completed, which will provide 5 MW of additional electrical capacity required to support operation of the Energy Systems Integration Facility Data Center at full build out without taxing the power needed to support the rest of the campus. The project also connected the photovoltaic array system on the roof of the employee parking garage to the Xcel Energy power grid.
- Installation of the E85 fueling station was completed and is currently being used to fuel fleet and test vehicles. Use of E85 fuel in fleet vehicles reduces NREL's overall greenhouse gas emissions.
- The Hydrogen Fueling Station was moved from the NWTC to the STM campus to facilitate additional research currently being conducted at the Energy Systems Integration Facility.
- Exterior improvements at the Solar Energy Research Facility and the Science and Technology Facility began. Ultimately the project will provide enhanced pedestrian movement and outdoor collaboration spaces.

An NREL worker uses the newly installed E85 tank on the STM campus to fill an NREL On-Demand van. *Photo by Dennis Schroeder, NREL 32161*

- Improvements to the drainage swale that crosses Jefferson County Open Space property and that discharges to the stormwater detention basin were completed. The channel bottom stabilization as well as reseeded side slopes will reduce sediment delivery to the STM campus stormwater detention basin, thus decreasing the risk of sediment ultimately reaching Lena Gulch, the offsite water body to which the campus drains.

NWTC Campus

- The 10 MW Electrical Storage/Controllable Grid Interface project was completed. This project allows manufacturers and system operators to test integration of utility-scale wind and solar generation technologies to the electrical power grid.
- Major roadway repairs were completed to address damage incurred during the 2013 100-year flood event.

2.2 INTEGRATED ENVIRONMENTAL STEWARDSHIP IN CONSTRUCTION MANAGEMENT

NREL designs and builds new facilities using an approach that integrates planning, design, and construction. An interdisciplinary team collaborates on each project beginning with planning and selection of design, continuing through construction. This integrated approach allows the laboratory to achieve mission needs while addressing environmental, health, safety, and community considerations.

Project Planning and Design

Environmental staff participates in an interdisciplinary project management team from a project's initiation,

continuing through construction. This includes developing and reviewing scopes of work, facilitating the inclusion of environmental requirements and best management practices (such as bird-friendly windows) into project designs, and monitoring proposed changes throughout the project to confirm that potential environmental impacts are considered and addressed. Some of the 2014 projects that demonstrate the integration of environmental considerations in planning and design are:

- A highly engineered drainage swale intended to minimize erosion and offsite sedimentation while maintaining a natural appearance to hikers on a nearby park trail
- A custom-designed spill control gate to prevent fuel spills from entering the storm drain system
- Design of landscaping improvements intended to increase wildlife habitat, promote stormwater infiltration, and minimize watering of vegetation.

Environmentally Responsible Construction Practices

During construction, DOE and NREL environmental staff participates in weekly construction team meetings, monitors performance criteria, and provides ongoing feedback to the project team regarding environmental management. Environmentally responsible construction practices include pre-construction review of project plans, performing nesting-bird surveys prior to commencing earth-disturbing activities, using a "plan of the day" to coordinate and control activities, implementation of stormwater controls prior to starting excavations, minimizing impacts to wildlife, tracking waste diversion, proper storage of hazardous materials, and controlling dust.



3

ENVIRONMENTAL MANAGEMENT SYSTEM AND POLLUTION PREVENTION

NREL's Environmental Management System (EMS) provides effective environmental stewardship and minimizes the environmental impacts of laboratory activities and operations. The EMS is a framework of policies, procedures, and programs that integrates environmental protection into daily work practices. The laboratory's EMS efforts include:

- Protection and enhancement of vegetation, wildlife, and natural resources of the laboratory sites
- Pollution prevention
- Compliance with environmental requirements
- Encouragement of continual improvement in environmental protection and sustainability performance.

The laboratory strives to continually minimize waste and prevent pollution, thus reducing its environmental footprint. Pollution prevention is implemented through the laboratory's EMS, the Hazard Identification and Control program, and the Sustainable NREL program.

Requirements

A federal Executive Order, EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, and DOE Order 436.1, *Departmental Sustainability*, require that the laboratory implement an EMS that conforms to the ISO 14001 structure. The EMS is implemented as part of a DOE-required Integrated Safety Management System, which systematically integrates safety and environmental protection into management and work practices at all levels to protect the public, the worker, and the environment.

Additionally, EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, together with the above-referenced executive and DOE orders, direct the laboratory to conserve natural

Green purchasing at NREL includes office products made of recycled materials. Photo by Christina Chase, NREL 19796

ISO 14001:2004 Certified

NREL's EMS is certified to the International Organization for Standardization (ISO) 14001:2004 standard for environmental management systems. ISO 14001 is a globally recognized standard that defines the structure of an organization's EMS to improve its environmental performance. ISO 14001 requires an organization to identify potential environmental impacts and establish controls needed to minimize impacts, to monitor and communicate environmental performance, and to establish a formal process for continually improving the system.

NREL's Environmental Aspects

NREL conducts an annual review of its activities that could potentially affect the environment. The laboratory's significant environmental aspects for 2014 were:

- Air emissions
- Surface water and groundwater discharges
- Wastewater releases
- Waste generation and management
- Resource use or conservation (energy, water, land, biological, cultural)
- Community.

Each of these aspects is addressed by the EMS.

resources, reduce energy use, develop renewable energy, reduce greenhouse gas emissions, manage buildings and transportation in a sustainable manner, and support pollution prevention.

3.1 ENVIRONMENTAL MANAGEMENT SYSTEM STRUCTURE

The EMS is structured based on a plan-do-check-act continual improvement framework described below and depicted in Figure 1.



Figure 1. NREL's continual improvement cycle.

Planning

- **Environmental policy** – NREL states its commitments to the environment through this overarching policy. The policy commits specifically to:
 - Environmental stewardship
 - Pollution prevention
 - Compliance with legal requirements and voluntary commitments
 - Continual improvement of environmental and sustainability performance.
- **Environmental aspects** – NREL's environmental aspects are those activities, products, or services that have the potential to interact with the environment. The significance of an identified aspect is determined by assigning a frequency of occurrence and a severity. Using this method, NREL's EHS staff reviews potential impacts to the environment annually, and activities in the EMS are prioritized by the identified significant aspects. NREL also utilizes a robust hazard identification and control process as part of its Integrated Safety Management System to manage environmental risks.
- **Legal and other requirements** – NREL maintains a formal process to identify regulations and standards that are necessary and sufficient to address specific environmental hazards, including federal laws and regulations, state and local requirements, executive orders (EOs), and DOE orders.
- **Objectives and targets** – Regular planning of activities and programs are necessary to achieve NREL's

environmental goals. The EHS Office and Sustainable NREL plan, implement, monitor, and report on environmental stewardship goals and actions to generate continual improvement. (For more details, see section 3.3, Performance Indicators and Progress.)

Implementing

- **Structure and responsibility** – NREL policies and procedures establish roles and responsibilities for environmental management within the organization.
- **Competence, training, and awareness** – NREL verifies that workers are competent on the basis of education, training, or experience, and implements a robust environment, health, and safety training program.
- **Communication** – NREL provides a number of avenues for communication between the laboratory and the community, such as community meetings, lunch-and-learn events, publically available websites, periodic newsletters, and community mailings. NREL tracks and responds to all environmentally related concerns through the Public Affairs Office. Internal communication regarding environmental issues is provided via intranet sites, newsletters, emails, meetings, posters, trainings, and personal interaction with EHS staff.
- **Operational control** – NREL plans and manages operations and activities in line with its environmental policy and objectives. Staff continually identifies and reviews activities that could impact the environment, and engineering and administrative controls are put in place to minimize or avoid impacts to the environment.
- **Document and record control** – Policies and procedures ensure that the current, correct versions of documents are available for use and that records are maintained to meet requirements.



An EHS staff member leads a nature walk on the mesa top for NREL employees as part of Earth Week and Bring-Your-Child-To-Work Day activities. Photo by Dennis Schroeder, NREL 29860

Checking and Corrective Action

- **Monitoring, measuring, and evaluating compliance** – NREL monitors key activities, tracks performance and progress toward environmental objectives, and conducts periodic assessments of compliance with legal requirements.
- **Internal assessment** – NREL periodically conducts assessments to verify that its EMS is operating as intended. A formal system for tracking corrective and preventive actions supports continual improvement of the management system. (For more details, see section 3.4, Assessment and Improvement.)

Management Review

- **Management Review** – NREL conducts regular management reviews of the EMS so that executive management can provide feedback and direction to the environmental management of the organization.

3.2 POLLUTION PREVENTION

NREL has made a formal commitment to pollution prevention through its laboratory-wide environmental policy. NREL fulfills this commitment by implementing a variety of controls to reduce the potential environmental impacts of laboratory operations. These operations include NREL's use and storage of chemicals and fuels, as well as laboratory activities such as employee commuting and travel, and energy and water use. NREL's hazard identification and control process helps staff regularly identify opportunities to prevent pollution, and formal pollution prevention assessments are conducted periodically to identify opportunities to reduce pollution and improve program effectiveness. In addition, resources are dedicated for sustainable operations and pollution prevention through the Sustainable NREL program. While the majority of NREL's environmental management programs were established to meet compliance requirements, many of these programs go beyond compliance requirements, continually improving environmental performance.

Management and Reduction of Regulated Refrigerants

Certain refrigerants and other chemicals are more highly regulated than others due to their ability to damage the Earth's protective ozone layer. NREL's Ozone-Depleting Substances (ODS) management program provides guidance for the management of refrigerants used at NREL, as well as the substitution and reduction of regulated refrigerants when possible. (For more details, see section 6,

Reducing Pollution

Examples of positive impacts of reducing pollution from NREL's activities include:

- Replacing toxic chemicals with safer alternatives where possible to reduce potential exposure to employees, the public, and local ecosystems
- Choosing bio-based and recycled-content products to reduce impacts on natural systems
- Encouraging employees to telecommute, take alternative transportation, and supporting Web-based meetings to reduce traffic, air pollution, and health effects on surrounding communities
- Using sustainable, low-energy, and low-water use designs for buildings to reduce greenhouse gas emissions and use of Colorado's limited water supplies.

Air Quality Protection.) The policies used to reduce regulated refrigerant use and limit their releases include:

- Regular monitoring of the availability of acceptable substitutes for regulated refrigerants
- Purchasing prohibition of any new refrigeration equipment using an ODS refrigerant
- Evaluation of proposed research activities to determine if any refrigerants used are ODS, and if so, investigation into the use of an EPA-approved alternative
- Strict adherence to requirements for ODS equipment refrigerant recovery, leak detection, and repair to minimize ODS emissions
- Where feasible, removal of ODS refrigeration equipment and recycling of the refrigerant.

3.3 PERFORMANCE INDICATORS AND PROGRESS

Each year measurable goals for environmental improvement are set. Goals are set through the following:

- **Performance Evaluation Measurement Plan** – DOE requires every national laboratory to develop

performance goals through a Performance Evaluation Measurement Plan. Each fiscal year, in collaboration with the DOE Golden Field Office, NREL's performance objectives are developed to enhance the function and compliance of laboratory activities.

- **Site Sustainability Plan** – Sustainable NREL develops a Site Sustainability Plan each year to establish sustainability performance commitments for the year and document activities in support of EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance requirements*. Results of the plan are presented in the next chapter of this report.

Goals are owned by individuals and groups throughout the laboratory. Progress on each of these goals is tracked throughout the year and results are reported annually. Some examples of performance for the year are described in Table 1.

3.4 ASSESSMENT AND IMPROVEMENT

Assessments support the continual improvement of environmental management. Periodic assessment of the EMS and its components provides assurance that the EMS continues to be an effective tool to achieve and maintain compliance with regulatory and legal requirements, meet the established environmental goals of the laboratory, and demonstrate to ourselves and others that NREL is "walking the talk." Internal and external assessments are performed to evaluate the functionality of NREL's EMS.

- **Internal assessment** – Staff performs regular internal assessments to evaluate consistency of the EMS with the ISO 14001 standard, legal, and other requirements.
- **External assessment** – Periodically, external third-party assessments may be conducted by technical experts for specific components of environmental programs as part of continual improvement efforts. Annual surveillance assessments and triennial recertification assessments are conducted for the EMS as a whole to maintain ISO certification.

Improvements are developed and implemented as necessary based on the results of each assessment performed.

2014 Assessments

In 2014, a number of assessments were conducted that allowed NREL to improve program effectiveness and make substantial environmental performance improvements. The following assessment activities took place in 2014:

TABLE 1. 2014 ENVIRONMENTAL GOALS AND ACHIEVEMENTS

2014 Goals	2014 Examples	Goal Met?
<p>Integrate environmental planning to effectively contribute to the execution of NREL programs and projects by ensuring environmental requirements are met in a timely manner.</p>	<p>Enhanced the capital project process workflow and supporting documentation to identify and include a discrete environmental review of proposed projects</p> <p>Revised the Five-Year Plan and Ten-Year Plan review cycles to incorporate an environmental review step</p> <p>Environment staff participated in monthly campus project meetings to review environmental planning and the status of current projects.</p>	<p>Yes</p>
<p>Actively identify potential EHS risks and modify practices accordingly.</p>	<p>Improved spill response readiness by deploying additional spill response materials in various locations around campus</p> <p>Developed “Standard Erosion and Sedimentation Control Notes” that must be added to all construction designs and drawings that involve earth disturbance</p> <p>Identified and addressed EHS considerations related to the NREL/CU-Boulder lease development, including National Environmental Policy Act requirements, operational activities, and environmental and safety liabilities.</p>	<p>Yes</p>
<p>Demonstrate continuous improvement of ISO 14001 and OSHAS 18001 management systems.</p>	<p>Completed third-party recertification audit that verified the laboratory’s continued conformance with the ISO 14001 and Occupational Health & Safety Advisory Services (OHSAS) 18001 management system standards</p> <p>Completed corrective actions and opportunities for improvement from the prior year ISO/OHSAS surveillance audit</p> <p>Completed an internal audit of the National Environmental Policy Act Program</p> <p>Improved completion rates for EHS trainings by:</p> <ul style="list-style-type: none"> ■ Sending monthly training reports to line managers ■ Developing and implementing effective metrics and oversight ■ Reviewing training completion status on a quarterly basis ■ Providing automatic notifications to workers regarding upcoming and overdue trainings. 	<p>Yes</p>

- **Internal assessments** – An internal assessment was conducted of the laboratory’s National Environmental Policy Act Program. Scheduled interviews were conducted, and reviews of relevant procedures and records were completed. Eight non-conformities and six opportunities for improvement were identified; implementation of solutions and improvements are currently in progress.
- **External assessments** – NREL was recertified under ISO 14001. The assessment was conducted by a team

of external auditors and included visits to a sampling of the lab’s facilities, interviews with staff at all levels of the organization, observations of processes in place, and reviews of documents and records. The assessment resulted in five findings and several opportunities for improvement. Corrective actions are underway to address deficiencies regarding training documentation and completion rates, labeling, record control, and environmental policy communication.



An NREL researcher cleans individual photovoltaic cells at the Outdoor Test Facility to measure the variance in performance between an uncleaned cell and a cell cleaned daily of dirt and pollutants. *Photo by Dennis Schroeder, NREL 21326*

2014 Accomplishments and Highlights

- NREL was successfully recertified to the ISO 14001:2004 standard. A team of external auditors conducted an independent assessment of the policies, procedures, tools, and roles and responsibilities used in environmental management. The assessment verified that the laboratory continues to meet the requirements of the ISO 14001 standard and demonstrates our commitment to environmental stewardship.
- The laboratory continued to enhance the integration of environmental considerations into planning processes.
- An internal assessment of the National Environmental Policy Act Program was conducted, identifying several areas for continual improvement. (For more details, see section 3.4, Assessment and Improvement.)

3.5 2014 AWARDS AND RECOGNITION

In 2014, NREL received several awards and recognition of its environmental and sustainability achievements including:

- DOE Green Buy Program Gold Award
- DOE Sustainability Award
- Federal Green Challenge Award

- Colorado Environmental Leadership Program Gold-Level Leader.

DOE Green Buy Program Gold Award

NREL received the gold-level DOE GreenBuy Award for achieving excellence in sustainable acquisition. This is the third year in a row that NREL has received the gold-level recognition. To achieve this award, NREL met the goals for 13 product types in six different categories.

DOE Sustainability Award

NREL received the DOE Sustainability Award for “Green IT Stewardship,” which recognizes exemplary performance in implementing Green IT (Information Technology), including power management, sustainable electronics acquisition, and data center sustainability. DOE Sustainability Awards recognize teams and individuals for their outstanding contributions to the DOE’s sustainability mission, including accomplishments in managing pollution, waste, energy, water, and vehicle fleets.

Federal Green Challenge Award

NREL received the EPA Region 8 Federal Green Challenge Award for “Overall Achievement” in sustainability performance. The Federal Green Challenge recognizes efforts to advance sustainability and leadership in reducing the environmental footprint of federal government activities.

Colorado Environmental Leadership Program Gold-Level Leader

NREL maintained its status as a Colorado Environmental Leadership Program Gold-Level Leader, the highest level awarded by the program. The Colorado Environmental Leadership Program is a voluntary partnership between the Colorado Department of Public Health and Environment and participating private and public



Figure 2. NREL maintained its Colorado Environmental Leadership Program Gold Leader status.

Colorado facilities, and is intended to recognize environmental leadership and performance.

In early 2004, NREL was the first laboratory accepted into the program as a Gold-Level Leader and has maintained this leadership level ever since. As a component of the program membership, the laboratory's voluntary environmental performance goals, described above, further enhance operations and performance at the laboratory. Colorado Environmental Leadership Program recognizes facilities that voluntarily:

- Exceed regulatory requirements
- Implement EMS (which focuses on incorporating environmental considerations into normal management processes and improving internal environmental management effectiveness)
- Work closely with their communities
- Establish three-year goals focusing on measurable results.
- Learn more about this voluntary program at the state website <https://www.colorado.gov/pacific/cdphe/environmental-leadership-program>.

Benefits of the EMS to NREL

Reduced risk to facility/organizational mission

NREL's Hazard Identification and Control Program incorporates environmental risk assessment. System improvements also support reduced risk of non-compliance with requirements and reduced risk of potential enforcement actions. For example, due to management system improvements, EHS training completion rates have risen from 86% a year ago to 94% today.

Improved fiscal efficiency and/or cost avoidance

Cost savings are realized through energy efficiency projects, new renewable energy installations, waste reduction and recycling, and reduced environmental incidents such as spills.

Greater understanding and recognition of environmental issues at all levels of the organization

Staff are made aware of the potential environmental impacts from their work activities through the *NREL Now* internal newsletter; postings on the NREL intranet; new employee orientation and activity-specific trainings; policies and procedures; management communications; Sustainable NREL communications; and special events such as Staff Awards (an annual employee recognition event), Earth Day, and Bike 2 Work Day. Improved awareness of environmental issues supports environmental performance throughout the lab.

Empowerment of individuals to contribute to the betterment of the organization's environmental footprint

Staff are empowered to reduce the lab's environmental footprint by participating in programs and events for recycling single-stream materials, batteries, electronic equipment, and shredded paper, as well as a composting program.

Integration of environment into organizational culture and operations

NREL strives to maintain a high level of awareness in the laboratory around safety, health, and environmental responsibilities. This is supported through regular

communications from executive management, trainings, inspections, and risk assessments.

Integration of environment into real property asset management

NREL includes environmental considerations into long-term planning for the STM and NWTC campuses. Long-term site plans consider wildlife movement across campus, surface water management, and climate change impacts.

Improved community relations

The laboratory works to improve community relations by responding to and tracking all community input through phone calls, email, community meetings, and soliciting feedback from stakeholders through the National Environmental Policy Act process. NREL takes proactive measures to engage the community with public tours, newsletters, and mailings to neighborhoods surrounding its facilities.

Improved effectiveness in overall mission

NREL's EMS supports the organization's overall mission and improves effectiveness by systematically addressing environmental opportunities and risks, ensuring compliance with regulations, and implementing voluntary commitments to achieve superior performance.

Improved collaborative conversation with other groups

The laboratory actively works in collaborating with stakeholders on environmental issues, such as sustainability, renewable energy, and resource conservation and management. This includes cooperating with other agencies in controlling noxious weeds and the management of conservation areas. Additionally, NREL is a member of the West Environmental Sustainability Team, a partnership that provides outreach and resources to help the community save energy, conserve resources, use environmentally friendly products, and practice sustainability. More information is available at: <http://www.lakewood.org/getgreen/>.

Benefits of the EMS to the Environment

Improved overall compliance management

NREL maintains a formal process to identify regulations and standards applicable to NREL, including federal laws and regulations, state and local requirements, executive orders, and DOE orders. In addition, compliance with these requirements is regularly reviewed through a variety of mechanisms, including internal assessments, inspections, and monitoring.

Personnel health and safety

Continually improving environmental, safety, and quality management helps make NREL a safer, more environmentally responsible workplace and enhances the quality of our work processes.

Pollution prevention

Staff regularly identifies opportunities to prevent pollution through NREL's hazard identification and control process. Resources are dedicated for sustainable operations and pollution prevention through the laboratory's sustainability program.

Improved air and water quality

The EMS goals relating to the use of alternative energy sources, the use of clean burning fuels, and the minimization of the quantity of chemicals used on campus contribute toward improved air quality. Through refinement and implementation of requirements related

to the management of runoff, operations, and outdoor storage/use of materials at both temporary construction sites and throughout campus grounds, NREL continually strives to protect water quality on site and offsite.

Improved hazardous material, hazardous waste, and solid waste management

Hazardous material tracking through the NREL chemical inventory reduces the purchase of new supplies by allowing staff to determine if a needed chemical already exists on campus. This in turn minimizes the generation of hazardous waste. The laboratory has averaged above a 75% landfill diversion rate for solid waste for several years, greatly exceeding DOE goals for waste diversion.

Improved conservation of water, natural resources, energy in facilities, fuel in vehicles

The laboratory sets goals for water, energy, and fuel usage annually and monitors progress toward each throughout the year.

Reduced number of permits needed to operate

Implementation of the EMS provides a mechanism to identify, evaluate, and implement pollution prevention opportunities including waste minimization, product substitution, and process modification. These efforts can reduce the number of regulatory requirements that the laboratory must meet.



4

SUSTAINABILITY

Sustainable NREL is a long-standing laboratory program that fosters environmental and social responsibility, working to establish the lab as a global model for sustainability. The program executes specific goals to reduce impacts on the community and environment, and provides technical expertise to organizations within the lab. Sustainable NREL provides leadership within the federal government and the community by actively mentoring and collaborating with other organizations to move sustainability into a new paradigm. NREL's campus is a living laboratory that showcases new technologies, design practices, and operating behaviors. In all campus development, opportunities to integrate energy efficiency and renewable energy, high-performance buildings, and sustainable transportation options are sought. On-site deployment of technologies developed by NREL researchers is also emphasized.

NREL integrates sustainability into its Environmental Management System. Technical experts from Sustainable NREL and the EHS Office work together regularly to improve operations and implement programs, including:

- Site sustainability and pollution prevention data tracking and reporting to DOE
- Sustainability and environmental management planning
- Measurement and tracking of environmental objectives, targets, and actions
- Awareness and engagement of staff and community members.

Planning is also underway related to the management of future impacts to the laboratory and laboratory operations as a result of climate change. Sustainable NREL is leading this effort with involvement of staff throughout NREL and selected external stakeholders.

Solar panels on the Research Support Facility.
Photo by Dennis Schroeder, NREL 31139

Requirements

A federal order, EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, specifies environmental sustainability performance goals for federal agencies. In addition, DOE Order 436.1, *Departmental Sustainability*, requires DOE facilities to prepare and implement an annual Site Sustainability Plan (SSP). Each site's plan is used to report on steps taken to meet the sustainability objectives of the executive and DOE orders and also outlines plans for the upcoming year.

Two executive orders and a DOE guidance document provide direction to NREL as to efforts that must be taken to prepare for potential risks to its operations resulting from climate change. EO 13514, *Federal Leadership in Environmental, Energy and Economic Performance*, issued in 2009, is intended to develop an integrated strategy of sustainability within the federal government. The executive order requires each federal agency to identify and evaluate the potential risks and vulnerabilities to their mission and operations resulting from climate change. The Council on Environmental Quality prepared a progress report in 2010 that recommended that each federal agency develop a climate adaptation plan that identifies aspects of climate change likely to impact the agency's ability to achieve its mission. Guidelines issued in 2011 by the Council on Environmental directed agencies to prepare their plans by June 4, 2012.

EO 13653, *Preparing the United States for the Impacts of Climate Change*, issued in 2013, further focused these plans by requiring each agency to continue to develop, implement, and update comprehensive plans that

integrate consideration of climate change into agency operations and overall mission objectives. The executive order defines the required contents of the plan, which include risk identification, policies/programs, and plans already in place to manage climate risk; how the agency will improve climate adaptation and resilience (including the costs and benefits of those improvements); and interagency coordination efforts. These plans are to be approved by the Council on Environmental Quality and Office of Management and Budget and updated annually. DOE issued its first agency-wide climate action plan in 2012 as an addendum to the 2011 Strategic Sustainability Performance Plan (SSPP).

Recent guidance from DOE requires that DOE sites, including NREL, determine climate change-related risks and build climate change resilience within their operations. Sites are required to describe current and ongoing efforts to identify and assess climate related impacts and the work being done to build climate change resilience capacity among site personnel. To support this requirement and as part of a pilot project for DOE's Sustainability Performance Office, NREL is undergoing a formal climate-change vulnerability assessment and resilience planning effort. This assessment and planning effort aims to develop a replicable process that could be used at other DOE sites.

4.1 SITE SUSTAINABILITY PLANNING

The following content, which describes NREL's site sustainability planning efforts, has been extracted from NREL's SSP for Fiscal Year (FY) 2015. The full report is located online. Download at: <http://www.nrel.gov/docs/fy15osti/63257.pdf>.



An NREL employee completes a blade inspection of a 3MW wind turbine at the NWTC campus. Photo by Dennis Schroeder, NREL 27198

Site Management Vision

As the nation's only federal laboratory dedicated to the research, development, commercialization, and deployment of renewable energy and energy efficiency, NREL takes sustainability seriously. While implementing its mission to advance the science and technologies needed for energy security and economic prosperity in the nation, NREL strives to operate its facilities as a model of environmental sustainability. The laboratory uses an integrated management approach, including engineering, administrative controls, and behavior change to facilitate sustainability across the laboratory as a whole.

Planning

Since 2008, the baseline year used for DOE's greenhouse gas reduction goal, NREL has seen a substantial expansion in both population and square footage on its campus—a 95% increase in population and a 147% increase in campus footprint. This growth has allowed NREL to move its mission forward; it has also required innovation and creative thinking to overcome the resulting challenges to meeting sustainability goals on campus.

Sustainability planning efforts in FY 2014 included:

- Continued execution of the Campus Master Plan, which includes established policies that promote sustainable design, operations, and maintenance practices
- Developed a Greenhouse Gas Reduction Plan, which will be finalized and implemented in FY 2015
- Continued work on a Strategic Energy Management Plan, to be finalized in FY 2015
- Participated in stakeholder planning efforts with the Regional Transportation District, Jefferson County, and other regional partners to improve local land use decisions and transportation facilities that support sustainability
- Updated the Fleet Management Plan
- Updated the Water Management Plan, to be finalized in FY 2015
- Implemented a Landscape Maintenance Plan, which was developed as part of the Sustainable Sites Initiative program
- Created an On-Site Renewables Master Plan
- Developed a Climate Change Resilience Plan, initiated in FY 2014, to be finalized in FY 2015.

These planning efforts continue to reveal the technologies, design ideas, behavior changes, and outreach goals that help NREL meet its sustainability goals.



NREL employees check out some electric and hybrid vehicles owned by fellow NREL employees as part of Earth Day events at NREL. Photo by Dennis Schroeder, NREL 29890

2014 Accomplishments and Highlights

- NREL was recognized with several prestigious awards that acknowledged the laboratory's exemplary performance in sustainability. (For more details, see section 3, Environmental Management System and Pollution Prevention.)
- The Renewable Fuel Heat Plant, which is a wood-fired boiler system that supplies heat to major STM campus buildings, provided 33% of all space heating through use of reclaimed wood such as beetle kill pine and sawmill residue. The displaced natural gas reduced NREL's greenhouse gas emissions by 20%.
- The Leadership in Energy & Environmental Design (LEED) Platinum-rated Research Support Facility met its goals for operating one full year at net-zero energy from April 2013 through April 2014.

4.2 2014 STRATEGIC SUSTAINABILITY PERFORMANCE PLAN GOAL PERFORMANCE

Table 2 summarizes each of DOE's SSPP goals and NREL's performance status. For more specific information, please refer to the full SSP referenced above.

TABLE 2. SSPP PERFORMANCE SUMMARY			
SSPP Goal #	DOE SSPP Goal	NREL Performance Status in FY 2014	Status
1.1	28% greenhouse gas reduction from sources such as heating, cooling, and electricity use by FY 2020 from a FY 2008 baseline	Emissions from energy use decreased 84% from the FY 2008 baseline.	On Track
1.2	13% greenhouse gas reduction from sources such as air travel and commuting by FY 2020 from a FY 2008 baseline	Emissions from sources such as air travel and commuting decreased 14% from the FY 2008 baseline.	On Track
2.1	30% building energy use per square foot (energy intensity) reduction by FY 2015 from a FY 2003 baseline	Energy intensity reduced 54% from the FY 2003 baseline.	On Track
2.2	Perform energy and water audits of 75% of covered buildings during a 4-year cycle	Audited 91% of covered facilities during the current 4-year cycle.	On Track
2.3	Individual buildings metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015)	100% of buildings have energy meters, chilled water meters, and hot water meters. No steam is used for comfort heating.	On Track
2.4	Energy efficient cool roofs, unless uneconomical, for roof replacements	Cool roofs make up 69% of roof areas.	On Track
2.5	15% of existing buildings that are greater than 5,000 gross square feet are compliant with the Guiding Principles of High Performance Sustainable Buildings by FY 2015	18% of existing buildings (4 out of 22 buildings) are compliant with the Guiding Principles of High Performance Sustainable Buildings.	On Track
2.6	All new construction, major renovations, and alterations of buildings greater than 5,000 gross square feet must comply with the Guiding Principles of High Performance Sustainable Buildings	All new construction complied with the Guiding Principles of High Performance Sustainable Buildings.	On Track
2.7	Increase regional and local planning coordination and involvement	Coordinated with Denver Regional Council of Government's WayToGo program to promote commuter options. Participated in Colorado Recovery Office Statewide Resilience Working Group. Supported Council on Environmental Quality's Colorado Preparedness Pilot Project. Finalized the NWTC and STM campus-wide environmental assessments. Worked with Jefferson County Planning and Zoning to improve drainage swale on the STM campus.	On Track
3.1	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline	Increased alternative fuel use 48% from the FY 2005 baseline. NOTE: The ability to increase alternative fuel use is challenging due to the low number of fleet miles traveled. In addition, most fleet vehicles are already alternative fuel vehicles.	Not On Track

TABLE 2. SSPP PERFORMANCE SUMMARY

SSPP Goal #	DOE SSPP Goal	NREL Performance Status in FY 2014	Status
3.2	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline	Increased petroleum fuel use 63% from the FY 2005 baseline. NOTE: Overall, petroleum use is higher than the FY 2005 baseline and lower than FY 2013 use. The increase from the baseline year is due to the increased use of the diesel shuttle buses since FY 2009.	Not On Track
3.3	100% of light-duty vehicle purchases must consist of Alternative Fuel Vehicles by FY 2015 and thereafter (75% FY 2000–2015)	No light-duty vehicles were purchased in FY 2014.	Not Applicable
4.1	26% potable water intensity (gallons per gross square foot) reduction by FY 2020 from a FY 2007 baseline	Reduced potable water intensity 43% from the FY 2007 baseline.	On Track
4.2	20% water consumption reduction of industrial, landscaping, and agricultural water by FY 2020 from a FY 2010 baseline	NREL does not use industrial, landscaping, or agricultural water.	Not Applicable
5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015	Diverted 75% of campus waste from the landfill in FY 2014.	On Track
5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015	Diverted 87% of construction waste from the landfill in FY 2014.	On Track
6.1	Procurements meet sustainability requirements and include sustainable acquisition clause (95% each year)	All construction and custodial contracts met sustainable acquisition requirements.	On Track
7.1	All data centers are metered to measure energy efficiency by FY 2015	The Research Support Facility and Energy Systems Integration Facility data centers are equipped with meters to measure monthly energy efficiency.	On Track
7.2	Maximum annual weighted average energy efficiency rating (Power Usage Effectiveness) of 1.4 by FY 2015	The average energy efficiency rating for the Research Support Facility data center was 1.18.	On Track
7.3	100% of eligible personal computers, laptops, and monitors with power management actively implemented and in use by FY 2012	Power management is enabled on 100% of applicable devices.	Goal Met
8.1	20% of annual electricity consumption from renewable sources by FY 2020	20% of electricity consumption was generated on-site from renewable sources in FY 2014.	On Track
9.1	Address DOE Climate Change Adaptation Plan goals	Initiated climate resiliency planning.	On Track
10.1	Utilize energy performance contracts	Pursued alternative financing mechanisms such as Power Purchase Agreements and Energy Savings Performance Contracts to the extent possible. To date, NREL has initiated one Energy Savings Performance Contract project (Renewable Fuels Heating Plant) and has installed 2.35 MW of photovoltaics using Power Purchase Agreements.	On Track



Floodwaters at the STM campus that resulted from unusual back-to-back storm events. *Photo by Dennis Schroeder, NREL 27625*



Electric vehicle charging stations at the STM campus parking garage. The 36 charging stations are part of a research project to test the impact of charging scenarios on the electrical distribution network. Use of electric cars has the potential to reduce carbon dioxide emissions that contribute to climate change. *Photo by Erik Nelsen, NREL 26488*

4.3 CLIMATE CHANGE ADAPTATION MANAGEMENT

With the potential for temperature increases, more frequent droughts, flash flooding, disease outbreaks, heat waves, floods, and winter storms, climate change has the potential to create additional challenges for NREL operations. Recognizing the increasing importance of current and future climate, NREL is proactively engaging in planning efforts to identify and manage site-specific climate risks, develop options for adapting to climate change, and improve resiliency in the face of climate change.

Program Management

NREL initiated its climate resilience planning in 2014. Key planning components include:

- Developing a general understanding of relevant climate science
- Translating science into site-specific climate change vulnerabilities

- Evaluating the associated risks to NREL’s operations and mission from these vulnerabilities
- Developing an adaptation and resiliency plan to address these risks
- Engaging stakeholders both internal and external to NREL to gain information and build consensus on climate vulnerabilities, organizational risks, and resiliency options.

The Climate Change Resilience Plan is intended to establish a framework to continually review and update the impacts and risk determinations as needed. The information collected will be used to enhance ongoing and existing planning and preparedness efforts at the lab.

In addition to efforts focused on the development of the Climate Change Resilience Plan, NREL has begun to engage external stakeholders for the purpose of a regional symposium to share what has been learned through the plan development, learn what community partners are doing to plan for climate change, and identify opportunities for local partnerships and cooperation. It is the goal of this outreach to initiate a long term dialogue to improve the collective understanding of climate change science, share best practices and data, and establish regional coordination in adaptation planning and policy.



5

COMPLIANCE SUMMARY

NREL is subject to many federal, state, and local environmental laws and regulations, as well as Executive Orders (EOs) and DOE orders and memoranda of understanding with government agencies. NREL continues its excellent record of environmental compliance.

Table 3 includes a brief description of the statute or regulation and how compliance requirements were met this year. More detailed information for each area of compliance is found in the referenced sections of this report. For information on required permits, registrations, and notifications, see Appendix C.

Building stacks at the Field Test Laboratory Building.
Photo by Genevieve Braus, NREL 33336

TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL AND COMPLIANCE STATUS

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
Climate Change Management	<p>EO 13514, <i>Federal Leadership in Environmental, Energy and Economic Performance</i>, and EO 13653, <i>Preparing the United States for the Impacts of Climate Change</i>, require federal agencies to identify and evaluate the potential risks and vulnerabilities to their mission and operations resulting from climate change. Each federal agency is also required to develop a climate adaptation plan and report on their progress in their annual Site Sustainability Plan documents. DOE guidance further requires reporting on climate change adaptation management in facilities' Annual Site Environmental Report.</p>	<p>Initiated climate resilience planning by identifying risks to NREL's operations and mission as a result of climate change, and subsequently developed a method to analyze, compare and rank those risks.</p>	<p>Executive Orders: EO 13514 EO 13653</p>
Air Quality	<p>The Colorado Department of Public Health and Environment (CDPHE) administers the Clean Air Act implementing regulations for all point sources (facilities or other types of operations) in Colorado, under authority delegated by the U.S. Environmental Protection Agency (EPA). Several main categories for air pollutants are regulated: criteria air pollutants, hazardous air pollutants (HAPs), ozone-depleting substances, and greenhouse gases.</p> <p>EPA regulation 40 Code of Federal Regulations (CFR) 82, Protection Of Stratospheric Ozone, requires that servicing records must be kept for appliances containing more than 50 pounds of Class 1 or 2 Ozone Depleting Substances refrigerant.</p> <p>EPA regulations require that certain facilities which emit greenhouse gas emissions track and report the amount of those emissions. Reporting and permitting of greenhouse gases is required under the EPA Prevention of Significant Deterioration regulation, Title V Tailoring Rule, and the EPA Greenhouse Gas Mandatory Reporting Rule.</p> <p>CDPHE regulations require federal, state, and local government facilities to track street sanding in the wintertime, and to minimize sand use with the goal of reducing particulate pollution in the Denver area.</p>	<p>All program activities were in compliance with requirements. NREL did not exceed any air permit standard or other air regulatory requirement at any facility.</p> <p>One new source, a diesel-fueled electrical generator, was issued a Permit to Construct, and subsequently issued a Permit to Operate following submittal of the Air Pollution Control Division (APCD) of CDPHE - required Self Certification package.</p> <p>Inspections of the Integrated Biorefinery Research Facility ammonia scrubber and particulate baghouse and the Integrated Biorefinery Research Facility Standby Generator were performed by the Jefferson County Health Department on behalf of the APCD in May, 2014, with no violations noted.</p> <p>An evaluation of hazardous air pollutant emissions indicated that emissions were well below reporting and permitting thresholds.</p> <p>All required ODS equipment registrations were completed. Facilities servicing refrigeration equipment were registered and all refrigeration service personnel maintain the federal and state required training and certification.</p> <p>The laboratory evaluated carbon dioxide equivalent (CO₂e) and greenhouse gas emissions and emissions were below the threshold for federal reporting and permitting rules.</p> <p>The required annual street sanding report was provided to the state and Jefferson County.</p>	<p>National Ambient Air Quality Standards: 40 CFR 50</p> <p>ODS: 40 CFR 82 and CDPHE Colorado Code of Regulations (CCR) 1001-19, Reg. 15</p> <p>New Source Performance Standards: 40 CFR 60</p> <p>New Source Review, Prevention of Significant Deterioration: 40 CFR 51</p> <p>Title V: 40 CFR 70 and 71</p> <p>National Emission Standards for Hazardous Air Pollutants, Hazardous Air Pollutant: 40 CFR 63 and CDPHE 5 CCR 1001-5, Reg. 3</p> <p>Permitting: CDPHE 5 CCR 1001-5, Reg. 3</p> <p>Greenhouse Gas: 40 CFR 98 and 40 CFR 51, 52, 70, 71</p> <p>Street Sanding: CDPHE 5 CCR 1001-18, Reg. 16</p>

TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL AND COMPLIANCE STATUS

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
Drinking Water Quality	The Safe Drinking Water Act establishes minimum drinking water standards and monitoring requirements for drinking water supplies. Drinking water quality is regulated for all public water suppliers in Colorado by CDPHE, under authority delegated by the EPA.	All program activities were in compliance with requirements. 465,563 gallons of drinking water were provided to NWTC users.	EPA: 40 CFR 141-149 CDPHE: 5 CCR 1002-11 Reg. 11
Groundwater Quality	Colorado groundwater quality standards are established by CDPHE. Permits for groundwater wells are issued by the Colorado Department of Natural Resources.	There are no compliance activities associated with the NREL groundwater program. NREL currently has five permitted monitoring wells at the STM campus. The wells are not currently used for monitoring activities.	CDPHE: 5 CCR 1002-41 2 CCR 402-2 2 CCR 402-10
Surface Water Quality	Surface water quality is controlled through the federal Clean Water Act, Energy Independence and Security Act of 2007, E.O. 13514, <i>Federal Leadership in Environmental, Energy, and Economic Performance</i> , and the Colorado Water Quality Control Act. Construction-related stormwater discharge regulations are administered by the EPA at federal facilities in Colorado. Non-federal facility construction-related stormwater discharges in Colorado are regulated by the Water Quality Control Division of CDPHE.	All program activities were in compliance with requirements. Permit coverage was obtained under the EPA Construction General Permit (CGP) for one new construction project at the STM campus. Permits are now in effect for three STM construction projects. Two permits for completed projects were terminated in 2014. No permits are in effect at the NWTC. Monthly stormwater inspections were performed for construction sites where EPA CGP permit coverage continues during the restoration phase of these projects. Weekly inspections occurred for construction sites with active EPA CGP stormwater permits. Successful revegetation, defined in the EPA construction stormwater permit as vegetative cover equivalent to 70% of pre-disturbance cover, was achieved at two major construction sites. Carefully selected seed mixes and mulches together with weed management and temporary irrigation were instrumental in achieving the EPA criteria.	EPA: 40 CFR 122.26 CDPHE: 5 CCR 1002-61 Regs. 38, 61, 65, and 93 Executive Orders: EO 13514
Waste-Water Management	The federal Clean Water Act and Colorado Water Quality Control Act regulations apply to wastewater management at NREL's STM and Denver West Office Park. The Metro Wastewater and Reclamation District manages wastewater for much of the Denver metro area, receiving wastewater from a number of smaller wastewater districts, including the Pleasant View Water and Sanitation District. Inspection and permitting of individual sewage disposal systems have been delegated to Jefferson County by CDPHE.	All program activities were in compliance with requirements. In 2014, plans were developed for a new clean room in the Science and Technology Facility. Activities contemplated for the new clean room, in which controls are put in place to eliminate dust and other contaminants as required for research related to the development of solar cell technology, will generate a large volume of corrosive waste which will be neutralized prior to discharge. It is not anticipated that the volumes will exceed the 25,000 gallon-per-day limit that defines a significant industrial user under the Metro District's Rule and Regulations, but NREL will provide notification to both the Metro District and Pleasant View of the newly installed neutralization process before discharge begins.	EPA: 40 CFR 122-136 CDPHE: 5 CCR 1002-62, 63

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TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL AND COMPLIANCE STATUS

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
Hazardous Materials Management	<p>EO 13423 <i>Strengthening Federal Environmental, Energy, and Transportation Management</i>, outlines requirements for Superfund Amendments and Reauthorization Act Title III, Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) compliance, and Toxic Release Inventory reductions for DOE facilities.</p> <p>NREL facilities are subject to various parts of EPCRA, which include Sections 302, 304, 311, 312 and 313. Section 302 of EPCRA, which requires a facility to notify the state and local emergency response and planning agencies if any extremely hazardous substances in the facility's inventory are stored in quantities greater than regulatory thresholds.</p> <p>EPCRA Section 304 requires facilities to immediately notify the state and local emergency response and planning agencies if there is an accidental spill or release of more than the predetermined reportable quantity.</p> <p>In accordance with Sections 311 and 312 of EPCRA, NREL provides Safety Data Sheets or SDS (per OSHA's new hazard communication requirements, the term SDS replaces MSDS or Material Safety Data Sheets) for chemicals that are stored on-site in quantities greater than regulatory thresholds, and provides inventory reporting for these same chemicals in the form of an annual Tier II hazardous materials report to state and local emergency response agencies and local fire departments.</p> <p>The laboratory is also subject to reporting requirements in the event of a release of a reportable quantity of any hazardous substance listed by EPCRA. EPCRA Section 313 requires that a toxic chemical release inventory report (Form R) be filed with the EPA for any chemical that is manufactured, processed, or otherwise used in quantities exceeding regulatory thresholds. Although not a manufacturing facility and not characterized by the standard industrial classification codes for which EPCRA Section 313 reporting is required, EO 13423, <i>Strengthening Federal Environmental, Energy, and Transportation Management</i>, requires that all federal facilities file a report, if applicable, regardless of the standard industrial classification code. NREL has never manufactured, processed, or otherwise used chemicals on the EPCRA Section 313 list in quantities exceeding regulatory thresholds, so has never had to report under EPCRA Section 313.</p> <p>Annual hazardous material permits are required by West Metro Fire Rescue for the STM and DWOP sites. Renewable Fuels and Lubricants Research Laboratory, located within the City and County of Denver, is subject to the Denver Fire Dept. Hazardous Materials Information System requirements, including permitting, inventory, and annual inspection.</p>	<p>All program activities were in compliance with requirements.</p> <p>NREL submitted reporting year 2013 Tier II hazardous material reports to the state, county Local Emergency Planning Committees, and fire departments for three NREL facilities (STM, NWTC and Solar Technology Acceleration Center), identifying diesel fuel, petroleum oil, and sulfuric acid in lead-acid batteries. Toxic Release Inventory reporting under EPCRA was not required by NREL for reporting year 2013.</p> <p>West Metro Fire Rescue conducted an annual hazardous material inspection and issued permits for seven facilities on the STM campus. The inventory of materials at the Renewable Fuels and Lubricants Research Laboratory facility was provided to the Denver Fire Department.</p>	<p>EEPA: 40 CFR 355, 370, 372</p> <p>Executive: Orders: EO 13423</p>

TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL AND COMPLIANCE STATUS

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
Regulated Waste Management	The Resource Conservation and Recovery Act established requirements for the management of regulated waste. In Colorado, CDPHE administers waste regulations under authority delegated by the EPA.	<p>All program activities were in compliance with requirements.</p> <p>All regulatory notifications were updated and applicable waste generator fees were paid for five NREL facilities.</p> <p>A Biennial Hazardous Waste Report for the STM campus (which detailed hazardous waste activities for calendar year 2013) was submitted to the state.</p> <p>A joint compliance inspection of the STM campus waste program was conducted by the EPA, and the Hazardous Materials and Waste Management Division of CDPHE on April 16, 2014. Areas of focus involved waste container management, proper documentation of regulated waste handling activities, employee training and facility contingency planning. A compliance advisory was issued for one instance of potential incompatible materials stored in close proximity to each other. This issue has been addressed and closed out by the state on May 5, 2014.</p>	EPA: 40 CFR 260-280 CDPHE: 6 CCR 1007-3
Above-ground storage tank management	Aboveground Storage Tanks (ASTs) are regulated in Colorado by the Colorado Department of Labor and Employment Oil Inspection Section under the Colorado AST regulation 7 C.C.R. 1101-14. Colorado requires that ASTs 660 gallons or larger be permitted prior to installation and registrations submitted annually.	<p>All program activities were in compliance with requirements.</p> <p>No reportable spills or releases from NREL's ASTs or related fueling activities occurred.</p> <p>A state inspection of registered ASTs was completed with no violations noted.</p> <p>A 1,000 gallon E85 fleet vehicle fuel tank was installed at the STM campus and registered with the Division of Oil and Public Safety of the Colorado Department of Labor and Employment.</p> <p>One 2,500 gallon AST at the Solar Technology Acceleration Center facility was transferred to another entity and is being removed from the inventory of NREL-registered ASTs.</p>	CDLE: Division of Oil and Public Safety (DOPS) Storage Tank Regulations, 7 C.C.R. 1101-14
Spill Prevention and Response	Spill prevention, control, and countermeasures (SPCC) plans are required by EPA and Colorado regulations for facilities that meet certain oil storage criteria. In general, a facility must have an SPCC plan if the facility stores more than 1,320 gallons of oil or where a spill has the potential to enter waters of the United States.	<p>All program activities were in compliance with requirements.</p> <p>Workers who manage and/or operate oil-containing equipment received annual SPCC training.</p> <p>There was one reportable spill of approximately one gallon which was reported to the Water Quality Control Division of CDPHE. This spill resulted from residual hydraulic fluid remaining from a vehicle-related spill. No hydraulic fluid left NREL property; no violation or compliance action resulted. No additional action was required by the state.</p> <p>Twenty-one minor spills of diesel, lubricant, coolant, and hydraulic fluids occurred at the STM campus, and one spill occurred at the NWTC. The size of spills ranged from less than 0.1 gallon to 12 gallons (0.38 to 45 liters). The majority of these spills were the result of leaks from vehicles and construction equipment. Each spill received immediate remedial action and did not result in any significant impact to the environment.</p>	EPA: Oil Pollution Prevention 40 CFR 112 CWA Section 319 CDLE: DOPS Storage Tank Regulations, 7 C.C.R. 1101-14 CWCC: 25-8-205 C.R.S

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TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL AND COMPLIANCE STATUS

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
Radio-logical materials and waste Management	<p>Air emissions are regulated by Section 112 of the Clean Air Act and implemented by the EPA. 40 CFR Part 61 established National Emission Standards for Hazardous Air Pollutants, and, more specifically, Subpart H, sets such standards for radiological materials.</p> <p>DOE Order 458.1, <i>Radiation Protection of the Public and the Environment</i> establishes radiation emission limits for DOE facilities.</p>	<p>All program activities were in compliance with requirements. No planned or unplanned radiological releases occurred.</p> <p>Only small quantities of low-level radioactive waste were generated and are currently in storage awaiting off-site disposal.</p> <p>The effective dose equivalent to the public from NREL activities was 0.036 mllirem (mrem) per year, far below the 10 mrem per year limit.</p>	<p>EPA: 40 CFR 61, Subpart H</p> <p>DOE: DOE Order 458.1</p>
National Environmental Policy Act	<p>National Environmental Policy Act (NEPA) requires that federal agencies determine environmental impacts of proposed federal actions and alternatives. DOE implements NEPA in 10 CFR 1021.</p>	<p>All program activities were in compliance with requirements.</p> <p>Three hundred ninety NEPA reviews were conducted for project activities on- and off-site during 2014.</p> <p>Site-Wide Environmental Assessments and Findings of No Significant Impact were completed for the STM and NWTC campuses. Public meetings and 30-day public review and comment periods were completed as part of these EAs.</p>	<p>Council for Environmental Quality: 40 CFR 1500-1508</p> <p>DOE: 10 CFR 1021</p>
Wildlife Management	<p>The Migratory Bird Treaty Act (MBTA) of 1918 is the main driver for protection of migratory birds in the United States. The MBTA and amendments implements several treaties between the U.S., Great Britain, Mexico, Japan, and the former Soviet Union. The MBTA prohibits the taking, killing, or possession of migratory birds, nests, and eggs.</p> <p>Under Colorado Revised Statute (CRS) 33-6-128: <i>Damage or Destruction of Dens or Nests—Harassment of Wildlife</i>, no wildlife dens or nests, young or eggs may be damaged or destroyed unless permitted by the Colorado Division of Parks and Wildlife and it is unlawful for any person to willfully harass wildlife including birds.</p> <p>Under the “Memorandum of Understanding (MOU) between DOE and the USFWS Regarding Implementation of EO 13186, <i>Responsibilities of Federal Agencies to Protect Migratory Birds</i>” DOE agrees to integrate migratory bird conservation principles, measures, and practices into agency activities, and avoid or minimize adverse impacts on migratory bird resources and their habitats.</p>	<p>NREL completed bird-friendly retrofits to selected windows at the Energy Systems Integration Facility. This effort is consistent with the requirements of the MBTA and DOE’s Memorandum of Understanding with the U.S. Fish and Wildlife Service (USFWS).</p> <p>NREL and DOE included MBTA discussions as part of the Endangered Species Act consultations with the U.S. Fish and Wildlife Service that were conducted as part of the Site-Wide Environmental Assessments for the NWTC and STM campuses.</p> <p>Per EO 13186, <i>Responsibilities of Federal Agencies to Protect Migratory Birds</i>, DOE and NREL provided an accounting of efforts at NREL campuses to protect migratory birds which was submitted for inclusion in the 2013 Council for the Conservation of Migratory Birds Annual Report .</p>	<p>U.S. Fish and Wildlife Service: MBTA 16 U.S.C. 703-712</p> <p>Colorado Division of Parks and Wildlife: CRS 33-6-128</p> <p>Memorandum of Understanding between DOE and the U.S. Fish and Wildlife Service</p> <p>Executive Orders: EO 13186</p>

TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL AND COMPLIANCE STATUS

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
Endangered Species and Species of Concern	<p>The Endangered Species Act (ESA) is intended to protect threatened and endangered wildlife and plant species and associated critical habitat.</p>	<p>All program activities were in compliance with requirements.</p> <p>The USFWS lists nine species in accordance with the ESA as threatened, endangered, or a candidate for listing that could potentially occur in Jefferson County or Boulder County. Of these, three have the potential to occur on the STM or NWTC campuses including the Preble’s meadow jumping mouse, the Ute ladies’ tresses orchid, and the Colorado butterfly plant. While the Preble’s meadow jumping mouse does not occur on site, the USFWS mapped critical Preble’s habitat within the upper reaches of Rock Creek, including a small area at the southeast corner of the NWTC. This area may not be disturbed without coordination with the USFWS.</p> <p>NREL assisted DOE in ESA consultations with the USFWS that were conducted as part of the development of the Site-Wide Environmental Assessments for the NWTC and STM campuses.</p> <p>In support of informal Section 7 ESA consultations, past surveys were used to document the potential for occurrence of threatened or endangered species listed in Jefferson County. No species or species habitat are found at either NREL campus.</p> <p>In support of formal Section 7 ESA consultations, Biological Assessments for the NWTC and the STM campuses were prepared that evaluated potential depletion of water to the South Platte River system from continued and proposed site activities.</p> <p>Biological Opinions for the NWTC and STM campuses were received from the USFWS that indicated that the proposed water-related actions of the two Site-Wide Environmental Assessments are covered under the Programmatic Biological Opinion developed for the Platte River Recovery Implementation Program.</p>	<p>U.S. Fish and Wildlife Service: 50 CFR 17</p>
Vegetation Management	<p>EO 13112, <i>Invasive Species</i> requires the control of invasive species at federal facilities. In Colorado, the Department of Agriculture Commissioner develops and implements state noxious weed management plans for three categories of weed species. Class A plants are targeted for eradication. Class B species are subject to management plans designed to stop their continued spread. Class C species are subject to plans designed to support the efforts of local governing bodies to facilitate more effective integrated weed management on private and public lands.</p> <p>The Federal Insecticide, Fungicide, and Rodenticide Act regulates the use, storage, and disposal of herbicides and pesticides. For application of certain types of herbicides designated as “restricted use” by the EPA, a certified applicator must be used.</p>	<p>All program activities were in compliance with requirements.</p> <p>In addition to mechanical and cultural control methods, herbicides were applied at the NWTC and the STM campuses as follows: At the NWTC, herbicides were applied to control B- and C-listed weeds to approximately 60 acres in April, 17 acres in June, and 40 acres in August.</p> <p>At the STM campus, herbicides were applied to control B- and C-listed weeds to approximately 27 acres in May, 13 acres in June, and 4 acres in October.</p>	<p>Executive Orders: EO 13112</p> <p>EPA: 40 CFR 162-171(f)</p> <p>CRS 35-5.5</p> <p>Department of Agriculture: Federal Noxious Weed Act of 1974 (Public Law 93-629, 88 Statute 2148)</p> <p>Plant Protection Act (Public Law 106-224)</p>

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TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL AND COMPLIANCE STATUS

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
Wetlands and Floodplains	<p>EO 11988, <i>Floodplain Management</i>, requires federal agencies to provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities.</p> <p>Under EO 11990, <i>Wetlands Protection</i>, federal agencies must provide leadership and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. Wetlands that meet certain soils, vegetation, and hydrologic criteria, are protected under the CWA Section 404, which is administered by the U.S. Army Corps of Engineers (USACE).</p> <p>Jefferson County requires approval of development proposed in floodplains within its jurisdiction.</p>	<p>All program activities were in compliance with requirements; no actions occurred that affected wetlands or floodplains.</p> <p>None of the wetlands present at NREL facilities have been designated “jurisdictional” by the USACE.</p> <p>The STM and NWTC campuses do not contain any floodplains.</p>	<p>Executive Orders: EO 11988 EO 11990</p> <p>USACE: CWA Section 404</p> <p>DOE: 10 CFR 1022</p>
Cultural Resources	<p>Cultural resources are protected under Sections 106 and 110 of the National Historic Preservation Act. Federal agencies must establish preservation programs—commensurate with their mission and the effects of their activities on historic properties—that provide for the careful consideration of historic properties. Significant cultural resources are either eligible for, or listed in, the National Register of Historic Places. Cultural resources are defined as any prehistoric or historic district, site, building, structure, or object considered important to a culture, subculture, or community for scientific, traditional, religious, or other reason. The National Historic Preservation Act is administered in Colorado by the Colorado Office of Archaeology & Historic Preservation (State Historic Preservation Officer).</p>	<p>All program activities were in compliance with requirements.</p> <p>DOE initiated consultation with the State Historic Preservation Officer under Section 106 of the National Historic Preservation Act for proposed actions of the STM Site-Wide Environmental Assessment. The State Historic Preservation Officer’s primary concern involved indirect visual impacts to the amphitheater and ammunition bunker from proposed new development near and within the viewshed of these resources. The State Historic Preservation Officer and DOE concluded that the best approach going forward will be to initiate consultations on a project-by-project basis when individual components of the proposed action are funded or authorized.</p> <p>DOE submitted the Memorandum of Agreement Summary Report, thereby completing DOE and NREL responsibilities per the 2011 Memorandum of Agreement for mitigation of impacts to the Camp George West firing lines resulting from construction of Research Road.</p>	<p>Advisory Council on Historic Preservation: 36 CFR 60 36 CFR 63 36 CFR 79 36 CFR 800 16 U.S.C. 470</p>

TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL AND COMPLIANCE STATUS

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
EMS and Sustainability	<p>DOE Order 436.1, <i>Departmental Sustainability</i> implements the objectives of EO 13423, <i>Strengthening Federal Environmental, Energy, and Transportation Management</i>, and EO 13514, <i>Federal Leadership in Environmental, Energy, and Economic Performance</i>, which direct federal agencies to conserve natural resources, reduce energy use, develop renewable energy, reduce greenhouse gas emissions, and manage buildings and transportation in a sustainable manner.</p> <p>DOE Order 436.1 requires that DOE develop a SSPP to ensure that the sustainability goals established in EO 13423 and 13514 are met. Individual DOE facilities must develop site specific SSPs designed to set goals for the coming year and discuss performance for the prior year.</p> <p>DOE Order 436.1 also requires that DOE facilities implement EMSs that are independently verified to meet the requirements of ISO 14001.</p>	<p>Each year, a Site Sustainability Plan is developed to report on past performance and set goals for the coming year. These performance goals are integrated with the laboratory's EMS and progress is tracked throughout the year.</p> <p>NREL's EMS has been registered to the ISO 14001:2004 international standard for environmental management systems since 2011. Annual assessments by the registrar verify that NREL meets the ISO standard and is continually improving performance.</p>	<p>Executive Orders: EO 13423 EO 13514</p> <p>DOE: DOE Order 436.1 DOE Order 450.1A DOE Order 430.2B</p>
N/A	<p>DOE Order 231.1B, <i>Environment, Safety and Health Reporting</i> was implemented to assure that DOE receives timely, accurate information about events that have affected or could adversely affect the health, safety and security of the public or workers, the environment, or the operations of DOE facilities. The order requires that DOE facilities report specific site environmental information annually including environmental management performance, environmental occurrences and response, compliance with environmental standards and requirements, significant programs and efforts, and property clearance activities for property contaminated with radiological materials.</p>	<p>NREL reports annually via this Environmental Performance Report.</p>	<p>DOE: DOE Order 231.1B</p>
Traffic Management	<p>There are no traffic regulations that pertain to the NREL campuses. Traffic demand management strategies are implemented to minimize traffic impacts in the local area.</p>	<p>Average 2014 PM (4:30 p.m. to 5:30 p.m.) peak hour traffic volume measured at the STM intersection of Denver West Parkway and Denver West Marriott Boulevard was 342 vehicle trips per hour. This traffic volume remained below the threshold to ensure a Level of service "D" or better (equivalent to 522 vehicle trips per hour) entering or leaving the site during the afternoon rush hour.</p> <p>Traffic volumes at the other NREL campuses are considered to be minimal at this time. Traffic analysis will be conducted in the future at those locations should increases in staff population and/or activities warrant such studies.</p>	<p>DOE/EA-1440-S-I (May 2008) Traffic Mitigation Action Plan</p>



6

AIR QUALITY PROTECTION

NREL strives to protect air quality by minimizing air emissions, monitoring air emissions from the larger on-site sources, and meeting federal and state air emissions and permitting requirements. Minimizing air emissions creates direct health benefits for neighbors immediately adjacent to the laboratory and for those in the Denver metropolitan area. Staff actively participates in project planning, safety evaluations, readiness verifications, and operations activities. This participation results in awareness of projects and planned air emissions while allowing staff to obtain the necessary regulatory approval for those emissions and maintain a current and accurate air emission inventory.

Requirements

The Clean Air Act, which is administered by both the EPA and the state, regulates several main categories of air pollutants:

- **Criteria air pollutants** – including carbon monoxide, nitrogen oxides, sulfur dioxide, particulate matter, respirable particulates, ozone, and lead
- **Non-criteria pollutants** – these include any air pollutant that is not defined as a criteria air pollutant. Regulated categories of these include the following:
 - **Hazardous Air Pollutants** – including specific organic compounds, metals, corrosives, asbestos, radionuclides, and pesticides established by the EPA
 - **Greenhouse gas compounds** – including carbon dioxide, methane, nitrous oxide, and many man-made refrigerant gases that contribute to climate change
 - **Ozone-Depleting Substances (ODS)** – including chlorofluorocarbons or “Freon” and hydrochlorofluorocarbons that are being phased out of use in comfort heating and cooling systems and equipment.

Diesel generator at the NWTC, used to supply emergency power to a portion of the site. *Photo by Genevieve Braus, NREL 33064*

2014 Accomplishments and Highlights

- Updated the air emissions inventory, including use of equipment-specific emission factors where available. This has resulted in a more accurate emission inventory and an estimated 10% decrease in the laboratory's nitrogen oxide emissions.
- Evaluated hazardous air pollutant emissions estimates and engineering controls used by research staff in the design of a laboratory renovation.
- Completed the annual evaluation of compliance with federal and state facility-wide permitting and emissions control requirements. All facilities and individual permitted equipment items remain classified as minor sources.

For facilities and stationary sources that emit criteria air pollutants and hazardous air pollutants, there are various federal and state requirements for permitting, reporting, emission controls, and operations, depending upon the type and amount of air pollutants emitted. Generally, these requirements become stricter as the quantity of air pollutants emitted increases or based upon the potential harm or effect of the air pollutants.

Greenhouse gases emitted by certain facilities are required by federal regulations to be tracked and reported, if the emissions are greater than 27,557 U.S. tons (25,000 metric tons) of carbon dioxide equivalent per year. The purpose of this reporting is to better identify actual emissions of such gases across the United States and provide the EPA with data upon which to base future greenhouse gas regulations. Additionally, federal permitting of greenhouse gases is required if carbon dioxide equivalent emissions are greater than 100,000 U.S. tons (90,718 metric tons) per year.

Certain refrigerants and other chemicals are more highly regulated than others due to their ability to damage the Earth's protective ozone layer. Federal and state regulations for these ODS, depending upon the quantity of ODS and the size of the comfort heating and cooling equipment, include registration, recordkeeping, refrigerant recovery, and leak monitoring and repair requirements. Most importantly, these regulations prohibit the intentional venting of these substances into the atmosphere.

There are several state air regulations for sources of particulate pollution, including large construction sites and street

sanding operations in the winter. Particulate emissions, such as dust, from construction sites larger than 25 acres (10.1 hectares), or occurring for longer than six months, are subject to state fugitive particulate emissions permits. Winter road sanding in Colorado can also result in particulate emissions when vehicle activity turns road-applied sand into finer particulates that then become airborne. These particulates may contribute to breathing and health problems for susceptible individuals. State regulations require federal, state, and local government facilities to track street sanding in the winter and to minimize sand use.

The primary sources of regulated pollutants at NREL are a result of burning fuel, laboratory chemical use, and facility operations. Sources include process heat boilers, process cooling systems, comfort heating and cooling systems, standby electrical generators, small equipment with gasoline or diesel engines, bench- and pilot-scale research activities using chemicals, and facility operations maintenance activities. Sand is not applied to roadways at NREL campuses.

Program Management

Criteria Pollutants and Hazardous Air Pollutants Permitting

The laboratory maintains an air emission inventory to track potential emissions and identify whether notification and permitting could be required for a particular facility or activity. Projected emissions for new sources are evaluated and air emission reporting and permitting are performed as required.

The laboratory maintains several air permits issued by the state for "minor" sources (such as standby electrical generators and pollution control systems) that are subject to minimal permit and compliance requirements. Currently, Title V "major" permitting is not required because all pollutant emissions are well below the permitting thresholds.

The laboratory also has a fugitive emission permit in place for the STM campus due to the construction activity over the last several years. To further minimize the generation of airborne particulates, NREL uses a non-sand deicer to maintain roadways. This minimizes potential fugitive particulate emissions from snow removal operations, contributing to improved air quality for neighbors and in the Denver metro region.

Greenhouse Gas Emissions Tracking and Permitting

Permitting and reporting of greenhouse gases are not currently required for NREL facilities as emissions are below EPA permitting and reporting thresholds. A summary of NREL facility estimated annual air pollutant emissions is included in Table 4.

TABLE 4. STM, NWTC AND DENVER WEST OFFICE PARK ESTIMATED ANNUAL AIR POLLUTANT EMISSIONS (IN U.S. TONS PER YEAR)¹

Year	CRITERIA POLLUTANTS					GREENHOUSE GASES			HAPs
	CO	NO _x	VOC	PM ₁₀	SO ₂	CO ₂	CH ₄	N ₂ O	Total
2011	5.82	8.03	0.44	0.97	0.15	8,310.00	0.24	0.17	0.1900
2012	6.35	16.28	1.09	2.37	0.22	7,175.00	0.41	0.17	0.3100
2013	6.02	13.83	0.47	3.16	0.360	8,584.00	0.51	0.25	0.5100
2014	5.82	14.06	0.99	1.39	0.10	6,263.41	0.30	0.11	0.1663

¹ Abbreviations: HAPs – Hazardous Air Pollutants, CO – carbon monoxide, NO_x – nitrogen oxides, VOC – volatile organic carbon, PM₁₀ – respirable particulate matter less than 10 microns in aerodynamic diameter, SO₂ – sulfur dioxide, CO₂ – carbon dioxide, CH₄ – methane, N₂O – nitrous oxide.

Ozone-Depleting Substances Permitting

The majority of refrigeration equipment at NREL either contains non-ODS refrigerants or uses very small amounts of regulated refrigerants. The only equipment containing more than 50 pounds (23 kilograms [kg]) of regulated refrigerant are the two chillers located in the Solar Energy Research Facility at the STM campus. Operators of these chillers must maintain records of service for this equipment.

NREL annually registers with the state those facilities where ODS maintenance activities occur, maintains EPA-approved training certification for all technicians servicing ODS-containing equipment, and renews registrations for ODS-containing equipment as necessary. The two previously mentioned Solar Energy Research Facility chillers also meet the requirements to be registered with the state (contain ODS compounds and have more than 100 horsepower of compression).

2014 Compliance Summary and Activities

- Program activities were in compliance with requirements. The laboratory did not exceed any air permit standard or other air regulatory requirement at any facility.
- A compliance inspection was conducted by the Jefferson County Health Department, on behalf of the state, of the permitted Integrated Biorefinery Research Facility ammonia scrubber and particulate baghouse. No deficiencies were identified.
- An evaluation of Hazardous Air Pollutant emissions indicated that emissions were well below reporting and permitting thresholds.
- NREL provided the required annual street sanding report to the state and Jefferson County confirming that no sand was used.
- The laboratory evaluated and concluded that carbon dioxide equivalent and greenhouse gas emissions were below the threshold for federal reporting and permitting rules.
- All required ODS equipment registrations were completed. Facilities servicing refrigeration equipment were registered and all refrigeration service personnel maintained their certification.
- One new source, a diesel-fueled electrical generator located at the Energy Systems Integration Facility, was issued a state Permit to Construct, and subsequently a state Permit to Operate, following NREL's submittal of a self-certification package.



7

WATER QUALITY PROTECTION

Water quality is critical to human health and the health of our natural ecosystems. At NREL, the focus of water quality protection is on four main areas:

- Drinking water
- Groundwater
- Surface water
- Wastewater

7.1 DRINKING WATER

Drinking water at the STM campus is provided by the public water provider Consolidated Mutual Water Company. The water is treated at the Maple Grove Water Treatment Plant through an advanced membrane water treatment method.

The NWTC does not have access to a public drinking water supply. For this reason, NREL operates a drinking water distribution system at the NWTC, serving about 150 employees. Drinking water is purchased from local municipalities and transported by truck to the site, where it is transferred to a large holding tank with a capacity of 15,000 gallons (56,781 liters). Water is pumped from the holding tank to a day tank where it is circulated around the site for use. There is no treatment of the water, but chlorine is added to boost disinfectant levels. The system is permitted by the state of Colorado. The water is tested monthly and annually in the same ways municipal water systems are tested for residual chlorine levels, bacteria, disinfection byproducts, lead, and copper.

Requirements

As a public water system regulated by the state of Colorado, the NWTC water system must comply with the Safe Drinking Water Act and federal and state regulations. The EPA has established allowable levels for drinking water

Drainage from much of the STM campus is routed through this energy dissipation structure and culvert to a large detention basin that promotes settling and infiltration, and provides habitat for wildlife. *Photo by Dennis Schroeder, NREL 23206*

constituents known as Maximum Contaminant Levels. Colorado has adopted these Maximum Contaminant Levels into the Colorado Primary Drinking Water Regulations. These regulations establish the state's authority to regulate drinking water providers to assure safe, reliable water supplies, and to implement EPA's special rules.

Program Management

The primary means by which NREL manages its drinking water system at the NWTC is through water quality testing as required by the monitoring plan issued by the state each year. The plan identifies which tests are to be performed and at what frequency. Monthly tests are required for bacteria and disinfectant levels, while

disinfection byproducts (haloacetic acids [HAA5] and trihalomethanes [TTHM]) are sampled once per year, and lead and copper are tested on a three-year rotating basis. Figures 3 and 4 show the results of the chlorine and disinfection byproducts monitoring for 2014.

2014 Compliance Summary and Activities

- All program activities were in compliance with requirements.
- All other monitored parameters in 2014 met applicable requirements.
- 465,563 gallons (1,762,348 liters) of drinking water were provided to NWTC users.

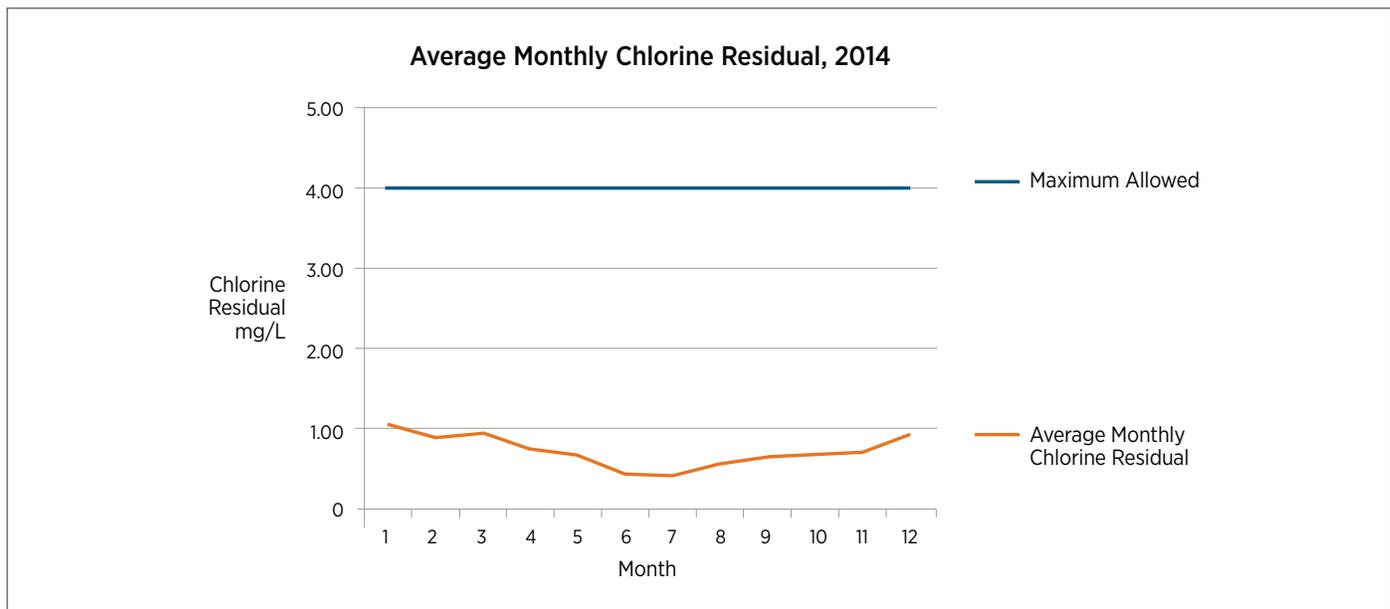


Figure 3. Results of 2014 average monthly chlorine residual monitoring

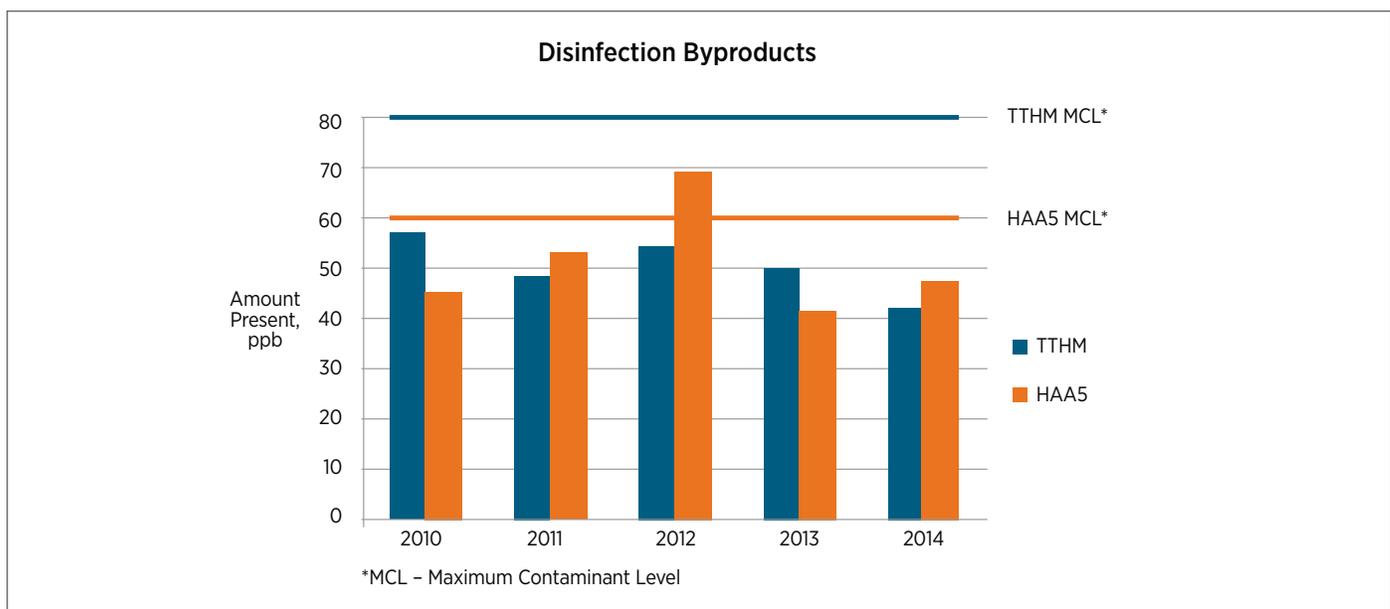


Figure 4. Comparison of disinfection byproducts monitoring, 2010 through 2014

7.2 GROUNDWATER

The Denver Basin aquifer system underlies an area of approximately 7,000 square miles that extends from Greeley south to near Colorado Springs and from the Front Range east to near Limon. The aquifer provides groundwater supplies to urban, rural, and agricultural users. The aquifers within the Denver Basin aquifer system, which include the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers, form a layered sequence of rock in an elongated, bowl-shaped structural depression. Both the STM and the NWTC campuses are located at the western edge of the Denver Basin aquifer system.

The STM campus overlies the shallowest portions of the Denver, Arapahoe, and Laramie-Fox Hills aquifers. The NWTC campus overlies the shallowest portions of the Arapahoe and Laramie-Fox Hills aquifers. The Dawson formation is the shallowest of the Denver Basin aquifers and is the one most relied on by the groundwater users in the basin. The northern extent of the Dawson aquifer is located approximately 20 miles (33 km) to the south and east of the STM campus; consequently, wells drilled at either the STM campus or the NWTC would not intersect the Dawson aquifer, nor would a source of contamination affect the groundwater quality in this aquifer.

Despite the limited ability of reaching the Dawson aquifer, NREL's groundwater management program is focused on the control of potential pollutant sources that could affect this important source.

Requirements

The state of Colorado regulates the installation of groundwater wells, requiring a permit for drinking water, geothermal, irrigation, livestock watering, dewatering, monitoring, and geothermal well installations. Groundwater quality is regulated by the state through the establishment of basic standards and site specific standards.

Program Management

Groundwater quality was previously monitored at the STM campus using a series of monitoring wells. There are currently five permitted monitoring wells that remain in place but there is no active monitoring being conducted

at this time. Should the laboratory conduct activities in the future that could impact groundwater, a monitoring program would be implemented and additional groundwater monitoring wells would be installed as needed.

There are two permitted closed-loop geothermal systems in operation at the STM Solar Radiation Research Laboratory and at the STM South Site Entrance Building.

To protect groundwater quality, NREL carefully evaluates all outdoor projects to eliminate, substitute, or control potential sources of pollution. If any materials are used that pose a risk to groundwater, the laboratory incorporates safeguards such as secondary containment, double-walled tanks, leak detection, and collection and offsite disposal of concrete wash water.

2014 Compliance Activities

An assessment of the groundwater program was conducted that resulted in one finding and two opportunities for improvement. The finding identified the need to properly abandon or obtain a variance in accordance with state regulations for those wells that have not been sampled or monitored for more than two years. Corrective actions are currently in progress.

7.3 SURFACE WATER

Surface water protection efforts seek to protect the quality of nearby receiving waters into which the STM and NWTC campuses drain. These receiving waters include Lena Gulch at the STM campus and Coal Creek and Rock Creek at the NWTC campus. Sediment, debris, and chemicals transported to these water bodies via stormwater runoff can harm or kill fish and other wildlife either directly or by destroying aquatic and riparian habitat. High volumes of sediment can result in stream bank erosion and clogging of waterways.



Improvements and erosion control measures at the Jeffco Swale.
Photo by Karri Bottom, NREL 32736

2014 Accomplishments and Highlights

There were no spills or releases that impacted groundwater in 2014.

2014 Accomplishments and Highlights

- The laboratory completed improvements to the drainage swale that crosses Jefferson County Open Space property (referred to as the Jeffco swale) and discharges into the stormwater detention basin for the central STM campus. The improvements include a low-flow infiltration channel in the swale bottom, armoring of the swale bottom and side slopes with geotextile fabrics, energy dissipation structures, reseeding, and the addition of irrigation sprinklers to enhance re-vegetation success and consequently soil stability. As the swale is partly located off campus, construction activities required permitting and inspections from the neighboring jurisdiction.
- Development of stabilization solutions for severe slopes located near the Integrated Biorefinery Research Facility and the Field Test Laboratory Building were initiated. Erosion in these areas was significantly worsened as a result of the rains associated with the 2013 flood event that was discussed in the 2013 NREL Annual Environmental Performance Report. (Download here: <http://www.nrel.gov/docs/fy14osti/62296.pdf>).
- The laboratory removed approximately 15,000 square feet (1,400 square meters) of asphalt parking lot at the STM campus, replacing it with native grasses. This will increase infiltration and decrease runoff delivered to the STM stormwater detention basin.
- Successful revegetation, defined in the federal stormwater permit as vegetative cover equal to 70% of pre-disturbance cover, was achieved at two major construction sites, thus allowing termination of EPA stormwater permit coverage. Carefully selected seed mixes and mulches, together with weed management and temporary irrigation, were instrumental in achieving the EPA criteria.

Water quality protection is accomplished through federal and state stormwater permitting, management of runoff that flows across active construction sites, inclusion of project design elements that promote infiltration and detention, and management of campus grounds to minimize erosion and support infiltration.

Requirements

The federal Clean Water Act, amendments, and implementing regulations apply to stormwater discharges from construction activities that disturb greater than one acre. The EPA is the regulating authority for stormwater at NREL, which is a federally owned facility. For onsite construction projects that disturb greater than one acre, a Notice of Intent must be filed with the EPA to be covered under their Construction General Permit and a site-specific Stormwater Pollution Prevention Plan must be prepared. The Stormwater Pollution Prevention Plan implements both the requirements of the EPA's Construction General Permit and NREL-specific requirements. For construction projects off federal property, such as at the Solar Technology Acceleration Center facility, Colorado Discharge Permit System stormwater permits may be required.

The Energy Independence and Security Act requires agencies to reduce stormwater runoff from federal development projects to protect water resources. Agencies can comply using low-impact design elements such as porous pavers, cisterns, and bioswales, or retain stormwater runoff and release at predevelopment levels. In addition, EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, sets requirements for efficient water use, reuse, and stormwater management.

Program Management

The surface water program focuses on managing construction site runoff, which has the potential to impact receiving waters into which NREL campuses drain.

Prior to construction, NREL implements an interdisciplinary planning and design process that involves reviews and approvals for compliance with the National Environmental Policy Act, and the assessment of design documents for potential impacts to stormwater and receiving waters. Design teams are encouraged to incorporate low-impact design elements that promote infiltration and evapotranspiration. NREL continues to monitor final design documents and construction implementation to look for additional opportunities to reduce runoff quantity and enhance runoff quality.

Erosion and sediment controls, proper chemical storage, fueling procedures, and good housekeeping practices are implemented during construction according to the

stormwater management plans developed by contractors and reviewed by project staff for both EPA permitted sites and those for which an EPA permit is not required. While construction projects that disturb less than one acre are not regulated by the EPA and typically involve minimal disturbance within a short timeframe, these projects still have the potential to contribute pollutants to stormwater runoff. For these projects, elements of the NREL stormwater pollution prevention program are followed, including the development of an abbreviated Stormwater Pollution Prevention Plan documenting basic contact, project, and best management practice information. An illustration showing the area of disturbance and locations of key site characteristics and best management practices is also required.

Regular inspections by contractors and staff are conducted throughout construction to verify that required controls are functioning properly. Any repairs or modifications to the plans are documented on an inspection report; prompt actions are required to correct any noncompliant conditions.

Management of campus areas outside active construction sites minimizes erosion, supports infiltration of rain water and snowmelt, and prevents contamination of stormwater with hazardous materials. Vegetation and landscaping are maintained to prevent erosion. Infiltration of precipitation is achieved through detention basins and grassy swales, as well as design elements including porous pavement and diversion of roof and perimeter drains to landscaped areas. In addition, hazardous wastes are stored indoors or in covered areas, and campus roads and sidewalks are swept to reduce sediment and other potential pollutants from entering the stormwater conveyance system.

2014 Compliance Summary and Activities

- Program activities were in compliance with requirements
- Permit coverage was obtained in 2014 under the EPA Construction General Permit for one new construction project at the STM campus. Permits are now in effect for three STM construction projects; there are no active construction stormwater permits at the NWTC.
- Two permits for completed projects were terminated in 2014
- Weekly stormwater inspections were performed per EPA stormwater regulations where active construction occurs; monthly stormwater inspections were performed for construction sites where EPA Construction General Permit coverage continues during the restoration phase of these projects.



Revegetation success at the NWTC. Photo by Genevieve Braus, NREL 32621

7.4 WASTEWATER

Untreated or poorly treated wastewater has the potential to contaminate surface and groundwater used for drinking water, irrigation, industrial, commercial, and recreational purposes. The majority of wastewater from the STM and Denver West Office Park facilities flows into the Pleasant View Water and Sanitation District's (Pleasant View) system, and ultimately to the Metropolitan Wastewater Reclamation District's (Metro District) central treatment plant. Wastewater from the Joyce Street Facility and the Renewable Fuels and Lubricants Research Laboratory also flows to the Metro District's treatment plant.

Research activities at the STM Integrated Biorefinery Research Facility develop, test, evaluate, and demonstrate processes for the production of bio-based products and fuels. Acids and bases are used in pilot-scale processes for converting cellulosic biomass into a variety of fuels and chemicals. The pH of the effluent from this process is adjusted prior to discharge into the sanitary sewer system. The Metro District and Pleasant View system managers periodically tour the facility and review the operational controls.

For those facilities that lack sanitary service, there are three small septic systems in place, each consisting of a tank and a leach field. One is located at the STM mesa top Solar Radiation Research Laboratory and two are at the NWTC campus. A preventative maintenance and inspection program is in place to confirm proper system function.

Requirements

Non-domestic wastewater discharges to the Metro District must comply with the Metro District's rules and regulations, which incorporate requirements of the

Clean Water Act, such as the Pretreatment Program. The Pretreatment Program is the set of regulations applied to industries and commercial operations that generate non-domestic wastewaters with potentially high levels of pollutants that could have an impact on wastewater treatment facilities and the environment.

The program includes specific regulations for certain types of industries, for dischargers of large quantities of industrial wastewater, and for all non-domestic wastewater discharges. NREL's operations are not among those identified as requiring specific discharge regulations, nor does the laboratory discharge a volume of water that would trigger requirement of a formal discharge permit from the Metro District for large industrial wastewater users. The lab does comply with all applicable requirements including the general prohibitions for all non-domestic wastewater discharges that protect Metro District's collection and treatment systems. These prohibitions include the discharge of hazardous materials, highly viscous substances, radioactive material, excessive oil and grease, or other substances that could cause material harm to the wastewater treatment system and the environment.

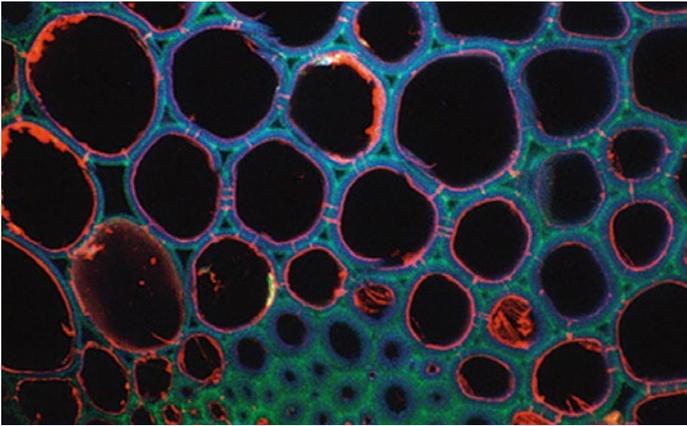
Program Management

NREL's wastewater management program is multi-faceted and encompasses all activities at the site, from green cleaning supplies to minimization of harmful chemicals in laboratory operations, and is intended to adhere to requirements and minimize potential impacts to the treatment processes.

NREL staff are trained in the requirements of the Metro District's rules and regulations. In addition, NREL sites have design criteria for waste drains in laboratory areas to minimize the possibility of a hazardous material discharge. These criteria include measures such as secondary containment for any chemicals used near sinks in laboratory exhaust hoods, no floor drains in laboratory areas unless a specific need can be shown, and caps for floor drains that are installed in laboratory areas. New research and operations activities as well as ongoing activities that undergo significant modifications are reviewed through NREL's risk assessment process for their potential effect on wastewater character.

2014 Compliance Summary and Activities

- Program activities were in compliance with requirements.
- In 2014, plans were developed for a new clean room in the Science and Technology Facility. The clean room would support solar cell technology research and would include the washing and etching of silicon wafers with basic and acidic solutions. Through integrated environmental stewardship in construction management, as discussed in section 2.2, NREL ensured that the project design included an appropriate wastewater neutralization system. It is not anticipated that the volumes will exceed the 25,000 gallon-per-day limit that would require NREL to obtain a permit as a significant industrial user under the Metro District's Rules and Regulations, but NREL will provide notification to both Metro District and Pleasant View of the newly installed neutralization process before discharges begin.



Laser microscope image of a cross section of corn stover, from which NREL researchers have developed a less toxic method of creating a precursor to the production of nylon. NREL 20331

8

HAZARDOUS MATERIALS AND WASTE MANAGEMENT

Responsible acquisition, use, and disposal of materials and wastes are critical to meeting our commitments to compliance, preventing pollution, and environmental stewardship. NREL seeks to purchase materials that are sourced responsibly and contain recycled content and lower impact materials. Use of materials is thoughtfully controlled with internal procedures designed to limit health and environmental risks. Wastes are carefully managed and disposed of through select contractors. Areas of focus include:

- Hazardous materials management
- Regulated waste management
- Aboveground storage tank management
- Spill prevention and response
- Radiological materials and waste management.

8.1 HAZARDOUS MATERIALS MANAGEMENT

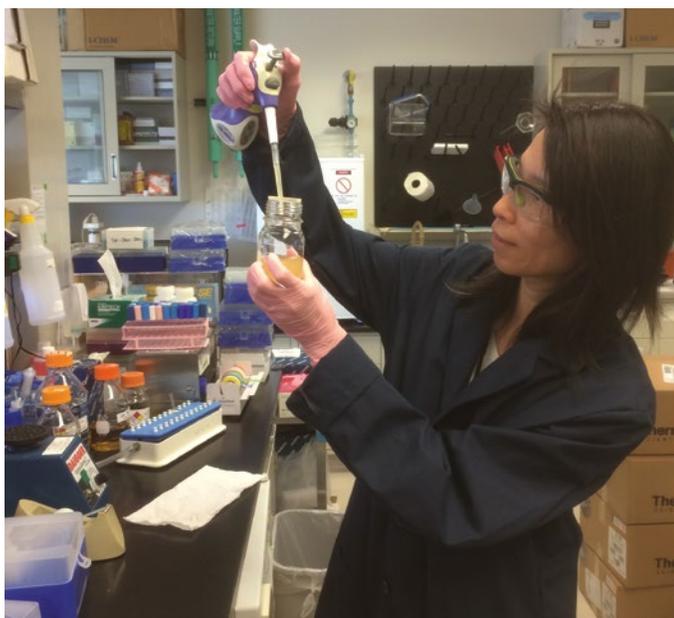
A variety of chemicals and materials, some of which are hazardous, are used in research activities. Hazardous materials are stored, used, and managed in a manner that is protective of laboratory personnel, the general public, and the environment.

Requirements

Hazardous material management is regulated at the federal level through the requirements of the Superfund Amendments and Reauthorization Act, which is also known as the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA). EPCRA was created to help communities plan for emergencies involving hazardous substances. EPCRA requires hazardous chemical emergency planning by federal, state, and local governments, and industry. It also requires industry to report on the storage, use, and releases of hazardous chemicals to federal, state, and local governments.

2014 Accomplishments and Highlights

- A site wide validation of accuracy of the chemical inventory was conducted at the STM campus, Renewable Fuels and Lubricants Research Laboratory, Denver West Office Park, and the NWTC. Over the course of the six-month effort, each chemical container's barcode number, chemical name, and physical location were physically verified.
- There were no releases of hazardous materials requiring reporting.



NREL researchers strive to limit their use of hazardous chemicals.
Photo by Dennis Smith, NREL 33209

NREL facilities are subject to various parts of EPCRA, which include Sections 302, 304, 311, 312 and 313. Please refer to Table 5, for NREL's EPCRA reporting status.

NREL is also subject to permitting requirements through local jurisdictions and obtains annual hazardous material permits from West Metro Fire Rescue for the STM campus and Denver West Office Park facilities. These permits are issued for a total of seven buildings where hazardous materials are stored and/or used. Prior to issuing the permits, a representative from West Metro Fire Rescue conducts a walk-through inspection of the entire STM campus and Denver West Office Park.

The Renewable Fuels and Lubricants Research Laboratory is within the jurisdiction of the City and County of Denver and is subject to the Denver Fire Department Hazardous Materials Information System requirements. This facility's inventory of listed materials, including various fuels such as biodiesel, must be reported to the Denver Fire Department annually. The Denver Fire Department inspects the facility and issues a hazardous materials permit.

Program Management

In addition to the EPCRA reporting obligations described above, a cornerstone of NREL's hazardous material management program is its laboratory-wide chemical management system, which serves as a centralized chemical inventory, as well as a tool for managing and reporting on chemicals used at the laboratory. Using an electronic barcoding system, the chemical management system tracks chemicals from the point of receipt through end-use and disposal. The system also contains technical data and reporting information for many of the chemicals in the chemical management system database. Key functions of the system include:

- Providing current inventories by room, building, and/or site
- Improving research efficiency and minimizing hazardous waste generation by allowing staff to determine if needed chemicals are already available on-site prior to making chemical purchases
- Providing quick access to chemical inventories and hazard information during emergency responses
- Facilitating accurate and efficient reporting to external agencies (e.g., fire districts, state and local emergency response agencies, EPA, and DOE).

Hazardous materials are rigorously managed, starting with the chemical management system that tracks chemical amounts, locations, and hazards. Each week, safety personnel receive a list of the chemicals and their hazards that were shipped to NREL during the previous week.

TABLE 5. 2014 EPCRA REPORTING

EPCRA Section	Description of Reporting	Status
EPCRA Section 302	Planning Notification	Not required
EPCRA Section 304	Extremely Hazardous Substance Release Notification	Not required
EPCRA Section 311-312	Safety Data Sheet/ Chemical Inventory	Reported
EPCRA Section 313	Toxics Release Inventory Reporting	Not required

"Not required" indicates that the laboratory was not required to report under the provision (e.g., did not meet the threshold or did not have an extremely hazardous substance release).

Researchers and safety personnel ensure that chemicals are properly stored in locations suitable for any hazards, such as storing flammable materials in designated flammables cabinets.

When requested by the state and local emergency response agencies or local fire departments, additional emergency response and reporting information is provided. NREL has been represented in the Jefferson County Local Emergency Planning Committee since its inception and is actively involved in the emergency planning concepts of EPCRA, with two active members on the committee.

Emergency response plans are also in place in the event of a spill or release of a hazardous material; these plans are coordinated with state and local emergency planning and response agencies and first responders, such as the West Metro Fire Rescue, Rocky Mountain Fire Rescue, and the Jefferson County Local Emergency Planning Committee.

2014 Compliance Summary and Activities

- All laboratory program activities were in compliance with requirements.
- Tier II hazardous materials reports were submitted to the required state and local emergency response and planning agencies, as well as local fire departments, for three facilities for reporting year 2013. Chemicals reported included diesel fuel, petroleum oil, and sulfuric acid in lead-acid batteries.
- West Metro Fire Rescue conducted an annual hazardous material inspection and issued permits for seven facilities.
- The inventory of hazardous materials at the Renewable Fuels and Lubricants Research Laboratory was provided to the Denver Fire Department.

8.2 REGULATED WASTE MANAGEMENT

Research and development activities and general facility operations create a variety of waste streams, including those containing toxic chemicals or metals.

NREL typically disposes or recycles the following categories of waste:

- Hazardous waste (as defined by environmental regulations)
- Non-hazardous waste such as propylene glycol from building chillers, diesel fuel, or spent biomass processing materials; does not include municipal solid waste, such as regular trash
- Universal waste such as mercury-containing light bulbs, lead-acid batteries, aerosol cans, and electronic

waste such as computers, monitors, and research instrumentation containing electronic circuitry.

Requirements

Regulated wastes are handled and disposed of according to the federal Resource Conservation and Recovery Act and the State of Colorado hazardous waste regulations. Additional applicable requirements for hazardous material transportation fall under the U.S. Department of Transportation regulations.

NREL maintains unique EPA identification numbers for each of its five facilities: STM, Denver West Office Park, NWTC, Joyce Street Facility, and Renewable Fuels and Lubricants Research Laboratory. Per state and federal regulations,



Batteries used at NREL are collected and either recycled or disposed of in an environmentally sensitive manner. *ISTock Photo 43191436*

2014 Accomplishments and Highlights

- As a best management practice, all NREL facilities are managed to the stringent Large Quantity Generator status hazardous waste regulatory requirements, including those for personnel training, contingency planning, and container management.
- Research staff continued to incorporate sound waste management practices during the early design phases of new research projects.
- Seventy-six cubic yards of internationally imported sugarcane bagasse was transported and disposed of in accordance with guidelines set forth by the United States Department of Agriculture's Animal and Plant Health Inspection Service.



Inspecting hazardous waste packaging prior to offsite shipment and disposal. Photo by Eric Schmitz, NREL 32737

annual generator notifications are made and applicable fees are paid to the state based on monthly volumes of hazardous waste that are generated at each facility. The three waste generator classifications are:

- Large Quantity Generator
- Small Quantity Generator
- Conditionally Exempt Small Quantity Generator.

Four out of five of NREL's EPA-permitted waste facilities fall under the waste generator category of Conditionally Exempt Small Quantity Generator because they generate minimal amounts of hazardous waste per calendar month. The STM campus typically produces quantities of hazardous waste well within the category of Small Quantity Generator; however, due to pilot-scale research experiments, the STM campus can episodically elevate to that of Large Quantity Generator category in one or more months during the year.

Program Management

Waste management and minimization efforts begin in the planning stages of all experimental and operational activities. Processes are evaluated based on the quantities and toxicities of products that will be brought on-site before an activity begins and lasting until material use is complete and it is ready for disposal. Hazardous materials proposed for use are also assessed for the potential substitution of less hazardous products, resulting in less hazardous waste streams.

The laboratory is committed to the appropriate management of regulated waste generated through its daily

operations. These wastes are handled, stored, and disposed of responsibly and per regulatory requirements to minimize the potential for health and environmental impacts that could result from a release or improper disposal.

Implementation of regulatory requirements includes:

- Documented waste management and minimization program
- Annual training for all staff who generate and/or handle regulated waste
- Regular inspection and tracking of all waste containers
- Storage, packaging, shipment, and tracking until final disposition at a fully permitted waste disposal or recycling facility
- Active monitoring of waste volumes to determine generator status
- Maintaining records that are generated through "cradle to grave" waste management activities.

For select unregulated materials that still pose a potential hazard, NREL follows a conservative waste management policy through collection and disposal as non-hazardous materials at federally permitted disposal facilities. For example, non-hazardous, nanomaterial-bearing wastes are not federally regulated, but because they pose a potential health risk, are managed and disposed of via the same management methods used for hazardous waste. Waste streams are accumulated on site for timeframes well within regulatory limits prior to being shipped for final disposal.

TABLE 6. COMPARISON OF FOUR WASTE CATEGORIES GENERATED AT ALL NREL FACILITIES [LBS. (KGS) NET WEIGHT]

	Hazardous Waste	Non-Hazardous Waste	Universal Electronic Waste	Other Universal Waste
2011	20,557 (9,324)	6,156 (2,792)	29,549 (13,403)	3,539 (1,605)
2012	33,386 (15,144)	8,805 (3,994)	41,355 (18,758)	4,803 (2,179)
2013	14,974 (6,792)	4,477 (2,031)	38,096 (17,280)	19,063 (8,647)
2014	14,683 (6,659)	15,198 (6,893)	28,551 (12,949)	6,738 (3,056)

In a general order of management preference, hazardous waste items are shipped off-site for final disposal via incineration, treatment, and landfill. Universal wastes are recycled or reclaimed.

Table 6 provides a summary of quantities and types of waste generated at NREL for the past four years.

2014 Compliance Summary and Activities

- Program activities were in compliance with requirements.
- All regulatory notifications were updated and applicable waste generator fees were paid for five NREL facilities.
- A Biennial Hazardous Waste Report for the STM campus (which detailed hazardous waste activities for calendar year 2013) was submitted to the state.
- A joint hazardous waste compliance inspection of the STM campus was conducted, by the EPA and the state. Areas of focus involved waste-container management, proper documentation of regulated waste handling activities, employee training, and facility contingency planning. A compliance advisory was issued for one instance of potential incompatible materials stored in close proximity to each other. This issue has been addressed and closed out by the state.

8.3 ABOVEGROUND STORAGE TANK MANAGEMENT

Proper tank management prevents or minimizes the size of spills and leaks of fuels or oils, avoiding contamination of soils, surface water, groundwater, and drinking water, and supports the laboratory's commitments to environmental stewardship and pollution prevention.

The aboveground storage tank management program applies to petroleum fuel tanks and is intended to:

- Minimize releases from tanks
- Confirm that safety features are present and functional
- Ensure compliance with tank design, operation, training, and inspection requirements.

The risk of underground soil and water contamination from storage tanks is minimized by using only aboveground tanks where storage is required. Unlike underground tanks, aboveground installations provide access for regular visual leak inspections and allow for less costly repair and cleanup.

NREL operates several aboveground storage tanks (ASTs) that it maintains using best management practices and according to applicable regulations.

Requirements

ASTs in Colorado are regulated by the state, which requires that ASTs with capacities of 660 gallons (2,498 liters) or larger be permitted prior to installation, be inspected by the state following installation, and be registered with the state within 30 days following commencement of use. Regulations require that ASTs be constructed and installed according to specific standards, be regularly inspected, that those inspections are documented, and that facilities meeting certain oil storage quantities employ a Spill Prevention, Control, and Countermeasures plan to manage oil sources 55 gallons (208 liters) or larger. (For more details, see section 8.4, Spill Prevention and Response.)

Eighteen ASTs are maintained at the STM campus with a total capacity of 13,222 gallons (50,045 liters); one AST

2014 Accomplishments and Highlights

- Annual AST training was provided to all staff identified as having responsibility for operating and fueling ASTs.
- A 1,000-gallon (3,785-liter) E85 vehicle fleet fuel tank was installed at the STM campus.
- A retrofit of a high-level-fill, audible alarm on the Solar Energy Research Facility standby generator diesel tank was completed.
- All tanks were reviewed to confirm continued adherence to recently revised regulations.



E85 fuel tank and fueling station at the STM campus. Photo by Larry Durbin, NREL 32761

at Denver West Office Park with a capacity of 500 gallons (1,893 liters); and four ASTs at the NWTC with a total capacity of 1,006 gallons (3,808 liters). There are no ASTs at the NWTC that need to be permitted or registered. One 2,500-gallon (9,463-liter) AST is located at the Solar Technology Acceleration Center. Five ASTs at the STM and the Solar Technology Acceleration Center AST are registered with the state.

In late 2014, the Solar Technology Acceleration Center tank and related experimental equipment was transferred to another entity and will be removed from the AST inventory. This tank will no longer be required to be registered by NREL with the state.

Program Management

NREL AST management program consists of permit compliance, inspections, tank maintenance and improvements, training, and spill response.

There are five tanks at the STM campus that are permitted with the state. There are no permitted ASTs at the NWTC, Joyce Street, Renewable Fuels and Lubricants Research Laboratory, or Solar Technology Acceleration Center facilities.

Staff actively participates in the program through:

- Participating in project planning, safety evaluations, and readiness verifications
- Conducting regular tank inspections and maintenance activities
- Achieving timely necessary regulatory approval
- Maintaining a current and accurate AST inventory
- Placing spill response supplies in key locations
- Planning and documentation of annual training activities.

Personnel who operate and manage ASTs are trained annually on program requirements including inspection and response requirements, spill history of each site, lessons learned, and recent changes in rules and regulations.

Several important mechanical and procedural safeguards have been incorporated into NREL's AST management program to prevent an accidental release of diesel or E85 fuel from the storage tanks. Mechanical safeguards include overfill and spill protection, double-wall tanks equipped with sensors that result in an alarm if the inner tank wall is leaking, and secondary containment for single-wall tanks. Procedural safeguards include written operating and tank-filling procedures, monthly and annual inspections, and recordkeeping of inspection

results. ASTs larger than 110 gallons (416 liters) are visually inspected monthly and all double-walled ASTs are inspected annually to confirm that there is no liquid in the interstitial space.

2014 Compliance Summary and Activities

- All program activities were in compliance with EPA and state AST requirements.
- A state inspection of registered ASTs was completed with no violations noted.
- The new E85 fleet vehicle fuel tank at the STM campus was registered with the state.
- One 2,500-gallon (9,463-liter) AST at the Solar Technology Acceleration Center facility was sold to another entity and is being removed from the AST inventory and list of NREL-registered ASTs.

8.4 SPILL PREVENTION AND RESPONSE

Spills of chemicals, fuels, and oils can result in contamination to soil, surface water, and groundwater, potentially causing damage to ecosystems, wildlife habitat, and human health. Comprehensive planning using spill prevention, control, and countermeasures plans (SPCC) can reduce spills and limit impacts to the environment when spills do occur.

Requirements

SPCC plans are required by the EPA and state of Colorado for facilities that meet certain oil storage criteria. In general, facilities that store more than 1,320 gallons (5,000 liters) of oil and have the potential for a spill to enter a *waters of the United States* or a Colorado water must have a SPCC plan. SPCC regulations require that any equipment or containers with the capacity to store 55 gallons (208 liters) or more of oil be included in the plan.

The plan must address such items as:

- Topography and location of waterways
- Location and quantity of oil sources
- Possible spill pathways
- Spill scenarios and potential spill volumes
- Spill prevention and response training
- Spill notification procedures and contact information
- Emergency response plans.

Due to the quantity of oils stored at the STM, NWTC, Renewable Fuels and Lubricants Research Laboratory, and Solar Technology Acceleration Center facilities, an SPCC plan is required for those locations.

2014 Accomplishments and Highlights

- The laboratory SPCC training course was updated to include new facilities and revised SPCC plans.
- A special spill control gate was installed near the new E85 fuel tank to prevent fuel from entering a nearby storm drain in the event of a spill.
- Four additional large portable spill control kits were placed at key STM campus locations to provide a more rapid response capability.

Program Management

The laboratory prepares for and continually improves spill response. Formal SPCC plans have been developed for four facilities. The plans are designed to minimize the number and size of spills, and speed the control and cleanup of spilled materials. SPCC plans are updated every three years, or whenever there is a significant change in regulations, operations, or equipment. This aggressive approach to spill prevention and control exceeds the EPA's requirement that SPCC plans be updated at least every five years.

Emergency notification and hazardous materials procedures are in place to provide additional support for spill response. Proper preventive planning and training minimizes the potential for spills, and advance preparation for spill response protects water and ecological resources.

SPCC training occurs annually for individuals who are responsible for oil-containing equipment and above-ground storage tank operation and maintenance. SPCC training is combined with aboveground storage tank training and educates staff on oil-containing equipment at each site. Training also includes inspection and response requirements, location and use of spill response equipment, and notification and spill reporting protocols.

The laboratory typically does not experience spills that require notification to federal and state agencies. Small, incidental hydraulic system leaks, lubricant leaks, and fuel transfer spills may occur on occasion. Lessons learned from spill incidents and clean-up activities are used to improve management and spill response planning.

2014 Compliance Summary and Activities

- Program activities were in compliance with all environmental requirements.
- Workers who manage and/or operate oil-containing equipment received annual SPCC training.
- There was one reportable spill of approximately one gallon (3.8 liters) of hydraulic fluid from a



Containment

- DOT shipping container purged of oxygen to reduce flammability potential
- Secondary containment provided
- Bonding and grounding to control static electricity.

Filling

- Low-flow diaphragm pump provided to slow filling and minimize vapor emissions
- Extra-long fill pipe used to prevent splashing and minimize generation of vapor emissions
- DOT shipping container only filled to 80% capacity to minimize potential for overflow.

Best management practices used when transferring ethanol from primary storage tank to smaller shipping containers are identified. Lessons learned from both NREL and industry experiences have been incorporated into NREL protocols. *Photo by Tom Bain, NREL 33028*

vehicle-related release that entered a Colorado water. The fluid did not leave NREL property and resulted in no violation or compliance action. Immediate notification was made to the state and a written report was submitted to the state following completion of cleanup activities that included deployment of sorbent materials in the forebay of the STM stormwater detention basin. No additional action was required by the state.

- Twenty-one minor spills of diesel, lubricant, coolant, and hydraulic fluids occurred at the STM campus, and one spill occurred at the NWTC. The size of spills ranged from less than 0.1 gallon to 12 gallons (0.38 to 45 liters). The majority of these spills were the result of leaks from vehicles and construction equipment. Each spill received immediate remedial action and did not result in any significant impact to the environment.

8.5 RADIOLOGICAL MATERIALS AND WASTE MANAGEMENT

NREL conducts a wide range of research and operational activities that incorporate the use of radiological materials. The laboratory occasionally uses small quantities of radioisotopes for biological labeling and electron microscopy staining. All of the radioisotopes have very low activity levels and are used in extremely small amounts. A number of sealed sources are present in analytical and process equipment, check sources, and emergency exit signs. Unlike many DOE facilities, NREL does not have legacy radiological contamination issues associated with past nuclear weapons production and research.

Requirements

Radiological air emissions are regulated by the EPA. DOE Order 458.1, *Radiation Protection of the Public and the Environment*, establishes radiation emission limits for DOE facilities. These facilities, including NREL, must annually demonstrate compliance with EPA radiological air standards that limit emissions to amounts that would prevent any member of the public from receiving an effective dose equivalent of 10 mrem per year or greater.

Program Management

NREL has established strict protocols for radiation-generating devices, equipment containing sources of radiation or for the use of radioisotopes in laboratory experiments through its radiation safety program. Some of these controls include:

- Confining work with radioisotopes to a small number of specific laboratories
- Limiting the types and quantities of radioisotopes onsite
- Monitoring equipment and facilities for removable contamination or sealed-source leakage.

No radioactive air emission monitoring is conducted at the laboratory because of the extremely low usage of radioactive material. Therefore, NREL demonstrates compliance with radiological air emission standards by using an EPA computer model (COMPLY Version 1.6) to determine the effective dose equivalent to the public.

Current laboratory procedures prohibit any activity that may result in a radioactive waste that is also federally regulated under the Resource Conservation and Recovery Act and thus categorized as “mixed waste.”

What Is “Effective Dose Equivalent?”

To understand *effective dose equivalent*, you must first define *dose* and *dose equivalent*:

- **Dose** – a generic term to describe the amount of radiation a person receives.
- **Dose Equivalent** – a measure of the biological risk of the energy that the radiation deposited in tissue, which depends on the type of radiation and the tissues exposed. The units of dose equivalent are called rems, and a thousandth of a rem is called a millirem, abbreviated as mrem.

- **Effective Dose Equivalent** – the total of the dose equivalent to the organ or tissue multiplied by weighting factors applicable to each of the body organs or tissues that are exposed to radiation.

An average person in the United States receives about 310 mrem each year from natural sources and an additional 310 mrem from medical procedures and consumer products.

Therefore, all radioactive waste generated is classified solely as low-level waste. Waste is temporarily stored on-site until disposal is arranged at an off-site facility permitted to accept low-level radioactive waste. Internal procedures prohibit the clearance of property unless it has been decontaminated to background levels.

2014 Compliance Summary and Activities

- Program activities were in compliance with requirements.

- Only small quantities of low-level radioactive waste were generated and are currently in storage awaiting off-site disposal.
- The effective dose equivalent to the public was 0.036 millirem (mrem) per year, far below the 10 mrem per year limit.



9

NATIONAL ENVIRONMENTAL POLICY ACT

NREL's National Environmental Policy Act (NEPA) program provides a mechanism to consider the potential for environmental impacts in decision-making processes and to promote sustainable and environmentally responsible operations. Under this program, the staff analyze the potential impacts for a wide range of activities prior to spending funds or commencing work.

Examples of activities requiring a NEPA analysis include new or revised laboratory research, construction activities, partnering arrangements, feasibility studies, and data analyses.

Requirements

NEPA is a federal law that requires potential environmental impacts to be considered for activities with a federal connection, such as those using federal funds, property, facilities, and equipment. NEPA represents the federal government's mandate to consider the environment equally to other factors when making decisions. It directs federal agencies to take into account, and publicly disclose, the environmental consequences of proposed actions.

Soon after NEPA was passed at the end of 1969, the president's Council on Environmental Quality enacted regulations that provided direction to federal agencies on how NEPA should be implemented. Subsequently, DOE established its NEPA Implementing Procedures that it, and NREL, use to comply with NEPA and the Council on Environmental Quality regulations.

Under NEPA, federal agencies consider and document environmental factors in decision-making processes using one of three levels of analysis:

- Categorical Exclusion (CX)
- Environmental Assessment (EA)
- Environmental Impact Statement (EIS).

Sun Edison 1.1 MW photovoltaic array at the NWTC.
Photo by Dennis Schroeder, NREL 30551

2014 Accomplishments and Highlights

- Completed the NWTC Site-Wide Environmental Assessment and Finding of No Significant Impact. This included a public meeting and a 30-day public review and comment period.
- Completed the STM Site-Wide Environmental Assessment and Finding of No Significant Impact. This included a public meeting and a 30-day public review and comment period.
- Continued to provide NEPA support in the preparation of proposals for DOE Funding Opportunity Announcements that support DOE's mission and the nation's energy objectives.

Categorical Exclusion

A CX determination is the lowest level of NEPA review and can be applied to activities that are known not to have a significant individual or cumulative effect on the quality of the human and natural environment. Each agency has a unique set of CXs based on their own routine activities. Examples of DOE's include information gathering and data analysis; specific types of site and facility maintenance and improvement; small-scale renewable energy research and development projects; and environmental monitoring.

Environmental Assessment

If the proposed action does not fit into a DOE CX, or there are extraordinary circumstances present (such as potential effects to environmentally sensitive areas or resources and public controversy), or the proposed action fits within a category of actions that DOE has determined to typically require an EA, then an EA must be prepared. The purpose of an EA is to determine the significance of the environmental effects and to look at alternative means to achieve the agency's objectives. The EA also provides sufficient evidence and analysis for determining whether or not to prepare and EIS, and facilities preparation of an EIS when one is necessary.

An EA is prepared for classes of activities such as siting, construction, and/or operation of energy system demonstration actions including wind, hydropower, geothermal, biomass, and solar energy projects and operations. The EA allows for public review and comment, and demonstrates compliance with NEPA (i.e., it helps to identify better alternatives and mitigation measures). When environmental



An NREL postdoctoral fellow operates an ultra-high vacuum surface analysis cluster tool at the Science and Technology Facility to decrease solar cell material costs through the optimization of earth-abundant inorganic materials. *Photo by Dennis Schroeder, NREL 29029*

analysis and interagency review conducted during the EA process conclude that no significant impacts will occur related to the quality of the environment, a Finding of No Significant Impact is issued.

Environmental Impact Statement

An EIS provides a detailed analysis of projects that have significant prospective environmental impacts. The EIS provides a discussion of significant environmental impacts and reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human and natural environment (including the consideration to not pursue the project). An EIS is also made available for public review and comment. As a final step, a Record of Decision is prepared, which states the decision, the alternatives considered, including the environmentally preferred alternative, and discusses mitigation plans, including any enforcement and monitoring commitments. It should be noted that NREL, to date, has had no activities have required an EIS.

Program Management

NREL employees initiate the NEPA process and provide support to DOE Golden Field Office in conducting a NEPA analysis before an activity begins. In accordance with regulations, all NREL activities (both on- and off-site) must undergo a NEPA environmental review. The outcome of this review is considered the NEPA determination. A final determination must be completed before federal funds are expended, before a contract award can be made, and before project activities begin.

NREL and DOE Golden Field Office use a type of programmatic NEPA document unique to DOE to streamline the



Western Kingbird nest in a tree near the Research Support Facility.
Photo by Bob Fiehweg, NREL 32754

environmental review process. These programmatic NEPA documents, known as Site-Wide EAs, are comprehensive site-wide analyses of potential environmental impacts associated with NREL's current and future actions over a period of five to ten years. These serve as planning tools that aid ongoing and future operational and development decisions related to NREL's sites. The Site-Wide EAs for the STM and NWTC provide a baseline environmental analysis that streamlines future environmental reviews; improves

and coordinates site and agency planning; and maximizes cost savings.

If proposed activities have not already been evaluated in an existing Site-Wide EA or supplemental NEPA document, then further environmental analysis must be conducted. Potential environmental impacts of an activity are evaluated and measures are taken, as needed, to avoid or minimize those impacts. The level of review conducted is appropriate to the potential impacts of the proposed activity. A planned construction project, for example, receives a more rigorous review than routine office or laboratory work

2014 Compliance Summary and Activities

- Complied with program activities requirements
- Conducted 390 NEPA reviews for project activities on- and off-site during 2014
- Finalized both the NWTC and the STM Site-Wide EAs and Findings of No Significant Impact in 2014
- Completed two assessments of the NEPA program, resulting in identification of several findings and opportunities for improvement. These findings related to inconsistencies in the application of the NREL NEPA procedure. The assessment results will be addressed in 2015.



10

NATURAL AND CULTURAL RESOURCES PROTECTION

NREL is committed to responsible stewardship of its natural ecosystems, native wildlife, vegetation, and important cultural resources. Natural resources at the STM and NWTC facilities are managed appropriately to ensure NREL's research needs are met while protecting native wildlife and vegetation. Responsible management not only benefits our environment, but also NREL employees and the surrounding community, and demonstrates the laboratory's leadership in the DOE and federal government as a whole. Management focuses on these key areas:

- Wildlife management
- Endangered species and species of concern
- Vegetation management
- Wetlands and floodplains
- Cultural resources.

10.1 WILDLIFE MANAGEMENT

The wildlife management program promotes responsible wildlife and habitat management, and gathers information to better consider impacts to wildlife when implementing projects onsite.

Many surrounding landowners, including residential neighbors and Jefferson County Open Space, value the benefits of maintaining wildlife habitat and opportunities to observe wildlife. Proper wildlife management at NREL therefore provides an important benefit to our community.

A variety of wildlife are seen at NREL campuses, where efforts are made to protect wildlife and preserve and enhance habitat. *Photo by Brent Nelson, NREL 23922*

2014 Accomplishments and Highlights

- Continued acoustic bat monitoring at two NWTC locations and documented the presence of several species of bats at the NWTC. This monitoring from May through October 2013 and April through June 2014 provided information on bat activity and usage of the site. Data results are shown in Figures 5 and 6 see page 66.
- Retrofitted the Energy Systems Integration Facility windows in August 2014 with visible markers (i.e., dots) to reduce the potential for bird strikes. From August 2013 through November of 2013, several birds collided with the facility's windows. After the windows were retrofitted, no additional bird strikes occurred from September to mid-November 2014.
- Installed a series of nest boxes around the stormwater detention basin for the STM campus to provide housing for a number of species, which include kestrels, bluebirds, wood ducks, bats, mason bees, and chickadees.
- Continued monitoring of mammalian predators at the STM and NWTC campuses in 2014. Collected data from two motion detection cameras at each site. STM cameras confirmed continued use of the site by several species, including red fox (*Vulpes vulpes*), coyote (*Canis latrans*), and striped skunk (*Mephitis mephitis*). NWTC cameras, once again, recorded two mammalian predators, coyote and bobcat (*Felis rufus*). Interesting coyote behavior was recorded: checking the scent station as a pack, and reacting to deer protecting themselves from the potential predator.
- Developed a prototype radar system that can detect large birds with the collaboration of staff biologists, NWTC wind researchers, and an industry partner during the 2014 spring and summer seasons. The intention of the prototype would be to detect raptors as they enter the airspace of wind farms. Biologists performed raptor surveys surrounding the NWTC and recorded species, time, distance, and altitude while the radar equipment was operational. The survey results were used to evolve the radar software into the next phase of the project, which was the use of a trained falcon able to carry a GPS device to record location data during flight. The radar system holds promise in allowing wind farms early detection of large birds, from which operational modifications can be made to reduce bird-turbine strikes.
- Held a community open-house with DOE Golden Field Office in October 2014, during which information concerning environmental stewardship at NREL campuses was presented. Topics discussed included the vegetation at the STM campus, past wildlife studies, cultural resources, and how NREL assesses environmental impacts.
- Provided staff assistance to DOE Golden Field Office in documenting migratory bird protection measures incorporated into STM infrastructure projects. DOE Golden Field Office subsequently received national recognition for the collaborative efforts.

Requirements

A Colorado statute, several federal laws, and an executive order comprise the regulatory framework for NREL's wildlife management program. (Please refer to section 9, National Environmental Policy Act, and 10.2, Endangered Species and Species of Concern, for discussion of other federal laws relating to wildlife management.)

Wildlife is considered a state resource under Colorado law, and no wildlife dens or nests, young, or eggs may be damaged or destroyed unless permitted by the Colorado

Division of Parks and Wildlife. It is unlawful for any person to willfully harass wildlife.

The Migratory Bird Treaty Act is the main driver for protecting migratory birds in the United States. In the biological sense, a migratory bird is a bird that has a seasonal and somewhat predictable pattern of movement. Generally, this includes all native birds in the United States, except those non-migratory species such as quail and turkey that are managed by individual states as game species. Currently, there are 1,026 species of birds protected by this law.



The Gyrfalcon (nicknamed Houdini) and handler prepare for radar testing on the Rocky Flats Refuge south of the NWTC. NREL staff coordinated with the U.S. Fish and Wildlife Service Refuge Office to use the refuge for research aimed at reducing raptor/turbine blade interactions. Photo by Jason Roadman, NREL 32614

The Migratory Bird Treaty Act makes it a federal crime to “take” birds or bird parts, including feathers, or to kill birds unless permitted by regulations issued by the U.S. Fish and Wildlife Service. The term “take” means to pursue, hunt, shoot, wound, kill, trap, capture, or collect any protected migratory bird or any part, nest, or egg of any protected migratory bird or to attempt those activities. The U.S. Fish and Wildlife Service has developed a system of permits for activities that involve the “take” of migratory birds, including those governing scientific collection and bird banding, and lethal and non-lethal measures taken to prevent depredation of agricultural crops and to protect public health and safety.

In 2001, EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, set requirements for federal agencies to minimize their impacts to migratory birds, to work cooperatively with the U.S. Fish & Wildlife Service, and to establish an interagency migratory bird committee for collaboration and information sharing. Additionally, the U.S. Fish & Wildlife Service issued guidance identifying goals



A coyote pack is captured by motion detection camera near an NWTC scent station. Photo by Tom Ryon, NREL 32776

for federal program activities based upon this executive order. This guidance highlighted measures to avoid and/or minimize potential impacts to migratory birds, eggs, and active nests, including but not limited to:

- Project modification
- Time-of-year restrictions on vegetation clearing
- Avoidance of cavity trees, colonial bird nests, and other active nests
- Avoidance of nests of species of concern.

The U.S. Fish & Wildlife Service also works to ensure that environmental analyses of federal activities under NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, particularly on species of concern.

The 2013 Memorandum of Understanding between DOE and the U.S. Fish & Wildlife Service regarding implementation of EO 13186 formalizes DOE’s commitments regarding the protection of migratory birds. Under the MOU, DOE agrees to integrate migratory bird conservation principles, measures, and practices into agency activities, and avoid or minimize, to the extent practicable, adverse impacts on migratory bird resources and their habitats.

Program Management

NREL’s wildlife management program was developed to implement measures to allow the laboratory to meet or exceed the regulatory requirements discussed above and to minimize or avoid impacts to wildlife species and their habitats while achieving NREL’s mission.

Staff biologists work with project managers and decision-makers as part of an integrated project team on construction projects to minimize impacts to wildlife and maintain habitat by avoiding sensitive areas and reclaiming lands once disturbance is complete.

A long-term objective is to maintain wildlife movement through the STM campus by retaining linkages between the open space areas north of the site, and Pleasant View Community Park and Lena Gulch to the south. At the NWTC, ecologically sensitive areas are preserved within the site and linkages with surrounding open space areas are maintained. At both campuses, periodic monitoring using wildlife surveys informs responsible management.

When control of pest wildlife species is necessary, a graded approach is used to humanely control pests and minimize other potential impacts. Building design features and administrative controls are the first line of defense against pests. When these are not fully effective, additional controls are used. Pests are relocated whenever possible.

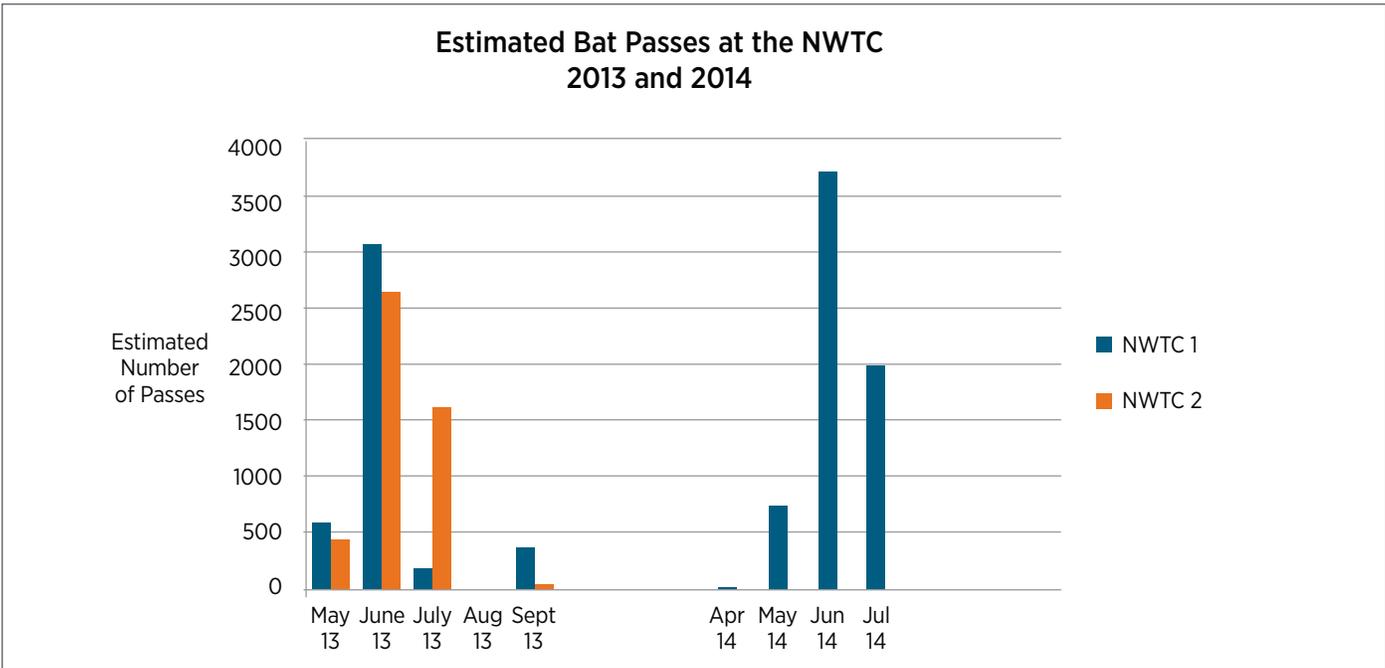


Figure 5. Bat detections at the NWTC during 2013 and 2014 monitoring periods

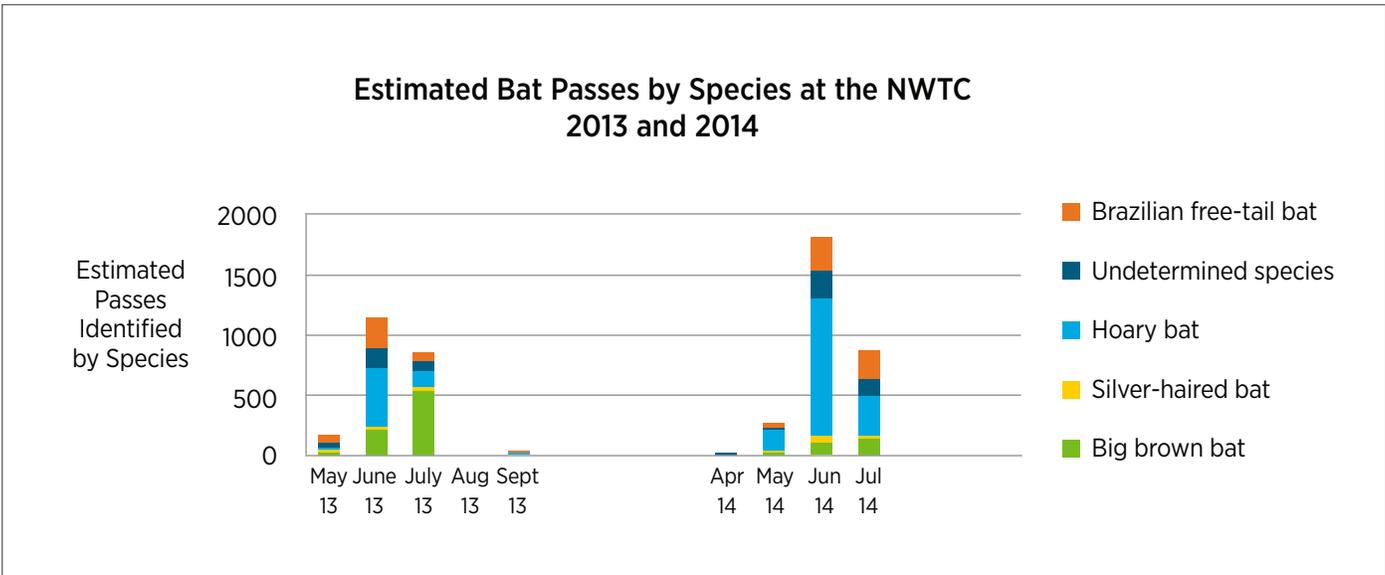


Figure 6. Bat species detected at the NWTC during 2013 and 2014 monitoring periods

When pests must be destroyed, mechanical methods are preferred over poisoning. When necessary, pesticides are selected that pose the least harmful effects to non-target wildlife.

Several activities occur periodically to achieve the program’s intent:

Monitoring – The laboratory conducts nesting bird surveys prior to any ground- or vegetation-disturbing activities conducted between March 15 and September 15 every year. If nests are found, the area is closed with a proper buffer area until nestlings fledge. Staff conducts

periodic surveys on a site-wide basis to document biological conditions at NREL facilities.

Surveys currently underway involve monitoring bat presence at the NWTC. Using microphones mounted on two meteorological towers (NWTC1 and NWTC2), bat calls have been collected from May through October 2013, and April through July 2014. Using the calls as an approximation of the number of times bats passed the meteorological towers, September 2013 results showed 50 passes, while June 2013 results indicated more than 3,000 bat passes (Figure 5). By comparing the recorded calls with

standard calls of a particular species, the following bats were detected: Big brown bat (*Eptesicus fuscus*), the Silver-haired bat (*Lasionycteris noctivagans*), the Hoary bat (*Lasiurus cinereus*), the Brazilian free-tailed bat, and three species of *Myotis* (Figure 6). These data provide information on bat activity and usage of the site.

Project Reviews – Biologists conduct project reviews to assess and reduce potential impacts to wildlife.

Coordination – Biologists coordinate with local, state, and federal agencies to improve wildlife management. They conduct these activities in concert with surveys for threatened and endangered species and habitats. (For more details, see section 10.2, Endangered Species and Species of Concern.) Because habitat is as much of a concern as the wildlife species themselves, program activities often overlap with vegetation management.

2014 Compliance Summary and Activities

- Completed bird-friendly retrofits to the glass located in the Energy Systems Integration Facility main entrance and all east facing windows. This effort is consistent with the requirements of the Migratory Bird Treaty Act.
- Included Migratory Bird Treaty Act discussions as part of the Endangered Species Act consultations with the U.S. Fish and Wildlife Service for the Site-Wide Environmental Assessments for the NWTC and STM campuses.
- Reported on migratory bird protection activities on NREL campuses for the 2013 Council for the Conservation of Migratory Birds Annual Report. This is required by 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*.



Energy Systems Integration Facility main entrance windows after a special film was applied to help prevent bird collisions. *Photo by Dennis Schroeder, NREL 31185*

10.2 ENDANGERED SPECIES AND SPECIES OF CONCERN

NREL manages research and operational activities to preserve and protect environmental quality. The laboratory is committed to the protection of imperiled species, and monitors for these species at its two main campuses: the STM and the NWTC.

Periodically, surveys are conducted for declining wildlife species and rare plants, including species that are federally or state protected, or otherwise considered imperiled or declining. Biologists also survey for potential habitat for these species. Should potential habitat be found, more targeted surveys may be conducted. These surveys identify the presence or absence of rare species or their habitats and aid in siting and planning new projects. While no protected or declining species have been detected at an NREL facility, appropriate steps would be taken should such a species be found.

Requirements

The federal Endangered Species Act provides for the designation and protection of wildlife, fish, and plant species that are in danger of extinction, and preserves the habitats on which these species depend. Federal agencies are required to abide by the Endangered Species Act and ensure that their actions do not adversely affect species that are federally listed under the Endangered Species Act as threatened, endangered, or candidate species.

The U.S. Fish and Wildlife Service (USFWS), which administers the Endangered Species Act, lists nine species in as threatened, endangered, or a candidate for listing that could potentially occur in Jefferson and Boulder Counties combined. Of these species, three have the potential to occur at the STM or the NWTC campuses, including the Preble's meadow jumping mouse, the Ute ladies' tresses orchid, and the Colorado butterfly plant.

Additional federal and state laws and regulations protect wildlife, such as the Bald and Golden Eagle Protection Act. The Colorado Division of Parks and Wildlife identifies a list of endangered, threatened, and wildlife species of concern for Colorado. Furthermore, the Colorado Natural Heritage Program has a list of rare species that, while not regulatory in nature, is useful as it is the only designation besides the Endangered Species Act that considers rare plants. The list of threatened, endangered, candidate species, and species of concern (i.e., bald and golden eagles, state-listed species, and Colorado Natural Heritage Program species) are all considered imperiled species

and can be referred to as a group known as “Threatened, Endangered, or Species of Concern” species.

Program Management

NREL conducts periodic surveys for the three listed species that have the potential to occur at the STM and NWTC campuses in order to document their presence or absence. While the Preble’s meadow jumping mouse does not occur on-site, the USFWS designated critical Preble’s habitat within the upper reaches of Rock Creek, including a small area at the southeast corner of the NWTC. This area may not be disturbed without coordination with the USFWS.

NREL also considers other plant and animal species that may be state listed or generally in decline. Current information is obtained from both the Colorado Division of Parks and Wildlife and the Colorado Natural Heritage Program. These two entities work together to track declining species and habitats throughout Colorado. Although not required by federal regulation, periodic surveys are conducted for species that may occur at NREL sites, typically every five years when baseline vegetation and wildlife studies are conducted. These baseline surveys are a vital part of NREL’s National Environmental Policy Act program where impacts to natural resources from mission activities are assessed.

The USFWS lists five other species occurring in the Platte River watershed in Nebraska in accordance with the Endangered Species Act as species that must be considered for projects in Colorado and Wyoming that may deplete water supplies to the Platte River system. These include three birds, the piping plover (*Charadrius melodus*), the whooping crane (*Grus americana*), and the least tern (*Sternula antillarum*); a fish, the pallid sturgeon (*Scaphirhynchus albus*); and a plant, the western prairie fringed orchid (*Platanthera praeclara*). For any NREL activities that may deplete water in the Platte River system, a consultation with the USFWS must be completed to determine potential impacts.

2014 Compliance Summary and Activities

- Program activities were in compliance with requirements.
- NREL assisted DOE in Endangered Species Act consultations with the USFWS that were conducted as part of the development of the Site-Wide Environmental Assessments for the NWTC and STM campuses.
- NREL and DOE prepared Biological Assessments for the NWTC and the STM campuses that evaluated potential depletion of water to the South Platte River system

from continued and proposed site activities included in the Site-Wide Environmental Assessments.

- Biological Opinions for the NWTC and STM campuses were received from the USFWS that indicated that the proposed water-related actions are covered under the Programmatic Biological Opinion developed for the Platte River Recovery Implementation Program.

10.3 VEGETATION MANAGEMENT

Native plants have evolved over long periods of time in harmony with the local climate and surrounding soil, growing in association with microorganisms and resident wildlife to create bio-diverse ecosystems. Through this evolution, native plants have developed natural defenses against pests and diseases specific to their locale. When non-native plants are introduced into an environment, they often overcome indigenous plants, attracting new types of pests and diseases and out-competing native plants for nutrients and water, while also sometimes depriving wildlife of nutrients and shelter. Plants such as kochia (*Bassia scoparia*), Canada thistle (*Cirsium arvense*), Russian olive (*Elaeagnus angustifolia*), diffuse knapweed (*Centaurea diffusa*), dalmation toadflax (*Linaria vulgaris*), and myrtle spurge (*Euphorbia myrsinites*) are examples of non-native plants that can have destructive effects on natural habitats.

Landscaped areas near buildings and common areas at both campuses are designed and installed with sustainability in mind, and include features such as native plantings, xeriscape principles appropriate for arid climates, and infiltration of stormwater to provide water and nutrients to landscape plants and to recharge groundwater in the area.

Requirements

Vegetation management at NREL must meet the requirements of EO 13112, *Invasive Species*, the Federal Noxious Weed Act, and the Federal Insecticide, Fungicide and Rodenticide Act.

The Federal Insecticide, Fungicide, and Rodenticide Act regulates the use, storage, and disposal of herbicides and pesticides. For application of certain types of herbicides designated as “restricted-use” by the EPA, a person with a certified applicator license must be used. Application of restricted-use herbicides is conducted in accordance with the regulation. NREL currently uses contractors for this type of application.

At the STM campus, vegetation management of 177 acres are under a conservation easement agreement with

2014 Accomplishments and Highlights

- Monthly review and coordination meetings were conducted to assess the success of seasonal herbicide applications and revegetation efforts.
- Knapweed is under control at the NWTC campus.
- Canada thistle, houndstongue (*Cynoglossum officinale*), and myrtle spurge (*Euphorbia myrsinites*) continue to be under control at the STM campus.
- Regular maintenance will be performed to continue the control of these species.

Jefferson County, which requires that the unique landscapes within the easement are left undisturbed. (For more details, see Section 11, Conservation Easement Lands.)

NREL voluntarily complies with the Colorado Noxious Weed Act.

Program Management

The focus of NREL's vegetation management program is to:

- Conserve existing ecosystems in their natural state as much as possible
- Strive to replace disturbed vegetation with native species, or with adapted but non-invasive species when necessary
- Implement a program of weed management to prevent the spread of noxious weeds and implement measures to control these species
- Implement a sustainable landscape design and maintenance program.

Approximately 60 acres of land within the NWTC campus boundaries are managed as conservation areas. As within the STM's 177-acre conservation easement, the laboratory limits development in these areas at the NWTC campus and manages them to conserve specific features including seeps, ephemeral drainages, ponds, native grassland habitat, areas supporting ancient soils (a soil structure in association with plant species forming a stable ecological community that is resistant to weed invasion), a small area designated as critical habitat for the Preble's meadow jumping mouse, an area of remnant tallgrass prairie,



Wildflowers at the NWTC. Photo by Warren Gretz, NREL 05303

and a rocky outcropping supporting ponderosa pine and shrublands.

To maintain the existing native vegetation and to ensure the success of revegetated areas, the laboratory has developed sustainable landscape management practices that:

- Provide supplemental water during seedling growth and establishment, and minimize water use thereafter
- Reduce the need for and use of pesticides and fertilizers
- Reduce maintenance costs
- Maximize ground cover to reduce soil erosion
- Establish a variety of habitats to support diverse wildlife
- Create an aesthetically pleasing landscape environment.

Where removal of native vegetation cannot be avoided, reseeding is done using grass and forb seed mixes native to the local area. A palette of native flowering plants, shrubs, and trees has been identified for use on both the STM and NWTC campuses to enhance ecosystem diversity and integrity. NREL staff continually evaluates and modifies revegetation techniques as needed to promote healthy plant establishment.

During construction of the Research Support Facility, NREL participated in the Sustainable Sites Initiative two-year pilot program, which was established by the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center at the University of Texas at Austin, the United States Botanic Garden, and a diverse group of other stakeholders. While a green-building rating system (i.e., Leadership in Energy and Environmental



Native grass and natural landscape materials provide food and shelter for NREL wildlife. *Photo by Michelle Slovensky, NREL 27577*

Design (LEED) certification) for new and existing buildings currently exists, there is no similar rating system for landscaped environments. The purpose of the Sustainable Sites Initiative program is to develop the first national rating system for sustainable landscapes. NREL received a rating of three out of four stars for the development of our Sustainable Sites Initiative pilot program, the implementation of which is ongoing.

NREL uses an integrated weed management approach that incorporates various types of weed control methods including mechanical practices (e.g., mowing or hand pulling), cultural (e.g., reclamation of disturbed areas), prevention (e.g., limiting or eliminating driving of vehicles off established roadways), and herbicide treatment. The effectiveness of control methods is periodically assessed. The use of multiple strategies for control has been successful in significantly reducing populations of diffuse knapweed (*Centaurea diffusa*) and Canada thistle (*Cirsium arvense*). The weed control program maintains the flexibility needed to respond to changes in weed populations from year to year. Periodic mapping of weed infestation areas assists in targeting weed control efforts.

The laboratory continues to address the control of these species using the integrated weed management approach described above. Comprehensive sitewide weed surveys and mapping are performed approximately every 5 years; smaller areas of both campuses are assessed annually. A list of noxious weed species identified at the STM and the NWTC is found in Table 7.

TABLE 7. NOXIOUS WEED SPECIES IDENTIFIED AT THE STM AND THE NWTC

Noxious Weed Class	Species Present at STM	Species Present at NWTC
Class A:	Myrtle spurge	None
Class B:	Canada thistle Common teasel Dalmation toadflax Diffuse knapweed Hoary cress (whitetop) Hound's tongue Musk thistle Russian olive Scotch thistle	Canada thistle Chicory Dalmation toadflax Diffuse knapweed Hoary cress (whitetop) Leafy spurge Musk thistle Sulfur cinquefoil
Class C:	Field bindweed Cheatgrass	Field bindweed Cheatgrass

For information on rare and imperiled plant species, see section 10.2, Endangered Species and Species of Concern.

2014 Compliance Summary and Activities

- Program activities were in compliance with requirements.
- In June, a representative from the Colorado Department of Agriculture was invited to tour the area near the historical ammunition bunker on the STM campus to advise on methods to eliminate the A-listed noxious weed, myrtle spurge. It was recommended that hand pulling of the remaining sprigs would be an effective method in the late summer. This was completed in August.
- At the NWTC campus, herbicides were applied to control B- and C-listed weeds to approximately 60 acres in April, 17 acres in June, and 40 acres in August.
- At the STM campus, herbicides were applied to control B- and C-listed weeds to approximately 27 acres in May, 13 acres in June, and 4 acres in October.



Worker uses a backpack sprayer to spot-spray noxious weeds at NWTC. This method, although labor intensive, targets only the appropriate plants and uses only the minimum amount of herbicide. Photo by Tom Ryon, NREL 32775

10.4 WETLANDS AND FLOODPLAINS

Floodplains are land areas adjacent to rivers and streams that are subject to recurring inundation. Wetlands are lands that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support distinct soil types and plant communities. Wetland areas typically take the form of swamps, marshes, bogs, and groundwater seeps and are frequently located within or adjacent to a floodplain.

Both wetlands and floodplains play a key role in providing floodwater storage, reducing flood flow rate and filtering floodwater. The resulting enriched floodplain soils promote the growth of wetland and riparian vegetation that provide habitat for a rich diversity of terrestrial and aquatic plants and animals. NREL preserves the important natural functions of its wetlands and floodplains, thereby protecting the physical, biological, and chemical integrity of receiving waters and riparian areas on and adjacent to the STM and NWTC campuses.

Requirements

Wetlands became regulated in 1972 when, under the Clean Water Act, the definition of *waters of the United States* was expanded to include tributaries to navigable waters, interstate wetlands, wetlands that could affect interstate or foreign commerce, and wetlands adjacent to other *waters of the United States*. Wetlands that fit within the definition and that meet certain soils, vegetation, and hydrologic criteria are federally protected under programs administered by the U.S. Army Corps of Engineers, with

2014 Accomplishments and Highlights

- Qualified laboratory staff reviewed wetland vegetation (see Appendix A) and wetland mapping for both the STM and NWTC campuses.
- A seasonal pond at the NWTC campus was delineated as a wetland. This area captures precipitation primarily during the spring and summer, allowing a new community of wetland plants to emerge.

program oversight provided by the EPA. These regulated wetlands are known as jurisdictional wetlands. Areas that do not meet the criteria above are not protected or regulated but still perform wetland functions and act as valuable ecologic components.

Wetland areas identified at the STM and NWTC campuses are managed as a valuable natural resource and in a manner consistent with the Clean Water Act as well as EO 11990, *Protection of Wetlands*, which requires that federal agencies minimize the destruction, loss, or degradation of wetlands; follow DOE policy to carry out the requirements of EO 11990; and preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities.

Counties regulate floodplains by mapping the 100-year floodplain boundaries within their jurisdiction in coordination with the Federal Emergency Management Agency and then develop regulations that control the type and amount of development within those areas. Federal facilities must further manage their impacts on floodplains per the requirements identified in EO 11988, *Floodplain Management*. This executive order requires federal agencies to minimize the impact of floods on human safety, health and welfare, and restore and preserve the natural and beneficial values served by floodplains.

NREL campuses and facilities do not fall within a 100-year floodplain.

Program Management

NREL protects its wetlands and floodplains through several means:

- Periodic vegetation surveys and wetland delineations
- Mapping of wetland areas potentially affected by proposed construction



Seasonal wetlands appear annually following spring snow melt and rain. These shallow depressions are found on the STM mesa top in various locations and are important habitat for insects and amphibians, especially Woodhouse's toad (*Bufo woodhousii*).
Photo by Tom Ryon, NREL 33063

- Identification of potential impacts
- Coordination with other jurisdictions on the control of floodwaters leaving NREL's STM and NWTC campuses.

At the STM campus, the U.S. Army Corps of Engineers issued a jurisdictional determination stating that all drainages examined are considered upland swales and consequently are currently not regulated.

Non-jurisdictional functional wetlands are considered valuable features, and the laboratory seeks to preserve these. Some wetlands have been delineated at the NWTC campus. While jurisdiction determinations have not been received from the U.S. Army Corps of Engineers, a request for a jurisdictional determination or other guidance will be submitted if activities that disturb these areas are proposed.

2014 Compliance Summary and Activities

- Program activities were in compliance with regulations.
- No NREL projects or activities that could impact wetlands or floodplains occurred in 2014.

10.5 CULTURAL RESOURCES

Cultural resources are defined as any prehistoric or historic district, site, building, structure, or object considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons.

Cultural resources can be divided into three major categories:

- Prehistoric and historic archaeological resources
- Architectural resources
- Traditional cultural resources.

Prehistoric and historic archaeological resources are locations where human activity measurably altered the earth or left deposits of physical remains, such as arrowheads, pottery, and tools. Prehistoric resources that predate the advent of written records in a region range from a scatter composed of a few artifacts to village sites and rock art. Historic resources may include campsites, roads, fences, trails, dumps, battlegrounds, mines, and a variety of other features.

Architectural resources include standing buildings, dams, canals, bridges, and other structures of historic or aesthetic significance. Architectural resources generally must be more than 50 years old to be considered for protection under existing cultural resource laws. However, more recent structures, such as Cold War facilities, may warrant protection if they manifest the potential to gain significance in the future.

A traditional cultural resource can be defined as a property that is eligible for inclusion in the National Register of Historic Places because of its association with cultural practices or beliefs of a living community that are rooted in the community's history, and its importance in maintaining the continuing cultural identity of the community. Traditional resources may include archaeological resources, buildings, neighborhoods, prominent topographic features, habitats, plants, animals, and traditional culture.

The STM campus has had a long history as a location with a variety of human uses. In 1903, the Colorado National Guard established the State Rifle Range at a location 3 miles (4.8 km) east of Golden, Colorado. The site, designated as "Camp George West" in 1934 in honor of Civil War veteran and Golden business man George West, became an integral part of Colorado National Guard activities throughout the first half of the 1900s. By the 1920s, the camp totaled 750 acres (303 hectares) and many buildings were added throughout the 1930s and 1940s.

During World War II, much of Camp George West was leased to the federal government for military training purposes. From the 1930s to the 1970s, several state entities took up residence at Camp George West, including the Colorado State Highway Patrol, the Colorado Law Enforcement Training Academy, and the Colorado Correctional Center. In 1981, more than 300 acres (121 hectares) were transferred to the federal government for solar energy research purposes, which would become NREL's main campus. An additional 25 acres (10.1 hectares) were transferred to DOE in 2003. Today, the STM campus totals 327 acres (132 hectares).



Aerial photo of Camp George West in the 1930's. The STM campus was a part of the Camp George West parcel at its largest extent of about 700 acres. Used with permission from the Denver Public Library

2014 Accomplishments and Highlights

The State Historic Preservation Office provided positive feedback to DOE and NREL for the Camp George West informational display that was constructed to mitigate impacts of the STM south access road. The State Historic Preservation Officer stated, *"The quality and content of the interpretative panel is commendable and we hope that this feature enhances the visitor experience to the Camp George West Historic District."*

The NWTC campus was established in the 1970s, so all current NWTC structures and buildings have been constructed since then. Consequently, none of the current structures or buildings have reached the 50-year threshold required for listing consideration by the National Register of Historic Places, nor have they been determined to be of exceptional importance for earlier consideration.

Requirements

Cultural resources are protected under the National Historic Preservation Act of 1966. Federal agencies must establish preservation programs commensurate with their mission and the effects of their activities on historic properties that provide for the careful consideration of historic properties. Significant cultural resources are either eligible for, or listed in, the National Register of Historic Places.

Program Management

Cultural resources are protected at NREL in several ways:

- Integrating cultural resource management into site activities and minimizing and/or mitigating impacts to historic properties and features.
- Implementing procedures to manage historic features and to protect undiscovered cultural resources and artifacts.
- Periodically conducting surveys to document presence or absence of cultural or historic resources while considering project impacts to the human environment. When surveys reveal artifacts, staff works with the Colorado Office of Archaeology and Historic Preservation to determine if the artifacts are eligible for consideration as cultural or historic resources.
- Requiring construction contractors to provide workers with site orientation training that includes guidance on what to do in the event they discover any evidence of cultural resources during ground-disturbing activities. Workers are to stop all work in the vicinity until a qualified archaeologist evaluates the significance of the find.

Several formal surveys of historic and cultural resources have been performed on the STM campus. As a result, three historical sites were recognized as significant cultural resources that should be preserved. These resources include:

- An open-air amphitheater
- A stone bridge spanning a natural drainage channel adjacent to the amphitheater
- A stone and concrete ammunition bunker below the amphitheater.

The three structures were constructed in 1930s and early 1940s during the Works Progress Administration era. Through NREL's efforts, these structures have been added to the National Register, with the amphitheater and stone footbridge listed together as a single resource. Additionally, a portion of STM campus south of Denver West Parkway lies within the 98-acre Camp George West Historic District.

An archeological survey of the NWTC campus was conducted in support of the 1996 environmental assessment to supplement previous surveys so no gaps in cultural surveys occurred. No significant historical or archeological resources were identified.

2014 Compliance Summary and Activities

- DOE completed National Historic Preservation Act consultations for the completion of the STM Site-Wide Environmental Assessment. The primary concern involved indirect visual impacts to the amphitheater and ammunition bunker from proposed new development near and within the viewshed of these resources. The State Historic Preservation Officer and DOE agreed that the best approach would conduct future consultations on a project-by-project basis when individual components of the proposed action are funded or authorized.
- DOE submitted the Memorandum of Agreement Summary Report, thereby completing DOE and NREL responsibilities per the 2011 Memorandum of Agreement for mitigation of impacts to the Camp Goerge firing lines from construction of the south access road to the STM campus.



Remnants of a stone bridge located on the STM campus.
Photo by Kurt Schlomberg, NREL 33061



11

CONSERVATION EASEMENT LANDS

In 1999, DOE granted a conservation easement for 177 acres (72 hectares) of the STM campus to Jefferson County. The purpose of the easement is to preserve the natural character of the property, including its visual, biological, and recreational resources.

The goals of the easement are to:

- Retain, preserve, and protect the natural, scenic, ecological, and historical aspects of the conservation easement property
- Protect the ecosystem and sustainable habitat for diverse vegetation and wildlife
- Ensure the scenic and biological integration with adjoining open-space land
- Prevent further industrial, commercial, or residential development of the conservation easement property
- Preserve the conservation easement property as natural open space.

Local policies established by Jefferson County, Golden, and Lakewood reflect community sensitivity with respect to the visual qualities provided by natural resources in the area around the STM campus. Specifically, the Jefferson County General Land Use Plan characterizes North and South Table Mountain as “unique landscapes,” and states that “maintaining landscapes that have a unique visual quality” is key to maintaining the quality of life in Jefferson County.

Figure 7 illustrates the location of the conservation easement at the STM campus. Vegetation within the easement area includes grasslands interspersed with shrubland communities, primarily in the drainages. Several seeps also occur throughout the area.

Grasslands in the conservation easement at the STM campus. Photo by Kurt Schlomberg, NREL 33062

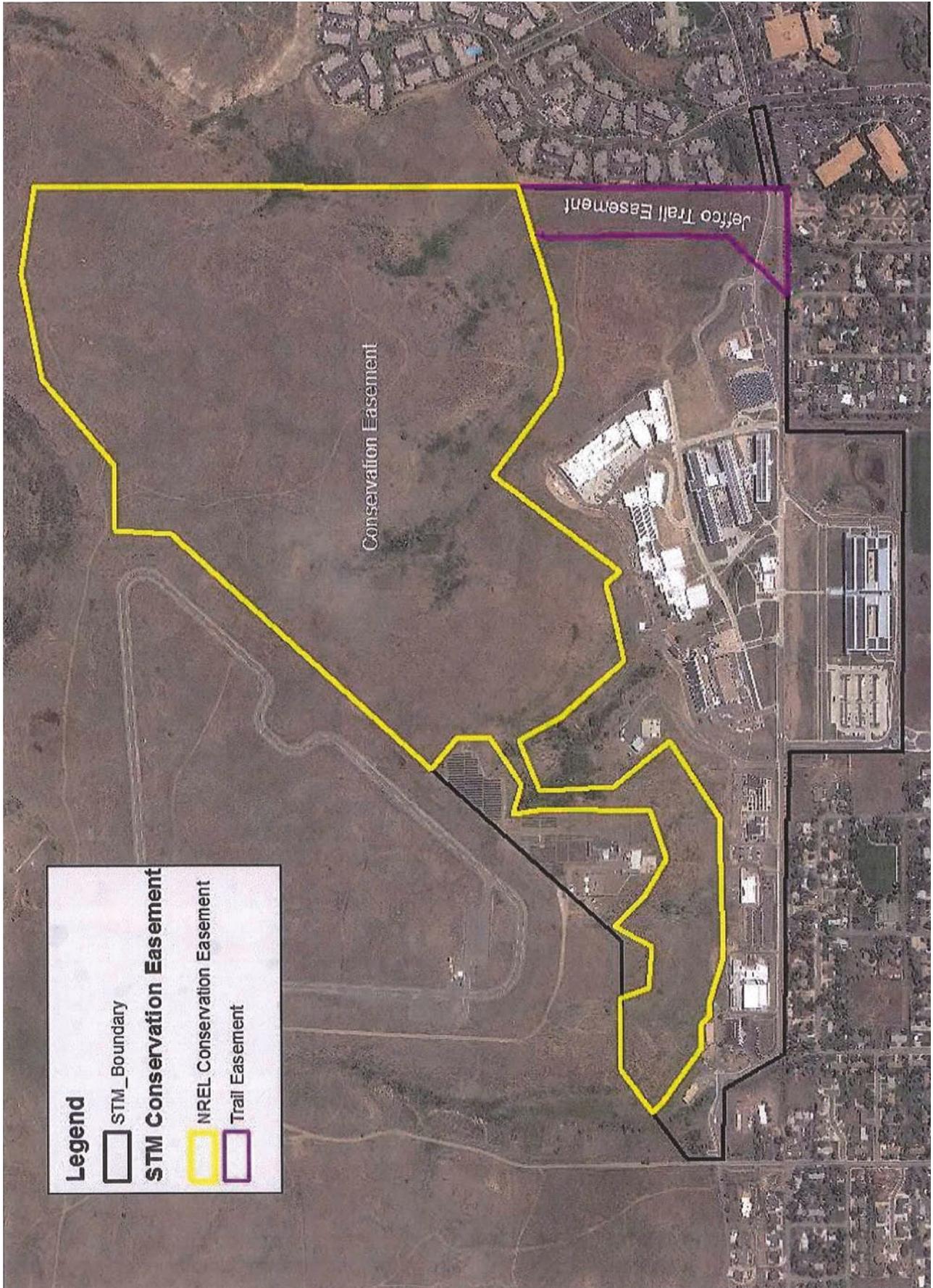


Figure 7. Conservation Easement at the STM Campus.

A baseline inventory of the property was prepared in June 1999 to document the current condition of the easement property and to assess the conservation value of the property.⁴ The baseline inventory includes a description of the geographical setting and adjacent property owners, access and use of the property by the public, and a description of the existing environmental conditions of the property (including geology, hydrology, vegetation, wildlife, and cultural resources).

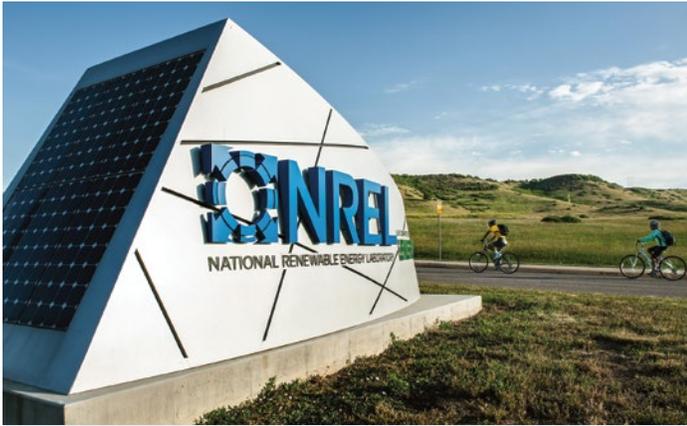
Jefferson County Open Space maintains formal trails on the conservation easement property. Two trails cross the easement, connecting Denver West Parkway (near the NREL east campus entrance) to the trails on the mesa top. NREL staff and the public use these trails frequently.

2014 Compliance Summary and Activities

- During 2014, NREL conducted a visual inspection of the conservation easement. Potential improvements to the management of the easement were noted, including addressing social trails, erosion, and weed control.

- There was no NREL activity on the conservation easement property having the potential to degrade the environmental condition of the property.
- A representative from Jefferson County Open Space conducted the annual assessment of the conservation easement. The resulting Conservation Easement Monitoring Report highlighted the significant natural features of the parcel, including wildlife habitat and unique landforms, as well as the passive recreational amenities provided by the public trails that cross the area. No significant changes to the land use and condition were observed from baseline observations.
- Signs were posted along the conservation easement boundary to deter unauthorized access to restricted DOE property. These signs also serve to protect the native grassland ecosystem located within the easement.

⁴U.S. Department of Energy, Golden Field Office (1999). National Renewable Energy Laboratory (NREL) Site Conservation Easement Baseline Inventory. Golden, Colorado.



12

TRAFFIC MANAGEMENT

The STM campus is the destination of hundreds of commuter vehicles daily, as well as visitor and delivery traffic entering and leaving the site. Traffic management for the site is important for minimizing negative impacts to traffic flow on Denver West Parkway and in nearby neighborhoods and business areas. Reducing traffic also reduces noise and light pollution, vehicle emissions, fuel use, parking requirements, and road maintenance costs.

Requirements

In 2008, as part of a National Environmental Policy Act assessment for the construction of additional buildings on the STM campus and the moving of additional employees to the campus from off-site leased locations,

2014 Accomplishments and Highlights

- NREL's April 2014 lab-wide commuter survey (see Table 8) indicates a positive trend in commuting habits with a 16% decrease of commuters who drive to work alone and an increase in hybrid, electric, and alternative fueled vehicles since 2007. Both public transit use and telecommuting have increased by 8% since 2007. The survey, administered every three years, provides a snapshot of commuter behaviors and guides the development and implementation of NREL's commuting program and infrastructure to reduce greenhouse gas emissions and other environmental impacts from employee commuting.
- NREL 2014 traffic monitoring indicated NREL-generated traffic volumes and inter section level of service remained within acceptable levels.

NREL employees opted for bicycles instead of their cars on the 2014 Bike-to-Work Day. *Photo by Dennis Schroeder, NREL 30467*

TABLE 8. NREL LAB-WIDE COMMUTER SURVEY RESULTS, 2007–2014

Mode	2007 Survey Responses	2011 Survey Responses	2014 Survey Responses	% Change from 2007
Drive Alone	81%	73%	65%	-16%
Walk	2%	1%	0%	-2%
Bicycle	3%	4%	4%	1%
Carpool	6%	7%	5%	-1%
Vanpool	6%	1%	2%	2%
Transit	6%	7%	14%	8%
Motorcycle/Scooter	N/A*	2%	1%	-1%
Telework	1%	5%	9%	8%

N/A* Motorcycle/Scooter included in Drive Alone in 2007



Strong winds and blowing snow can wreak havoc on area roads. NREL employees utilize alternative modes of commuting to decrease single-car ridership through vanpools, RideShare Connections, and RTD Ecopasses. *Photo by David Parsons, NREL 06915*

a traffic Mitigation Action Plan was prepared to ensure that traffic impacts would not become significant. This plan established periodic monitoring at affected intersections, the development of traffic thresholds, and actions to be taken to reduce the traffic volumes. These measures have been incorporated in the laboratory’s traffic management program described below.

Periodic traffic monitoring at the STM campus provides information regarding total traffic volumes and peak-hour vehicle trips. Baseline traffic levels were established in 2008 prior to moving increased numbers of staff into newly constructed buildings at the STM campus. Since 2008, traffic has been monitored to measure changes in traffic volumes to better inform traffic management.

Intersection traffic analysis, referred to as Level of Service analysis, has also periodically been performed to measure

the impacts of NREL-generated traffic volumes on traffic flow at the nearby intersections of Denver West Parkway and Denver West Marriott Boulevard, as well as at Quaker Street and South Golden Road. The analysis is conducted to confirm that traffic flow at the intersections adjacent to the STM campus has not degraded to an unacceptable level. Level of Service is a measure of traffic flow based on the average delay per vehicle trips at an intersection. Typically, a Level of Service of “D” or better indicates acceptable conditions at an intersection. From its traffic analyses, NREL has developed specific traffic thresholds for NREL-generated traffic volumes at the nearby intersections. Monitoring will continue to be conducted on an as-needed basis.

Program Management

NREL has implemented an active transportation demand-management program to reduce traffic impacts on the surrounding community and to reduce petroleum fuel use and greenhouse gas emissions by promoting alternative modes of transportation. Program activities include encouraging and supporting alternative modes of commuting, flexible workplace practices, telecommuting, teleconferencing, and periodic traffic monitoring. These activities are described below.

Alternative Modes of Commuting

- EcoPasses provided to employees encourage use of the Regional Transportation District (RTD) public transportation system. This includes unlimited RTD regional, express, local, light rail, and Call-n-Ride services.
- Shuttle routes provide connections between NREL facilities in Golden and RTD transit stations in Lakewood and Wheat Ridge.
- Incentive parking is provided for vanpools and carpools at the STM campus and at the Denver West Office Park.
- Vanpool incentives are available for participants who commute in formal organized vanpools.
- Bike racks, bike lockers, and bicycle maintenance stations are in key locations on the STM campus. Bike racks on shuttle vehicles permit staff to take their bikes with them when they commute or move between buildings.
- RideShare Connections, an intranet site, allows staff to post and search listings for potential carpool and vanpool partners within NREL.
- Literature kiosks in key building locations provide shuttle and RTD schedules, bicycle maps, and telecommuting information.



A flex fuel E-85 shuttle used on NREL's STM campus allows staff to take their bikes with them when they commute or move between buildings. Photo by Dennis Schroeder, NREL 32218

- Information-sharing events promote safe bicycling, rideshare (e.g., carpool and vanpool), and RTD services.

Flexible Workplace Practices

Conferencing by video, telephone, and the internet as well as alternating work schedules provide flexibility in how people work, saving staff time, energy, and money. An alternating work schedule policy allows employees to work varying schedules, with management approval, and reduces the miles driven by employees to and from the laboratory.

Telecommuting

Telecommuting allows staff, with management approval, to work from home at least one day per week or occasionally, as needed, reducing the days they commute to the lab. Laboratory-wide employee surveys have confirmed that adoption of this program has been very strong.

Teleconferencing

The laboratory promotes and encourages the use of teleconferencing and videoconferencing for meetings to decrease local vehicle trips and air travel.

2014 Compliance Summary and Activities

- Active transportation demand management activities were continued in 2014.
- In 2014, the average afternoon (4:30 p.m. to 5:30 p.m.) peak-hour traffic volume measured at the intersection of Denver West Parkway and Denver West Marriott Boulevard was 342 vehicle trips per hour. This traffic volume remained below the threshold to ensure a Level of Service "D" or better (equivalent to 522 vehicle trips per hour) entering or leaving the site during the afternoon rush hour.

Detailed Traffic Metrics and Results

Previously conducted traffic studies indicated that the greatest impact to traffic in the local area from NREL STM activities occurs between 4:30 p.m. and 5:30 p.m. This hour has been designated the PM peak hour.

PM peak-hour video traffic surveillance was conducted in 2014 over three, 3-week periods during May, August, and December at the STM east entrance (intersection of Denver West Parkway and Denver West Marriott Boulevard), west entrance (intersection of Quaker Street and South Golden Road), and the south entrance (at South Golden Road and Research Road). Table 9 shows the traffic count results at these three locations.

Traffic counts were evaluated at the east and west entrances. At the east entrance, traffic counts were compared against the threshold, which identifies the acceptable number of vehicle trips NREL can contribute to the intersection of Denver West Parkway and Denver West Marriott Boulevard without causing significant degradation to flow. The applicable traffic volume threshold identified at this location is 522 vehicle trips in the PM peak hour (from 4:30 p.m. to 5:30 p.m.). In 2014, the PM-peak-hour traffic volume averaged 342 vehicle trips, thus remaining below the NREL-established threshold.

At the west entrance, NREL has identified a traffic threshold of 36 vehicle trips in the PM peak hour. In 2014, the PM-peak-hour traffic volume average remained below the threshold at 14 vehicle trips.

As the south entrance was not constructed at the time of the original traffic analysis, 2014 traffic count data cannot be compared to a vehicle trip number threshold.

TABLE 9. 2014 TRAFFIC COUNTS AND COMPARISON WITH THRESHOLD VALUES

Gate (Affected Intersection)	PM Peak-Hour Vehicles (in- and out-bound)				
	May-14	Aug-14	Dec-14	Average	Threshold
East Entrance (Denver West Parkway/Denver West Marriott Blvd.)	349	319	358	342	522
West Entrance (Quaker St./South Golden Road)	17	14	10	14	36
South Entrance (South Golden Road/Research Rd.)	205	178	169	184	N/A

APPENDIX A:

PLANT COMMUNITIES AT THE STM AND THE NWTC

Vegetation surveys are periodically completed for the STM and NWTC campuses, with the most recent survey occurring in 2011. Plant communities and species were identified for each campus at that time, and changes from similar surveys completed in 2000 are noted below.

STM Plant Communities

The majority of vegetation at the STM campus belongs to the grassland community type. Within that association, there are two distinct community types: short grassland on the mesa top and mixed grassland located on the slopes and toe area. Other mapped vegetation communities at the STM campus include ravine shrubland, tall shrubland, short shrubland, and wetlands. The plant communities are described below and mapped as illustrated in Figure 8.

Short Grassland

Short grassland is found on the flat top of the mesa. The dominant grass species are blue grama (*Chondrosium gracile*), a native prairie species, and cheatgrass (*Anisantha tectorum*), a noxious weed. Populations of diffuse knapweed (*Acosta diffusa*) and Dalmatian toadflax (*Linaria genistifolia subsp. dalmatica*) are scattered throughout the whole community. These two noxious weeds comprise approximately 1% of the short grassland.

Alyssum (*Alyssum parviflorum*), an introduced species, is the dominant forb. Several species of prickly pear cactus (*Opuntia fragilis*, *O. macrorhiza*, *O. phaeacantha*, and *O. polyacantha*) occur throughout the short grassland on the mesa top, as well as hen-and-chicks (*Echinocereus viridiflorus*) and pincushion cacti (*Coryphantha missouriensis* and *C. vivipara* var. *vivipara*). Well-draining hillocks often support thick stands of needle-and-thread grass (*Hesperostipa comata*) and yucca (*Yucca glauca*). Some short shrubs such as rubber rabbitbrush (*Chrysothamnus nauseosus subsp.*), chokecherry (*Padus virginiana*), and

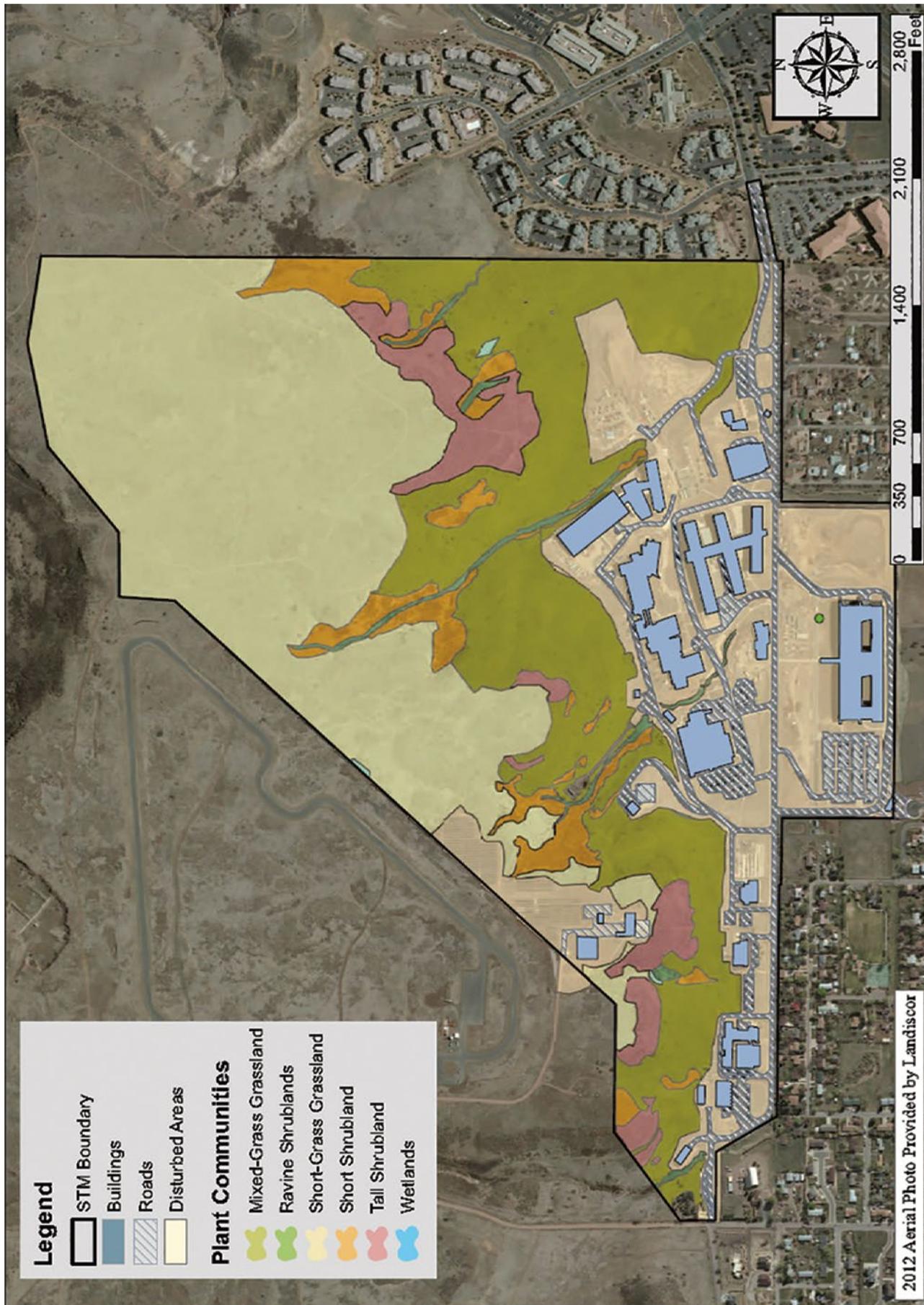


Figure 8. STM land cover types surveyed in 2011. Note: map was updated in 2012 to reflect campus building changes.

skunkbrush (*Rhus aromatica* subsp. *trilobata*) occur infrequently in the short grassland area and concentrate along the rimrock areas. Several large hackberry trees (*Celtis reticulata*) are clustered at the very edge of the mesa top.

Historically, this short grassland was probably dominated by blue grama grass and other short-grass species such as buffalo grass (*Buchloë dactyloides*), intermixed with the other species associations described above. However, the entire mesa-top area has become dominated by cheatgrass, an aggressive noxious weed. This weed is changing the appearance and general species composition of the area by apparently out-competing native plants.

Mixed Grassland

The mesa slopes and toe areas on the STM campus also support blue grama and cheatgrass, but are dominated by a mixed-grass species association of needle-and-thread grass and western wheatgrass (*Pascopyrum smithii*), with smaller amounts of big bluestem (*Andropogon gerardii*), sideoats grama (*Bouteloua curtipendula*), three-awn (*Aristida purpurea*), and green needlegrass (*Nassella viridula*). As in the short grassland areas, a large number of forbs also occur in the mixed grasslands.

A few patches of anomalous vegetation occur within the mixed grasslands where subsurface water appears to be close to the surface. These areas support wide swaths of mat muhly (*Muhlenbergia richardsonis*). One is located on a southern-facing slope, near the eastern property boundary. The other is located on a southwestern-facing slope of the ravine north of the NREL Education Center, formerly known as the Visitors Center. This area is notable for a large population of poison ivy (*Toxicodendron rydbergii*), which grows in thickets of tall (one meter and larger) plants that have a woody, shrub-like growth form. A small number of plains cottonwood (*Populus deltoides*) saplings, skunkbrush, chokecherry, and snowberry occurs in this patch as well.

The mixed-grass areas grade into both the upland and ravine shrublands and contribute the majority of the understory in these areas. Some mixed-grass areas also blend into disturbed areas, where reclamation species such as crested wheatgrass (*Agropyron cristatum*) and smooth brome have been planted and have subsequently spread into the mixed-grass community.

Upland ShrUBLANDS

Shrubland habitat occurs along the upper sides of ravines and on the steeper mesa slopes, becoming more prominent as elevation increases up to the top of the mesa. The upland shrubland habitat, which excludes the shrublands

in the ravine bottoms, comprises tall shrubland and short shrubland communities very similar in overall composition but distinguished by the dominant species.

Tall Shrubland

The tall shrubland areas are defined by stands of mountain mahogany (*Cercocarpus montanus*) that occur along the rim of the mesa, usually where volcanic cap rock is exposed, and on the upper mesa slopes below rimrock areas. The understory is notably sparse throughout this community, with a large amount of bare soil. Cheatgrass is the most common herbaceous species in these areas, intermixed with needle-and-thread grass, yucca, and many cacti.

Short Shrubland

The short shrublands occur on elevated flat areas amidst the surrounding grasslands, some of which appear to have experienced surficial disturbance in the past. These areas are distinctive because of the dominance of rubber rabbitbrush. The other common location for short shrublands is on the outer slopes of the ravines. Skunkbrush defines these and other short shrublands along the upper portions of the steepest slopes of the mesa. These communities usually grade into the ravine shrublands along the drainage bottoms and the tall shrublands near the top of the mesa slopes. The short shrubland community also has a sparse understory of the same grasses and forbs as the tall-shrub community.

Ravine Shrublands

Ravine shrublands are limited to the lower sides and bottoms of the drainages that cut down through the mesa slopes. These communities support a variety of shrubs such as skunkbrush, chokecherry, and wild plum (*Prunus americana*), often growing in dense, impassible thickets. A few plains cottonwoods and peachleaf willow (*Salix amygdaloides*) trees occur at the top of the ravine channels and in other portions of the channel where the subsurface water table appears to be relatively high. A diverse herbaceous component is found in these drainages. In one instance near the southeast campus boundary, a ravine shrubland grades into an ephemeral drainage at the toe of the mesa. This drainage is vegetated with grassland species and conducts only occasional surface water runoff.

Wetlands

Five very small communities on the STM campus were found to support wetland vegetation. These communities were not examined for the soils and hydrology that would classify them as functioning wetlands; rather, they

are noted only for their dominance of wetland vegetation. These are limited to very small areas (less than half an acre in total). One is in a shallow swale at the mouth of the ravine at the southwestern corner of the campus boundary where surface water and/or subsurface drainage have created a pocket of saturated soil. Species here include sedges (*Carex spp.*), rushes (*Juncus spp.*), bulrush (*Schoenoplectus spp.*), and peachleaf willow. The second wetland could have formed as a result of past construction activities. This linear depression supports wetland vegetation along the central portion of the western campus boundary, northeast of the photovoltaic array. Perhaps situated where equipment was once staged, this area appears to hold seasonal water for enough consecutive growing seasons to support some wetland vegetation including Arctic rush (*Juncus arcticus*), American speedwell (*Veronica americana*), and broadleaf cattail (*Typha latifolia*).

The wetland at the mouth of the ravine may no longer experience the hydrology that originally allowed these plants to establish there. In 2002, this plant community supported populations of cattails that were not observed in the 2011 survey.

Three small seeps are located on the hill slope between the Education Center and the public trail on the far eastern boundary of the campus. These seeps are dominated with sedges, rushes, and Canada thistle (*Cirsium arvensis*).

A seventh wetland community that was observed by Plantae⁵ no longer appears to support wetland vegetation. In 2002, cattail species near an old stock tank in the easternmost drainage appeared to have been supported by a pipe coming out of the hillside. Although the stock tank was observed in the 2011 survey, it appears the cattails have not persisted in the intervening years.

Disturbed/Reclaimed

This habitat type comprises all of the areas at the campus that have experienced surface disturbance to vegetation caused by human activities. These mostly occur on the perimeter of the buildings, roads, parking lots, and soil dumping areas. Most of these areas appear to have been re-vegetated and support a combination of native grassland plants, planted ornamental re-vegetation species, and native and introduced weeds.

NWTC Plant Communities

The majority of the vegetation at the NWTC campus belongs to the mixed-grass prairie association of the grassland formation. Mixed-grass prairie is defined by the

presence of grass species typical of the tallgrass or true prairie such as big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and prairie dropseed (*Sporobolus heterolepis*), with species more typical of the short-grass prairie such as blue grama (*Chondrosum gracile*) and buffalograss (*Buchlōe dactyloides*). Intermediate grasses (mid-grasses) such as the needle grasses (*Hesperostipa and Nassella spp.*), wheat grasses (*Pascopyron, Agropyron, Elytrigia, Elymus, and Thinopyrum spp.*), and blue grasses (*Poa spp.*) are also important constituents of mixed-grass prairie.

The grasslands at the NWTC fall into the xeric mixed-grassland community type identified and classified primarily on available soils and soil moisture, reflected in xeric mixed-grassland plant species assemblages.

A number of changes in vegetation patterns noted since the NWTC campus was previously mapped (Plantae 2000⁶) is discussed below by specific plant community.

The plant communities are described below and mapped as illustrated in Figure 9.

Xeric Mixed Grassland

Xeric mixed grassland is by far the largest and most widespread community type at the NWTC site. These areas do not have access to regular soil moisture (xeric conditions) and are dominated by typical short- and mixed-grass prairie species. This plant community includes a large variety of native grass species as well as a diverse forb component, typical of mixed grasslands. Dominant species noted include big bluestem, little bluestem, prairie dropseed, blue grama, and buffalo grass. Intermediate grasses (mid-grasses) such as the needle grasses, wheat grasses, and blue grasses are also important constituents of mixed-grass prairie. Species flowering in late spring include little bluestem, cheatgrass, sand lily (*Leucocrinum montanum*), wild iris (*Iris missouriensis*), Lambert locoweed (*Oxytropis lambertii*), mouse-ear (*Cerastium strictum*), western wallflower (*Erysimum capitatum*), and prairie golden pea (*Thermopsis rhombifolia*).

Wet Meadow

Three locations support wet meadows⁷ at the NWTC. One is south of the SunEdison solar array, the second is at the upper end of the Rock Creek tributary along Row 4, and the third is adjacent to the Building 251 east parking lot. A wet meadow is a type of grassland that transitions between mesic and hydric conditions (i.e., an transition area between upland grasslands and wetlands). These

^{5,6} Plantae Consulting Services (2000). Vegetation Survey, NREL National Wind Technology Center. Boulder, Colorado.

⁷ In the 2000 and 2011 surveys, wet meadows were identified as mesic mixed grassland. These areas were reclassified in 2012 as wet meadows due to an apparent change in vegetation and hydric conditions.

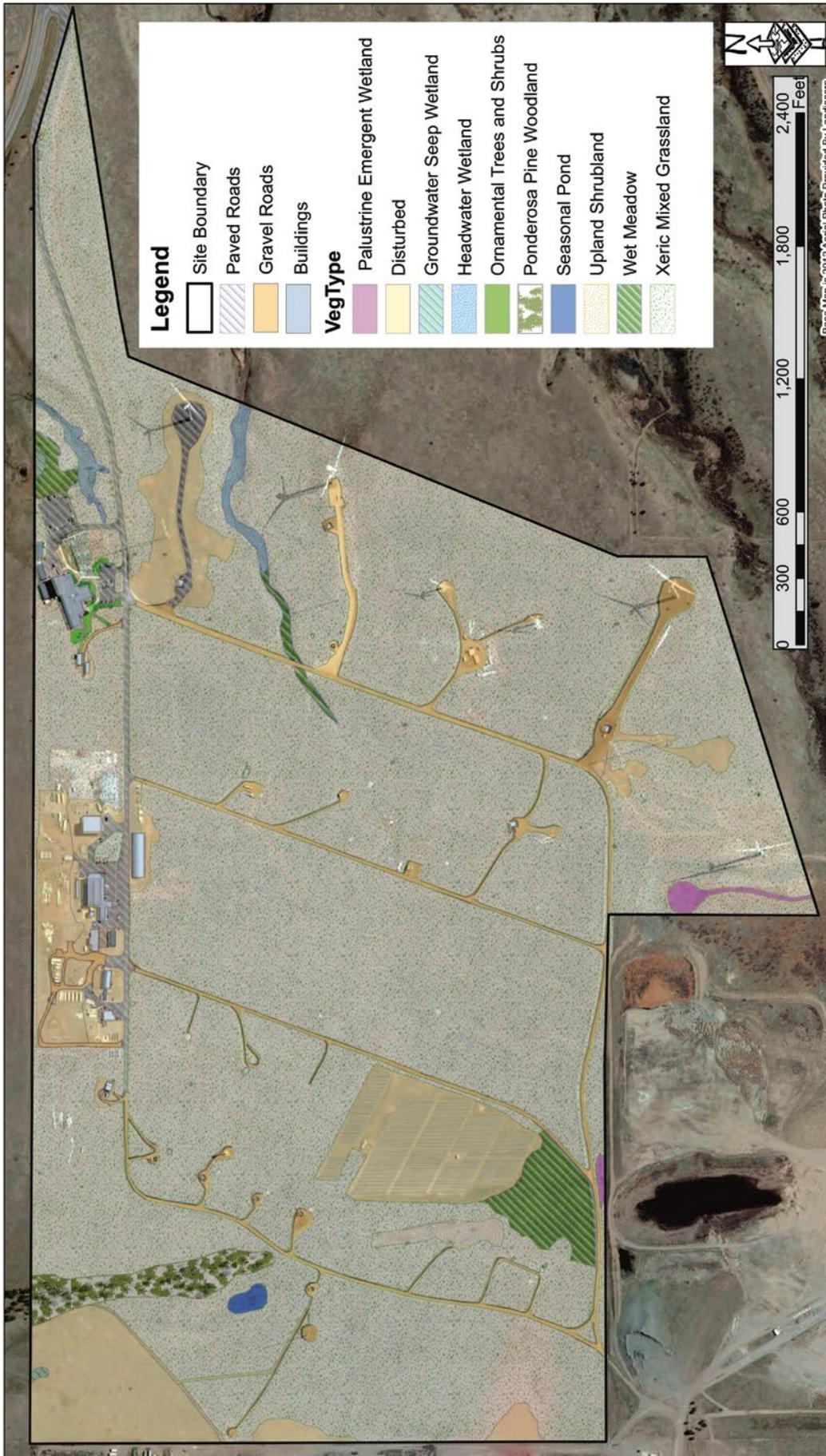


Figure 9. NWTC land cover types surveyed in 2012.

areas support Arctic rush, Canada bluegrass (*Poa compressa*), reedtop bentgrass (*Agrostis stolonifera*), Canada thistle, western wheatgrass, common three-square (*Schoenoplectus pungens*), showy milkweed (*Asclepias speciosa*), and wild iris (*Iris missouriensis*).

Ponderosa Pine Woodland

One woodland habitat, defined by a single community of the ponderosa pine (*Pinus ponderosa*) woodland, occurs in the northwestern corner of the campus along a granite outcrop. This small area supports a very diverse native plant community including common grassland and foothills species, as well as a number of introduced and noxious weeds. Dominant species include ponderosa pine (*Pinus ponderosa*), smooth brome grass, crested wheatgrass, and green needlegrass (*Nassella viridula*). Species flowering in late spring include sand lily, western snowberry (*Symphoricarpos occidentalis*), groundsel (*Senecio* sp.), and wax current (*Ribes cereum*).

Upland Shrubland

A small upland shrub community is located to the southeast of the ponderosa pine woodland, where the same ridge arises to a lesser degree from the surrounding grassland community. This rocky ridge supports shrub species interspersed with grasses and forbs representative of the surrounding grasslands. Dominant species noted include western snowberry, Canada wild rye (*Elymus canadensis*), Canada bluegrass, Kentucky bluegrass (*Poa pratense*), and little bluestem. Species flowering in late spring include prairie golden pea.

An isolated group of hawthorn (*Crataegus erthyropoda*) shrubs occurs along the western campus boundary, within the NWTC campus boundary. These trees are at the top of the slope and occur directly east of an active area of construction disturbance, which is outside the NWTC campus boundary.

Palustrine Emergent Wetland

Two wetlands on the campus fall into the palustrine emergent category. The first is a linear depression on the southern side of the south road. This area appears to have developed as the result of soil excavation intercepting sufficient surface water runoff from the adjacent road to support sedge species (*Carex* spp.). A second wetland is located on the southern boundary in an area previously disturbed from the neighboring industrial activities. This wetland comprises a center of cattails (*Typha angustifolia*) surrounded by a stand of coyote willow (*Salix exigua*).

Two palustrine emergent wetlands were mapped in the mesic mixed grassland in the 2000 growing season. These

areas appear to have dried considerably in the intervening 10 years. The small wetland pockets of cattails (*Typha* spp.) that occurred in the southern portions of this area are no longer present, apparently replaced by large stands of Canada thistle. Dead remnants of Baltic rush (*Juncus balticus*) can be found in the area litter (prior years' herbaceous vegetation). The dominant species noted was smooth brome grass.

Headwater Wetland

Areas of headwater wetland occur along the two ephemeral drainages on the NWTC campus. Both drainages occur in the northeastern portion of the campus, one flowing east and one flowing north. Both show evidence of intermittent surface flow. The northern-most drainage is a tributary of Coal Creek, and the second drainage is a tributary of Rock Creek.

Surface flow in the drainage to the northeast appears to be augmented by outflow from the groundwater seep wetland on the western bank. The second and larger drainage conducts surface flows through the center of the campus off to the eastern fence line. The upper reaches of this drainage are a shallow grassland swale. This channel deepens as it flows east across the campus. At its eastern reaches, this drainage clearly intercepts subsurface water, although not in sufficient quantities to produce consistent surface flow. At the point where this drainage leaves the NWTC campus, there is a human-constructed rock wall. Dominant species noted include Canada thistle, Baltic rush, curly dock (*Rumex crispus*), common evening primrose (*Oenothera villosa*), smooth brome grass, and western wheatgrass (*Pascopyrum smithii*).

Groundwater Seep Wetland

Two areas of groundwater seep wetland are located on the NWTC campus. The first occurs west of the ponderosa pine woodland, in the northwestern portion of the campus along the northern fence line. This area now includes more upland species than noted in 2000.

The second occurs over a very small area on the banks of the northern drainage. This community is a clearly demarcated area of primarily wetland plants amidst the surrounding grassland. Fifty plant species were identified in this community in 2000, many of which also occur in the headwater wetland to the south. Dominant species noted include sedges (*Carex* sp.) and rushes (*Juncus* sp.). Common teasel (*Dipsacus fullonum*) has invaded the northern drainage area. Species flowering in late spring include common teasel, showy milkweed (*Asclepias speciosa*), wild iris, field-mint (*Mentha arvensis*), and Canada thistle.

Seasonal Pond

A seasonal pond and pond margin occur at the northwestern corner of the campus, west of the southern terminus of the ponderosa pine woodland. This area appears to depend on an elevated spring and early summer water table for the hydric soil moisture conditions that support this community. Observers have noted that the pond depression often contains standing water in the spring and early summer in some years.⁸ However, no standing water was observed in this area during the most recent survey. These drier soil conditions are reflected in a shift of dominant plant species in this community between the 2000 and 2011 surveys. Dominant species noted include curly dock, Canada bluegrass, smooth brome grass, and Canada thistle.

Disturbed

These plant associations reflect surface disturbance due to human activities on the site. These areas include roadsides, pad sites, parking lot perimeters, construction sites, and storage areas. Some of these areas have been revegetated and now include a combination of species from surrounding natural plant communities, reclamation species, and adventive (non-native) or ruderal (native or adventive, disturbance colonizer) species. Dominant species noted include smooth brome grass and cheatgrass.

Ornamental Trees/Shrubs

Disturbed areas around buildings have been planted with a combination of native and ornamental trees and shrubs. The trees include multiple species of junipers (*Sabina spp.*) and pines (*Pinus spp.*) interspersed with ornamental deciduous trees. Shrubs in these areas are mainly chokecherry (*Padus virginiana*) and rose (*Rosa spp.*) bushes.

⁸Plantae Consulting Services (2000). Vegetation Survey, NREL National Wind Technology Center, Boulder, Colorado.

APPENDIX B:

WILDLIFE SPECIES OBSERVED AT THE STM AND THE NWTC

The following are lists of common and scientific names of wildlife species observed at the STM and NWTC campuses. The species for the NWTC were identified during surveys

completed in 2011. The species listed for STM were observed by staff and/or observed in surveys completed in 1987, 2005, and 2011.

TABLE 10. WILDLIFE SPECIES AT THE STM*

SPECIES COMMON NAME	SCIENTIFIC NAME	1987 Survey	2005 Survey	2011 Survey
BIRDS				
American crow	<i>Corvus brachyrhynchos</i>		X	X
American goldfinch	<i>Carduelis tristis</i>			X
American kestrel	<i>Falco sparverius</i>	X	X	X
American pipit	<i>Anthus rubescens</i>			X
American redstart	<i>Setophaga ruticilla</i>			X
American robin	<i>Turdus migratorius</i>	X	X	X
American tree sparrow	<i>Spizella arborea</i>		X	X
American white pelican	<i>Pelecanus erythrorhynchos</i>			X
Bald eagle**	<i>Haliaeetus leucocephalus</i>			
Barn swallow	<i>Hirundo rustica</i>			X
Black-billed magpie	<i>Pica hudsonia</i>	X	X	X
Black-capped chickadee	<i>Poecile atricapilla</i>		X	
Black-crowned night heron	<i>Nycticorax nycticorax</i>		X	
Black-headed grosbeak	<i>Pheucticus melanocephalus</i>			X
Blue-gray gnatcatcher	<i>Poliophtila caerulea</i>			X
Blue jay	<i>Cyanocitta cristata</i>		X	X
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	X		X
Brewer's sparrow	<i>Spizella breweri</i>			X
Broad-tailed hummingbird	<i>Selasphorus platycercus</i>			X
Broad-winged hawk	<i>Buteo platypterus</i>			X
Brown-headed cowbird	<i>Molothrus ater</i>	X	X	X
Bullock's oriole	<i>Icterus bullockii</i>		X	X
Bushtit	<i>Psaltriparus minimus</i>			X
California gull	<i>Larus californicus</i>		X	
Canada goose	<i>Branta canadensis</i>		X	X
Cedar waxwing	<i>Bombycilla cedrorum</i>			X
Cassin's kingbird	<i>Tyrannus vociferans</i>			X
Chestnut-collared longspur	<i>Calcarius ornatus</i>			X
Chipping sparrow	<i>Spizella passerina</i>			X
Cliff swallow	<i>Petrochelidon pyrrhonota</i>			X

TABLE 10. WILDLIFE SPECIES AT THE STM*

SPECIES COMMON NAME	SCIENTIFIC NAME	1987 Survey	2005 Survey	2011 Survey
BIRDS				
Common grackle	Quiscalus quiscula			X
Common nighthawk	Chordeiles minor	X	X	X
Common raven	Corvus corax		X	X
Common snipe	Gallinago delicata		X	
Cooper's hawk	Accipiter cooperii		X	X
Dark-eyed junco	Junco hyemalis		X	X
Double-crested cormorant	Phalacrocorax auritus			X
Eastern kingbird	Tyrannus tyrannus			X
Eurasian collared dove**	Streptopelia decaocto			
European starling	Sturnus vulgaris	X	X	X
Golden eagle	Aquila chrysaetos		X	
Grasshopper sparrow	Ammodramus savannarum			X
Great blue heron	Ardea herodias		X	X
Green-tailed towhee	Pipilo chlorurus			X
Hepatic tanager	Piranga flava			X
Hermit thrush	Catharus guttatus			X
Horned lark	Eremophila alpestris	X		X
House finch	Carpodacus mexicanus		X	X
House sparrow	Passer domesticus		X	X
House wren	Troglodytes aedon			X
Killdeer	Charadrius vociferous	X	X	X
Lark bunting	Calamospiza melanocorys	X	X	
Lark sparrow	Chondestes grammacus			X
Lazuli bunting	Passerina amoena			X
Lesser goldfinch	Carduelis psaltria			X
Loggerhead shrike	Lanius ludovicianus		X	
MacGillivray's warbler	Oporornis tolmiei		X	
Mallard	Anas platyrhynchos		X	
Mountain bluebird	Sialia currucoides	X	X	
Mountain chickadee	Poecile gambeli			X
Mourning dove	Zenaida macroura	X	X	
Northern flicker	Colaptes auratus	X	X	
Northern goshawk	Accipiter gentilis			X
Northern harrier	Circus cyaneus		X	
Osprey	Pandion haliaetus		X	
Peregrine falcon	Falco peregrinus			X
Pine siskin	Carduelis pinus			X
Prairie falcon	Falco mexicanus		X	
Red-breasted nuthatch	Sitta canadensis		X	
Red-tailed hawk	Buteo jamaicensis	X	X	
Red-winged blackbird	Agelaius phoeniceus	X		
Rock dove	Columba livia		X	
Rock wren	Salpinctes obsoletus		X	
Ruby-crowned kinglet	Regulus calendula			X
Sage thrasher	Oreoscoptes montanus			X
Say's phoebe	Sayornis saya		X	

Table 10 continued on page 90

TABLE 10. WILDLIFE SPECIES AT THE STM*

SPECIES COMMON NAME	SCIENTIFIC NAME	1987 Survey	2005 Survey	2011 Survey
BIRDS				
Sharp-shinned hawk	<i>Accipiter striatus</i>			X
Spotted towhee	<i>Pipilo maculatus</i>		X	
Swainson's hawk	<i>Buteo swainsoni</i>		X	
Tree swallow	<i>Tachycineta bicolor</i>		X	X
Turkey vulture	<i>Cathartes aura</i>		X	
Vesper sparrow	<i>Pooecetes gramineus</i>		X	
Virginia's warbler	<i>Oreothlypis virginiae</i>			X
Violet-green swallow	<i>Tachycineta thalassina</i>			X
Western kingbird	<i>Tyrannus verticalis</i>	X	X	
Western meadowlark	<i>Sturnella neglecta</i>	X	X	
Western scrub-jay	<i>Aphelocoma californica</i>		X	
White-crowned sparrow	<i>Zonotrichia leucophrys</i>		X	
White-faced ibis	<i>Plegadis chihi</i>			X
White-throated swift	<i>Aeronautes saxatalis</i>			X
Yellow-breasted chat	<i>Icteria virens</i>			X
Yellow-rumped warbler	<i>Dendroica coronata</i>			X
MAMMALS				
Black-tailed jackrabbit	<i>Lepus californicus</i>	X		X
Bushy-tailed woodrat	<i>Neotoma cinerea</i>	X		
Coyote	<i>Canis latrans</i>	X	X	X
Deer mouse	<i>Peromyscus maniculatus</i>	X		X
Elk**	<i>Cervus canadensis</i>			
Fox squirrel	<i>Sciurus niger</i>		X	
Long-tailed weasel	<i>Mustela frenata</i>		X	
Mexican woodrat	<i>Neotoma mexicana</i>		X	X
Mountain cottontail	<i>Sylvilagus nuttalli</i>	X	X	X
Mule deer	<i>Odocoileus hemionus</i>	X	X	X
Prairie vole	<i>Microtus ochrogaster</i>	X	X	
Raccoon	<i>Procyon lotor</i>	X	X	X
Red fox	<i>Vulpes vulpes</i>	X		X
Striped skunk	<i>Mephitis</i>			X
Western harvest mouse	<i>Reithrodontomys megalotis</i>	X	X	X
Western spotted skunk	<i>Spilogale gracilis</i>			X
White-tailed jackrabbit	<i>Lepus townsendii</i>		X	
Yellow-bellied marmot	<i>Marmota flaviventris</i>	X		
REPTILES AND AMPHIBIANS				
Bull snake	<i>Pituophis catenifer</i>	X		X
Plains garter snake	<i>Thamnophis radix</i>	X	X	
Prairie lizard	<i>Sceloporus undulatus</i>			X
Racer	<i>Coluber constrictor</i>			X
Six-lined racerunner	<i>Cnemidophorus sexlineatus</i>		X	
Tiger salamander	<i>Ambystoma tigrinum</i>		X	X
Western rattlesnake	<i>Crotalus viridis</i>	X	X	X
Woodhouse's toad	<i>Bufo woodhousii</i>			X

*No terrestrial arthropod genera of specific concern were detected during surveys in 2010.

**Species observed at a time other than in a survey.

TABLE 11. WILDLIFE SPECIES AT THE NWTC*

SPECIES COMMON NAME	SCIENTIFIC NAME	1996 Survey	2003 Survey	2011 Survey
BIRDS				
American crow	<i>Corvus brachyrhynchos</i>			X
American goldfinch	<i>Spinus tristis</i>		X	X
American kestrel	<i>Falco sparverius</i>	X	X	X
American pipit	<i>Anthus rubescens</i>			X
American robin	<i>Turdus migratorius</i>		X	X
American tree sparrow	<i>Spizella arborea</i>			X
Bald eagle	<i>Haliaeetus leucocephalus</i>			X
Barn swallow	<i>Hirundo rustica</i>		X	X
Black-billed magpie	<i>Pica hudsonia</i>		X	X
Black-capped chickadee	<i>Poecile atricapillus</i>		X	X
Blue-gray gnatcatcher	<i>Polioptila caerulea</i>		X	
Blue jay	<i>Cyanocitta cristata</i>			X
Brewer's blackbird	<i>Euphagus cyanocephalus</i>		X	X
Brewer's sparrow	<i>Spizella breweri</i>			X
Broad-tailed hummingbird	<i>Selasphorus platycercus</i>		X	X
Broad-winged hawk	<i>Buteo platypterus</i>	X		
Brown-headed cowbird	<i>Molothrus ater</i>		X	X
Bullock's oriole	<i>Icterus bullockii</i>			X
Canada goose	<i>Branta canadensis</i>			X
Cedar waxwing	<i>Bombycilla cedrorum</i>			X
Chipping sparrow	<i>Spizella passerina</i>		X	X
Cliff swallow	<i>Petrochelidon pyrrhonota</i>		X	
Common grackle	<i>Quiscalus quiscula</i>		X	X
Common nighthawk	<i>Chordeiles minor</i>		X	
Common raven	<i>Corvus corax</i>		X	X
Common snipe	<i>Gallinago delicata</i>			X
Cooper's hawk	<i>Accipiter cooperii</i>	X		
Dark-eyed junco	<i>Junco hyemalis</i>			X
Double-crested cormorant	<i>Phalacrocorax auritus</i>		X	
Downy woodpecker	<i>Picoides pubescens</i>			X
Eurasian collared-dove	<i>Streptopelia decaocto</i>			X
European starling	<i>Sturnus vulgaris</i>		X	X
Ferruginous hawk	<i>Buteo regalis</i>		X	X
Franklin's gull	<i>Larus pipixcan</i>			X
Golden eagle	<i>Aquila chrysaetos</i>	X	X	X
Grasshopper sparrow	<i>Ammodramus savannarum</i>		X	X
Gray catbird	<i>Dumetella carolinensis</i>			X
Great blue heron	<i>Ardea herodias</i>		X	X
Great horned owl	<i>Bubo virginianus</i>			X
Green-tailed towhee	<i>Pipilo chlorurus</i>		X	
Hairy woodpecker	<i>Picoides villosus</i>			X
Horned lark	<i>Eremophila alpestris</i>		X	X
House finch	<i>Carpodacus mexicanus</i>		X	X
Killdeer	<i>Charadrius vociferus</i>			X

Table 11 continued on page 92

TABLE 11. WILDLIFE SPECIES AT THE NWTC*

SPECIES COMMON NAME	SCIENTIFIC NAME	1996 Survey	2003 Survey	2011 Survey
BIRDS				
Lark bunting	Calamospiza melanocorys			X
Lark sparrow	Chondestes grammacus		X	
Loggerhead shrike	Lanius ludovicianus			X
Long-billed curlew	Numenius americanus			X
Mallard	Anas platyrhynchos		X	X
Merlin	Falco columbarius	X		
Mountain bluebird	Sialia currucoides		X	X
Mountain chickadee	Poecile gambeli			X
Mourning dove	Zenaida macroura		X	X
Northern flicker	Colaptes auratus		X	X
Northern goshawk	Accipiter gentilis	X		
Northern harrier	Circus cyaneus	X	X	X
Osprey	Pandion haliaetus	X		
Peregrine falcon	Falco peregrinus		X	X
Prairie falcon	Falco mexicanus	X	X	
Red-headed woodpecker	Melanerpes erythrocephalus			X
Red-tailed hawk	Buteo jamaicensis	X	X	X
Red-winged blackbird	Agelaius phoeniceus		X	X
Rough-legged hawk	Buteo lagopus	X	X	X
Ruby-crowned kinglet	Regulus calendula			X
Sandhill crane	Grus canadensis			X
Savannah sparrow	Passerculus sandwichensis			X
Say's phoebe	Sayornis saya		X	X
Sharp-shinned hawk	Accipiter striatus	X		
Song sparrow	Melospiza melodia			X
Spotted towhee	Pipilo maculatus			X
Swainson's hawk	Buteo swainsoni	X		X
Tree swallow	Tachycineta bicolor			X
Turkey vulture	Cathartes aura	X	X	X
Vesper sparrow	Pooecetes gramineus		X	X
Western kingbird	Tyrannus verticalis		X	X
Western meadowlark	Sturnella neglecta		X	X
Wilson's warbler	Wilsonia pusilla		X	
Yellow-rumped warbler	Dendroica coronata		X	

TABLE 11. WILDLIFE SPECIES AT THE NWTC*

SPECIES COMMON NAME	SCIENTIFIC NAME	1996 Survey	2003 Survey	2011 Survey
MAMMALS				
Big brown bat	<i>Eptesicus fuscus</i>			X
Black-tailed prairie dog**	<i>Cynomys ludovicianus</i>			
Bobcat**	<i>Felis rufus</i>			
Coyote	<i>Canis latrans</i>			X
Deer mouse	<i>Peromyscus maniculatus</i>			X
Desert cottontail	<i>Sylvilagus audubonii</i>			X
Eastern red bat	<i>Lasiurus borealis</i>			X
Elk	<i>Cervus canadensis</i>			X
Fringed myotis	<i>Myotis thysanodes</i>			X
Hoary bat	<i>Lasiurus cinereus</i>			X
Masked shrew	<i>Sorex cinereus</i>			X
Meadow vole	<i>Microtus pennsylvanicus</i>			X
Mexican woodrat	<i>Neotoma mexicana</i>			X
Mule deer	<i>Odocoileus hemionus</i>			X
Myotis bats	<i>Myotis sp.</i>			X
Prairie vole	<i>Microtus ochrogaster</i>			X
Silver-haired bat	<i>Lasionycteris noctivagans</i>			X
Thirteen-lined ground squirrel	<i>Spermophilus tridecemlineatus</i>			X
Western harvest mouse	<i>Reithrodontomys megalotis</i>			X
REPTILES AND AMPHIBIANS				
Boreal chorus frog	<i>Pseudacris maculata</i>			X
Bull snake	<i>Pituophis catenifer</i>			X
Woodhouse's toad	<i>Bufo woodhousii</i>			X
TERRESTRIAL ARTHROPODS				
Aphrodite fritillary	<i>Speyeria aphrodite</i>			X
Cabbage white	<i>Pieris rapae</i>			X
Checkered white	<i>Pontia protodice</i>			X
Common wood nymph	<i>Cercyonis pegala</i>			X
Dainty sulphur	<i>Nathalis iole</i>			X
Gray hairstreak	<i>Strymon melinus</i>			X
Orange sulphur	<i>Colias eurytheme</i>			X
Western white	<i>Pontia occidentalis</i>			X

*The 1996 study addressed only raptors. Mammals, reptiles, amphibians, or terrestrial arthropods were not the subject of a survey at the NWTC until the 2011 baseline survey.

**Species observed at a time other than in a survey.

APPENDIX C:

ENVIRONMENTAL PERMITS, REGISTRATIONS, AND NOTIFICATIONS APPLICABLE TO NREL DURING 2014

TABLE 12. NREL'S ENVIRONMENTAL PERMITS, REGISTRATIONS, AND NOTIFICATIONS IN 2014

Type	Location/ Description	Category	Issuing Agency	ID #	Permit or Registration Status
AST for petroleum storage	STM ESIF AST	Registration	DOPS	19275-1	Completed
AST for petroleum storage	STM PDU AST	Registration	DOPS	2873-2	Completed
AST for petroleum storage	STM RSF2 AST	Registration	DOPS	19211-1	Completed
AST for petroleum storage	STM SERF AST	Registration	DOPS	2873-1	Completed
AST for petroleum storage	E85 AST	Registration	DOPS	2873-4	Completed
AST for petroleum storage	SolarTAC AST	Registration	DOPS	19325-1	Completed
Air	Laboratory-wide servicing of CFC-containing equipment	Notification	APCD	647	Active
Air	STM SERF, 2 CFC-containing stationary sources	Registration	APCD	647	Active
Air	STM FTLB waste gas combustor	Permit	APCD	99JE0400	Active
Air	STM RFHP wood waste boiler	Permit	APCD	07JE0277	Active
Air	STM fugitive dust from construction activities	Permit	APCD	08JE0889L	Active
Air	STM RSF 1 diesel-fired standby electrical generator	Permit	APCD	10JE1400	Active
Air	STM RSF 2 diesel-fired standby electrical generator	Permit	APCD	11JE1303	Active
Air	STM FTLB diesel-fired standby electrical generator	Permit	APCD	10JE1630	Active
Air	NWTC Site 4.0 diesel-fired standby electrical generator	Permit	APCD	10JE1712	Active
Air	STM parking garage diesel-fired standby electrical generator	Permit	APCD	11JE1997	Active
Air	STM ESIF diesel-fired standby electrical generator	Permit	APCD	11JE3542	Active
Air	STM ESIF research electrical generator #3	Permit	APCD	13JE2829	Active
Air	STM IBRF scrubber and baghouse	Permit	APCD	11JE1798	Active
Air	STM ESIF research electrical generator #1	APEN	APCD	12JE1734 XP	Active

TABLE 12. NREL'S ENVIRONMENTAL PERMITS, REGISTRATIONS, AND NOTIFICATIONS IN 2014

Type	Location/ Description	Category	Issuing Agency	ID #	Permit or Registration Status
Air	STM ESIF research electrical generator #2	APEN	APCD	12JE1735 XP	Active
Air	STM IBRF standby electrical generator	APEN	APCD	13JE2276 XP	Active
Air	NWTC STL standby electrical generator	APEN	APCD	13JE2271 XP	Active
Air	NWTC Building 251 standby electrical generator	APEN	APCD	13JE2272 XP	Active
Alcohol	STM IBRF alcohol fuel production	Permit	TTB	AFP-CO-00255	Active
Alcohol	STM tax-free alcohol use	Permit	TTB	TF-CO-0331	Active
Drinking water system	NWTC drinking water system ID number	Registration	WQCD	CO0230860	In Effect; Does Not Expire
Earth disturbance	STM stormwater detention basin grading permit	Permit	Jefferson County	10-126950GP	Terminated
Earth disturbance	STM parking lot grading permit	Permit	Jefferson County	10-127351GP	Terminated
Groundwater well	STM groundwater monitoring well MW-1	Permit	DWR	37229	Active
Groundwater well	STM groundwater monitoring well MW-2	Permit	DWR	37228	Active
Groundwater well	STM groundwater monitoring well MW-3	Permit	DWR	37231	Active
Groundwater well	STM groundwater monitoring well MW-4	Permit	DWR	37230	Active
Groundwater well	STM groundwater monitoring well MW-5	Permit	DWR	37233	Active
Hazardous materials	STM WHF hazardous material storage and use permit	Permit	WMFR	4976	Active
Hazardous materials	STM SERF hazardous material storage and use permit	Permit	WMFR	4982	Active
Hazardous materials	STM S&TF hazardous material storage and use permit	Permit	WMFR	4979	Active
Hazardous materials	STM FTLB hazardous material storage and use permit	Permit	WMFR	4977	Active
Hazardous materials	STM IBRF hazardous material storage and use permit	Permit	WMFR	4978	Active
Hazardous materials	STM Shipping and Receiving hazardous material storage and use permit	Permit	WMFR	4980	Active
Hazardous materials	DWOP building 16 hazardous material storage and use permit	Permit	WMFR	4981	Active
Hazardous materials	ReFUEL hazardous material storage and use permit	Permit	Denver Fire Department	32178	Active
Hazardous waste	DWOP RCRA hazardous waste generator status EPA ID	Notification	HMWMD	CO4890000017	Completed
Hazardous waste	STM RCRA hazardous waste generator status EPA ID	Notification	HMWMD	CO3890090076	Completed
Hazardous waste	JSF RCRA hazardous waste generator status EPA ID	Notification	HMWMD	COD980805162	Completed
Hazardous waste	NWTC RCRA hazardous waste generator status EPA ID	Notification	HMWMD	COD983802448	Completed
Hazardous waste	ReFUEL RCRA hazardous waste generator status EPA ID	Notification	HMWMD	COR000207563	Completed
Historic registration	STM amphitheater	Registration	NPS	93000378	In effect; does not expire
Historic registration	STM stone bunker	Registration	NPS	93000379	In effect; does not expire

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TABLE 12. NREL'S ENVIRONMENTAL PERMITS, REGISTRATIONS, AND NOTIFICATIONS IN 2014

Type	Location/ Description	Category	Issuing Agency	ID #	Permit or Registration Status
Stormwater	STM ESIF construction project	Permit	EPA	COR12A60F	Active
Stormwater	STM electrical upgrade project	Permit	EPA	COR12B06F	Active
Stormwater	NWTC dynamometer expansion construction project	Permit	EPA	COR12A41F	Terminated
Stormwater	STM RSF II Construction Project	Permit	EPA	COR12A62F	Terminated
Stormwater	STM SERF & STF Landscape Improvements/DWP Safety Enhancements (FTLB)	Permit	EPA	COR12AW4F	Active

Acronyms used in the table

- APCD – Air Pollution Control Division of Colorado Department of Public Health and the Environment (CDPHE)
- APEN – Air Pollutant Emission Notice
- AST – Aboveground Storage Tank
- CFC – Chlorofluorocarbon
- DFD – Denver Fire Department
- DOPS – Division of Oil and Public Safety of the Colorado Department of Labor and Employment
- DWOP – Denver West Office Park
- DWR – Division of Water Resources
- EPA – Environmental Protection Agency
- ESIF – Energy Systems Integration Facility
- FTLB – Field Test Laboratory Building
- HMWMD – Hazardous Materials and Waste Management Division of CDPHE
- IBRF – Integrated Biorefinery Research Facility
- NPS – National Park Service of the U.S. Department of the Interior
- NWTC – National Wind Technology Center
- PDU – Process Development Unit
- RCRA – Resource Conservation and Recovery Act
- ReFUEL – Renewable Fuels and Lubricants Research Laboratory
- RFHP – Renewable Fuel Heat Plant
- RSF – Research Support Facility
- S&TF – Science and Technology Facility
- SERF – Solar Energy Research Facility
- STM – South Table Mountain
- TTB – Alcohol and Tobacco Tax and Trade Bureau of the U.S. Department of the Treasury
- WHF – Waste Handling Facility
- WMFR – West Metro Fire Rescue
- WQCD – Water Quality Control Division of CDPHE



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Office of Energy Efficiency and Renewable Energy
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NREL/MP-1900-64208 • August 2015

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