**SITEWIDE ENVIRONMENTAL ASSESSMENT
FOR THE
NATIONAL RENEWABLE ENERGY LABORATORY
GOLDEN, COLORADO
DOE/EA-0850**

MASTER

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The frontispiece is a photomosaic of four-color aerial photographs which depict the eastern portion of South Table Mountain (STM) and vicinity. The photographs were taken in August of 1991; their scale is

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Executive Summary

The Solar Energy Research, Development, and Demonstration Act of 1974 authorized a federal program to develop solar energy as a viable source of the nation's future energy needs. Under this authority, the National Renewable Energy Laboratory (NREL) was created as a laboratory of the Department of Energy (DOE) to research a number of renewable energy possibilities. The laboratory conducts its operations both in government-owned facilities on the NREL South Table Mountain (STM) Site near Golden, Colorado, and in a number of leased facilities, particularly the Denver West Office Park. In the interest of furthering the DOE's goals and to achieve more efficient and effective operations, NREL proposes to continue its current operations and to work towards consolidation and expansion of operations. It is anticipated that operational expansion will occur on the STM site as funding becomes available. Since its inception, NREL has been committed to accomplishing its activities in full compliance with the National Environmental Policy Act (NEPA) of 1969 and other environmental acts, laws, regulations, and guidelines. This programmatic or site-wide environmental assessment (EA) was prepared in continuing fulfillment of this commitment.

Current, expanded, and proposed NREL operations considered in this EA include research in energy technologies, and other areas of national environmental and energy technology interest. Examples of these technologies include electricity from sunlight with solar cells (*photovoltaics*); energy from wind (*windmills* or *wind turbines*); conversion of plants and plant products (*biomass*) into liquid fuels (*ethanol* and *methanol*); heat from the sun (*solar thermal*) in place of wood, oil, gas, coal and other forms of heating; and *solar buildings*.

The New National Energy Strategy emphasizes the need for more aggressive development and deployment of conservation and renewable (C&R) energy technologies as environmentally safe, reliable, and renewable means to meet U.S. energy demands in the 21st century. This demand increases the need for NREL to expand its current research and development (R&D) efforts. The present level of NREL R&D activity is achieved through a combination of subcontracts with universities/private industry and in both government-owned facilities at the STM Site and leased facilities in the Golden area. Over the last few years, NREL has expanded its in-house research as far as it can within existing leased facilities without adding more leased space. This leaves the DOE with three options for expansion. First, push for the rapid development, expansion, and consolidation of NREL's in-house R&D activity at DOE's STM Site, holding the present percentage of subcontracting activity constant. Second, expand R&D activities into additional leased facilities. Or third, expand R&D activities by increasing the percentage of funds awarded through subcontracts to universities and private companies. Only the first (or preferred) alternative accomplishes all of the stated goals of the DOE. The alternative of expanding R&D into additional leased facilities fails to meet many of the DOE's stated goals, results in federal funds being diverted from R&D into property leases (\$3.75M in FY93), and increases DOE's obligations and liabilities for restoration of leased properties. The alternative of expanding R&D activities by subcontracting also fails to meet many of DOE's stated goals. Additionally, significant restrictions are realized in disseminating and marketing the technological developments funded by DOE due to patent rights and other legal impediments.

Therefore, NREL proposes to continue and expand the present R&D efforts in C&R energy by making infrastructure improvements and constructing facilities to eventually consolidate the R&D and associated support activities at its STM Site. In addition, it is proposed that operations continue in current leased space at the present levels of activity until site development is complete. The construction schedule proposed is designed to develop the site as rapidly as possible, dependent on Congressional funding, to accommodate not only the existing R&D that is being conducted in leased facilities off-site but to also allow for the 20-year projected growth. Impacts from operations currently conducted off-site are

quantified and added to the cumulative impacts at the STM Site as new facilities are constructed, leases are terminated, and operations are relocated to the STM Site.

This sitewide EA analyzes the potential for an increase in the NREL budget from \$167 million in 1993 to \$265 million in 2012 for in-house research activities that would be accomplished in facilities near Golden and subcontracted research activities at private companies and universities. Currently, 50 percent of the research is conducted through subcontracts, each of which is addressed in other, contract-specific NEPA documents. It is anticipated that, as the budget increases at an estimated rate of 4 percent over the next twenty years, the percentage of research subcontracted to outside consultants will remain at the present rate of 50 percent. In-house activities include continued operation in leased buildings in the Denver West Office Park, and development and operation of permanent facilities on the STM Site from the existing 9,664 to 72,280 gross square meters of building space, along with infrastructure such as utility lines, roads, and parking lots. Activities would be moved from leased facilities to STM Site facilities as they become available, and leased space would be returned to building owners. In addition to buildings and indoor research operations, NREL would expand outdoor facilities for solar cell, mirror, wind turbine testing, and other activities. Public meetings were held to consider comments on the development of the STM Site. Comments generated from these meetings are addressed in this EA.

This EA provides quantified information to determine the magnitude and severity of impacts on the human and natural environment from the proposed action. It provides the basis on which to determine whether a finding of no significant impact to the environment (a FONSI) is appropriate, or whether potential impacts from the proposed action warrant development of an environmental impact statement. In this regard, no agency contacted in development of this EA opposed the proposed action. A number of agencies did, however, have contributing comments. A summary of these issues and courses of action is presented in Section 4.1.12.

1.0 Purpose and Need

NREL proposes ongoing operations in fulfillment of research plans and programs in leased facilities (primarily the Denver West Office Park) and at government-owned facilities at the South Table Mountain (STM) Site in Jefferson County, Colorado. NREL also proposes to implement its Site Development Plan (SDP) to provide adequate facilities and consolidation of activities for existing and expanded operations at the STM Site.

The policy of NREL and the DOE is to conduct all activities in compliance with applicable environmental statutes and regulations, including the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 *et seq.*); Council of Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA; DOE's implementing procedures for compliance with NEPA (10 CFR Part 1021), and DOE Order 5440.1E. Accordingly, this sitewide environmental assessment (EA) evaluates the individual and cumulative effects on the human and natural environment from existing operations and proposed continued development and eventual consolidation of operation at the STM Site.

1.1 Background

The Solar Energy Research, Development, and Demonstration Act of 1974, as amended, 42 U.S.C. 5551 *et seq.*, authorized a federal program to develop solar energy as a viable source of the nation's future energy needs. As a means of implementing the act, NREL, formerly designated the Solar Energy Research Institute (SERI), was created to be the nation's primary research laboratory responsible for the development of the renewable energy technologies necessary to advance the nation's goals of improving the environment, maintaining economic competitiveness, and achieving energy security. Research is conducted in photovoltaics, wind, biomass, solar thermal, and solar buildings energy technologies, as well as other areas of national environmental and energy technology interest.

NREL anticipates growth represented by an increase in total annual operating budgets from \$167 million in 1993 to \$265 million in 2012. Nearly half of NREL's budget (\$65 million to \$133 million) is expended on in-house research and support activities at its facilities near Golden, Colorado (Figure 1.1). The balance is committed to research activities accomplished by subcontractors. NREL research has been conducted in both leased and government-owned facilities near Golden on a continuous basis since the late 1970s (Figure 1.2). Since its inception, the majority of NREL research and support operations have been conducted in leased facilities located in the Denver West Office Park and leased facilities have made up a significant portion of NREL's assets for many years. Activities performed in these facilities include indoor bench-scale experimentation, theoretical studies, outdoor pilot plant testing, and all administrative and support functions. Figure 1.3 shows the distribution of functions for the STM site, Joyce Street (JS) facility, Denver West Office Park (DW), and the National Wind Technology Center (NWTC).

NREL anticipates expanded research in biomass gasification, technoeconomic analyses for geothermal technology, analysis of environmental effects of hydropower, manufacturing research and development and systems development and demonstration of photovoltaics, wind technology and support to users, biomass-to-liquid fuel (both ethanol and methanol), solar cooling, engineering development and demonstrations in day-lighting of non-residential buildings, engineering and systems programs in solar thermal detoxification, biobased materials, solar materials processing, municipal waste management, plastics recycling, flexible-fueled engines, and manufactured buildings. Levels of effort are expected to remain relatively stable in core photovoltaics research and development, solar thermal electric, solar heating, and passive solar heating.

National Renewable Energy Laboratory

GENERAL LOCATION MAP
Golden, Colorado

Distribution of Functions for NREL as of September, 1992

In 1982, the State of Colorado donated 1.2 square kilometers (300 acres), the southeast half of Section 36, Township 3 North (T3N), Range 70 West (R70W), on South Table Mountain near Golden to the federal government (DOE) for development of the permanent renewable energy research complex. The first building on this site, the Field Test Laboratory Building (FTLB), was completed in 1984, as was site development infrastructure (utilities, roads, drainage, etc.), temporary test sites, and some semi-permanent structures. Existing real property improvements are illustrated on Figure 1.4; the FTLB is Building Number 5308.

Environmental impacts were continually evaluated as NREL developed and occupied the STM Site. In April 1980, an EA (Reference 1) was prepared to address site-wide impacts, and a finding of no significant impact was found to be justified. This document contributed information leading to the decision to develop the STM Site for the permanent NREL facilities. An addendum (2) updating the 1980 EA was prepared and published in September 1988 to re-evaluate the impacts of continued development of the STM Site. This addendum supported the earlier FONSI. A number of other environmental or related assessments, reports, and studies were also completed. They include a report on wildlife (3), a historical review of the STM Site (4), a safety analysis review for the use of hazardous materials in photovoltaic applications (5), a traffic impact analysis (6), development of technical site information (7), and an EA for the construction and operation of a laboratory building (8). A primary function of this site-wide EA is to identify and evaluate the cumulative impact on the environment from total implementation of current proposed and alternative actions at the STM Site. A separate EA has already been completed for the Joyce Street facility.

1.2 Purpose and Need

NREL is operated for the DOE with congressionally mandated goals established to provide state-of-the-art research and development in renewable energy technologies. In addition, the DOE has programmatic needs for the existence of a single center of excellence with direct, unclassified access to assist private and public sector researchers and decision-makers in the commercialization of renewable energy technologies through collaborative research and development, provision of access to specialized capabilities, and dissemination of technical results. The purpose of this EA is to analyze the alternatives to continued and expanded operations of NREL. Immediate space requirements would be satisfied through the continued occupancy of leased and government-owned facilities. Long-term space needs would be satisfied through the continued development of government-owned facilities on the STM site compliant with DOE environment, safety, and health requirements.

1.2.1 Program Growth

NREL anticipates real growth in its funding and staff throughout the next 20 years. Figure 1.5 presents a 20-year projection of total funding. Currently, about 150 NREL personnel work on the STM Site and 550 work in nearby leased facilities. Over the next five years, the NREL staff is expected to increase by about 7 percent per year, while funding would grow by about 8 percent per year. By 2012, NREL would employ approximately 2,000 personnel and would have an annual budget (projected) of \$391 million.

1.2.2 Development of Adequate Facilities

Since its inception, NREL has conducted the bulk of its research in leased buildings in the Denver West Office Park. Buildings originally designed for office use were converted to temporary laboratory use. These modifications provide functional but highly inefficient space for conducting research activities. Important events in NREL site development are presented in Table 1.1.

Table 1.1. Important Events in NREL Site Development

Year	Event
1975	State of Colorado donated 300 acres for NREL.
1977	NREL opened its doors in Denver West Office Park.
1981	NREL begins using surplus government house trailers and modular buildings for labs and offices
1982	NREL formally assumed responsibility for STM site from State of Colorado.
1984	First research building completed at STM site (Field Test Laboratory Building).
1984	Some infrastructure completed at STM site (utilities, roads, drainage).
1985	NREL assumes responsibility for wind research at Rocky Flats site.
1985	Small research facility occupied (Biotechnology Research Facility).
1987	I-70 Interchange opened; improved access to major NREL populations.
1988	Field Test Laboratory Building expansion completed.
1988	Bulk storage building completed.
1988	Facilities storage shed completed.
1992	Groundbreaking for second major research building (Solar Energy Research Facility).

Given the nature of the buildings' original purpose and design, the temporary facilities lack many features normally found in a laboratory building. For example, the buildings lack loading docks, service corridors, and have structural and configuration limitations which make it difficult to meet space requirements of the research staff. Installation or removal of large pieces of equipment requires costly demolition of interior and exterior walls and results in unnecessary program delays. In addition, expenditures involved with use of leased space are more costly in terms of taxpayer dollars than would be realized with operation and maintenance of government-owned facilities.

NREL occupies four distinct sites, as shown on Figures 1.2 and 1.3. Three of these sites, South Table Mountain (STM), Denver West (DW), and the National Wind Technology Center (NWTC) have been occupied for several years. These sites are now, and will continue to be, of major importance for NREL's site development plans. The other site, Joyce Street (JS), has a five year lease and is considered a temporary facility. This temporary facility is representative of the type of leased space available to NREL for its expanding research operations and is not considered to be adequate for long-term use.

Modern and efficient laboratories with the flexibility to accommodate multiple use activities are essential to maintaining the integrity, viability, and quality of NREL's progress in accomplishing its mission.

1.2.3 Consolidation of Operations

Consolidation of operations is another of NREL's goals. Co-location of research staff promotes the interchange of ideas and the creativity resulting from interdisciplinary exchanges. Closer coordination in environmental, safety, and health programs also reduces associated risk. Development of government-owned facilities in close proximity on government-owned property permits cost savings through reduced

utility charges, building operating and maintenance costs, lease payments, and building modification and restoration expenses. Co-location would also reduce the need for vehicular transportation between activities, with corresponding reductions in exhaust emissions and risk of vehicle accidents.

1.2.4 Enhancement of Public Interest

Finally, consolidation and co-location of research activities would allow NREL to more efficiently and effectively accomplish its congressionally mandated goal of stimulating public interest in alternative energy technology through demonstrations, tours, seminars and public meetings.

2.0 Alternatives

2.1 Proposed Action

NREL proposes to continue and expand existing operations, in fulfillment of authorized federal programs, at its leased and STM site facilities. This proposed action includes continuation of existing operations and research programs, and construction of new facilities. This proposed action is required to meet the needs of the nation and the DOE for research and development in conservation and renewable energy technologies.

2.1.1 Facilities

Proposed permanent STM Site facilities to support NREL research programs are summarized in Table 2.1 and illustrated in Figure 2.1. A cumulative total of 64,662 gross square meters (gsm) of permanent buildings in a medium-density, campus-style development would be constructed in phases to house research laboratories, test space, offices, and space for administrative support activities. Of this total, 9,665 gsm of permanent buildings already exist on the site. Existing temporary buildings on the STM Site would be demolished or remodeled to meet temporary, project-specific auxiliary space requirements as mission tasks are completed and future programs are undertaken. Table 2.2 is a list of existing and proposed major facilities, their existing or proposed uses, and brief descriptions of actions required to attain planned configurations. Table 2.3 is a program summary of construction proposed for the STM Site over the next five years.

Site infrastructure improvements are included in the proposed action. Denver West Parkway (Figure 2.1), which crosses the southern edge of the STM Site, would be upgraded from the existing 2-lane, 2-way road to a divided 4-lane parkway from the eastern edge to a point midway across the site. The parkway would be extended from its present western terminus through to Quaker Street. The western access on to the site from Quaker Street would be a controlled entrance, restricted to emergency vehicles and NREL staff. All public access, including shipping and receiving traffic, would be via the east entrance. The existing gravel road from the north end of Quaker Street to the top of the South Table Mountain mesa experimental sites would be upgraded to an all-weather asphalt surface. Construction of access lanes and parking lots would be scheduled concurrently with associated building construction.

With the exception of natural gas, upgrade of all utilities on the site would be required and is an element of the proposed action. NREL would provide appropriate easements to utility companies for required improvements. All utility services are proposed to be located underground. Water and sanitary sewer mains would be located within, or parallel to and just north of, the Denver West Parkway. Water distribution mains would loop all building groups, with branches for fire protection and domestic uses stubbed from the loop to each individual building module. Electricity and telecommunication distribution lines would be located immediately to the south of, and parallel to, Denver West Parkway. Switches capable of 300 stations are proposed for each major facility. Satellite telecommunications and Token Ring and Ethernet data systems would be installed, including fiber optic and coaxial cables. Facilities to the west of the FTLB would be supplied with hot and chilled water from a central plant (an expansion of the FTLB) by buried lines running east-west just north of the field test sites. Branches from all the mains and distribution lines would serve phased developments as they occurred, including essential services to experimental sites at the top of the mesa. Surface storm water drainage would be controlled to historic or regulated flow requirements by detention ponds adjacent to parking lots and drainage structures.

Proposed security measures include completion of a wire perimeter fence around the entire STM Site with pedestrian and wildlife openings provided. Individual buildings, test sites, and other areas would be

provided with "point security" measures (e.g., fencing, access control, lighting) required to meet DOE or other client security requirements. A proposed visitor center near the main entrance and a nearby site access control building will enhance overall security of the STM Site.

Table 2.1. Resource Requirements for Facilities to be Constructed, Reassigned, or Remodeled

Building	Building Description	Gross Square Meters
Miscellaneous	Test Facility	279*
AFUF	Alternative Fuels User Facility	1,394
ITUTF	Industrial Thermochemical User Test Facility	1,115
TTF	Thermal Test Facility	1,412
OTF	Outdoor Test Facility	910
SRWF	Shipping/Receiving/Warehouse Facility	1,300
BTRF	Biotechnology Research Facility	1,115*
FTLB	Field Test Laboratory Building	7,899
SERF	Solar Energy Research Facility	10,590
RSB	Research Support Building	26,106
CBRF	Chemical and Biological Research Facility	12,542
Total Gross Square Meters		64,662

*Existing structures which will be reassigned or remodeled.

LEGEND

NREL SOUTH TABLE MOUNTAIN SITE BOUNDARY

PAVED HIGHWAY, ROAD OR STREET

UNPAVED ROAD

FENCE

PERMANENT FACILITY

TEMPORARY FACILITY

FACILITY
STORAGE BUNKER
(UNDER HISTORIC CONSIDERATION)

4317

SERF
(UNDER CONST.)

PROPOSED PARKING

PROPOSED DRIVE

DENVER WEST PARKWAY

0 50 100 150

METERS

SCALE: 1 : 3000
(ON 22"x 34" DRAWING)

2	2/10/93	FIG# CHANGE, SIATF NAME GDP CHANGE, AS PER W13459	GDP
1	12/10/92	serf added, arrays deleted	GDP
No.	Date	Description	By

Revisions

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NOV. 92

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11/16/92

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Operated for the
U.S. Department of Energy
by Midwest Research Institute

Sheet Title

EXISTING PERMANENT
SITE DEVELOPMENTS
CIVIL PLAN VIEW

WR#

W10940

Drawing Number

C-PV-000-19

Sheet Number

FIG. 1.4

**FINDING OF NO SIGNIFICANT
IMPACT FOR THE SITEWIDE
ENVIRONMENTAL ASSESSMENT
FOR THE NATIONAL RENEWABLE
ENERGY LABORATORY
GOLDEN, COLORADO
DOE/EA-0850**

DEPARTMENT OF ENERGY

**FINDING OF NO SIGNIFICANT IMPACT
FOR THE NATIONAL RENEWABLE ENERGY LABORATORY
AT GOLDEN, COLORADO**

AGENCY: Department of Energy

ACTION: Finding of No Significant Impact

SUMMARY: The National Renewable Energy Laboratory (NREL) in conjunction with the Department of Energy (DOE) has prepared an Environmental Assessment (EA), DOE/EA-0850, to evaluate the environmental impacts of the continued and expanded operations of the NREL located at Golden, Colorado. Research and development activities in energy conservation and renewable energy technologies would be expanded through infrastructure improvements and construction of facilities on NREL's South Table Mountain (STM) site. In addition, operations would continue in current leased space at the present level of activity until site development is complete.

Based on the analysis in the EA, DOE has determined that the proposed action is not a major Federal action significantly affecting the quality of the human environment, within the meaning of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321, *et seq.*). Therefore, the preparation of an environmental impact statement is not required and the DOE is issuing this Finding of No Significant Impact.

COPIES OF THE EA ARE AVAILABLE FROM:

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BACKGROUND: The DOE has identified a need to develop alternative energy sources to lessen dependence on foreign oil imports and impacts on the environment from production and use of fossil fuels. Continuing research at NREL in photovoltaics, wind, biomass, solar thermal, and solar buildings energy technologies as well as other areas of national environmental and energy technology helps to meet the nation's goals of improving the environment, maintaining economic competitiveness, and achieving energy security. This EA addresses the individual and cumulative impacts, in accordance with NEPA, of continuing and expanding NREL's operations.

NREL is operated for the DOE with congressionally mandated goals established to provide state-of-the-art research and development in renewable energy technologies. NREL is a single center of excellence with direct, unclassified access to assist private and public sector researchers and decisionmakers in the commercialization of renewable energy technologies, provision of collaborative research and development, provision of access to specialized capabilities, and dissemination of results.

NREL proposes to continue ongoing operations in fulfillment of research plans and programs in leased facilities, primarily the Denver West Office Park, and at government owned facilities at the South Table Mountain Site (STM) in Golden, Jefferson County, Colorado. It also proposes to implement its Site Development Plan (SDP) to provide adequate facilities and consolidation of activities for existing and expanded operations at the STM site.

NREL research has been conducted in both leased and government owned facilities near Golden on a continuous basis since the late 1970s. In 1982, the State of Colorado donated 1.2 square kilometers (300 acres) on South Table Mountain near Golden to the DOE for development of the permanent renewable energy research complex. The first building on this site, the Field Test Laboratory Building, was completed in 1984 along with infrastructure such as utilities, roads, etc., temporary test sites and some semi-permanent structures. Existing operations performed here include indoor bench-scale laboratory experiments, theoretical studies, outdoor pilot plant testing, and all administrative and support functions.

Currently NREL occupies four distinct sites. Three of these sites, the STM, the Denver West Office Park and the National Wind Technology Center, have been occupied for several years. They will continue to be operational. A temporary facility at Joyce Street is leased.

Facilities proposed for construction during the five year construction program under the SDP would be: the Alternative Fuels User Facility, the Industrial Thermochemical User Test Facility, Thermal Test Facility, Outdoor Test Facility Shipping/Receiving/Warehouse Facility, Field Test Laboratory, Solar Energy Research Facility, Research Support Building and Chemical and Biological Research Facility. Facilities to be reassigned or remodeled would be the Test Facility and the Biotechnology Research Facility.

PROPOSED ACTION: NREL proposes to continue to conduct research and development in conservation of energy and renewable energy technologies and to implement its SDP to provide adequate facilities and consolidation of activities for existing and expanded operations. This proposed action includes continuation of operations, research programs, and construction of new facilities in fulfillment of authorized federal programs at its leased and STM site facilities. This proposed action is required to meet the needs of the nation and the DOE for research and development in conservation and renewable energy technologies.

NREL anticipates expanded research in biomass gasification, technoeconomic analyses for geothermal technology, analysis of environmental effects of hydropower, manufacturing research and development and systems development and demonstration of photovoltaics, wind technology and support to users, conversion of biomass-to-liquid fuel (both ethanol and methanol), solar

cooling, engineering development and demonstrations in day-lighting of nonresidential buildings, engineering and systems programs in solar thermal detoxification, biobased materials, solar materials processing, municipal waste management, plastics recycling, flexible-fueled engines, and manufactured buildings. Levels of effort are expected to remain relatively stable in core photovoltaics research and development, solar thermal electric, solar heating, and passive solar heating.

ENVIRONMENTAL IMPACTS: The analysis provided in the EA demonstrates that the proposed action would not result in impacts significantly affecting the quality of the human environment, health or safety. No negative impacts would occur to floodplains, wetlands, cultural/historical resources, or other designated sensitive areas or to threatened and endangered species. Impacts to the STM topography would be minimal due to restricting proposed construction activities to the base of the slopes. The proposed infrastructure improvements and facilities are sited beyond rockfall zone limits and no impacts to slope stability would occur.

Hydrology. No impact on groundwater resources is anticipated from the proposed action. Potential for contamination from accidental spills would be minimized by incorporating spill containment features in the facility designs. No conduit to groundwater would be available in the already impermeable soils. The facilities would be isolated from groundwater and the Denver Formation aquifer by the use of engineered barriers, and the potential for groundwater contamination is considered very low.

Construction activities which would disturb more than five square meters of land would be evaluated for applicability of the 1990 storm water discharge regulations. If deemed necessary, a storm water discharge permit would be acquired for proposed construction activities from the Colorado Department of Health under the National Pollutant Discharge Elimination System.

No impact to surface water quality is anticipated from the proposed activity during operation. All effluents would eventually be discharged into the sanitary sewer system, and spill containment systems would be employed to control spills. NREL would continue to work with the Pleasant View Water and Sanitation District and participate in a study to determine sewer system requirements for handling the Discharges from NREL's operations. No drainage channels would be adversely affected by proposed construction activities.

Air Quality. The emissions from the proposed action would not individually, or collectively with ambient conditions, exceed either Federal or State Ambient Air Quality Standards. Additionally, the analyses in the EA demonstrate that the emissions from the proposed action would not be sufficient to be classified as a major stationary source to which the provisions of the prevention of significant deterioration

of air quality regulations would apply. Continued monitoring and use of such Best Available Technology such as sterilizers, filters, and scrubbers would be incorporated into new facility designs so that operations comply with air quality, health, safety, and other public nuisance regulations.

Solid/Hazardous Waste. The proposed action would result in generation of approximately 8,840 cubic meters (11,930 cubic yards) per year of solid waste. The commercial firm presently under contract to provide solid waste disposal services to NREL has indicated that it has the capacity necessary to dispose of wastes from the proposed activities.

Full implementation of all research activities would result in generation of approximately 3,779 kilograms (8,352 pounds) of hazardous wastes per year. All elements of the existing disposal process (transportation, receipt, and disposal) have indicated to NREL a capacity to handle disposal of anticipated hazardous wastes from the proposed action.

Threatened and Endangered Species. Field surveys and literature searches produced no information that any federally listed threatened and endangered species, including the Ute Ladies' tresses orchid, are known to exist on the site. The occurrence of Bell's twinpod, a federal candidate species, is unlikely due to the lack of appropriate habitat.

Human Health and Safety. Construction activities associated with the proposed action are common to most light industrial and commercial facilities. All such activities would be performed in accordance with the

Occupational Safety and Health Administration (OSHA) regulations. Overall operational risk for NREL would be minimal due to strict compliance with OSHA and DOE occupational safety and health regulations. The analyses in the EA for the continued and expanded operation of the NREL establish that the action would not significantly impact onsite workers or the adjacent offsite public.

Historic/Archeological Resources. Three features at STM, which is a Natural Landmark, have been nominated for the National Register of Historic Places. NREL will report and protect any unknown archeological resources that may be discovered on the STM. The State Historic Preservation Office advised that there are two structures of significance at the site and expressed no concern regarding effects of construction on them.

Transportation. Additional vehicular traffic associated with the proposed future development of the STM site would increase traffic during morning and evening rush hours at two access points to the site. NREL recognizes existing and increased demand on transportation networks to the site and would provide administrative and technical support to the Colorado Department of Transportation in the design and construction of road improvements. NREL is coordinating with several government agencies on regional development of highway interchanges and road networks.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER STUDY: .

No Action. The No Action alternative addresses two courses of action: to continue the present course of action without substantial new proposals, or no change in the status quo; or to discontinue the present course of action by phasing out operations in the near term and decommissioning the site so that there would be no research activities at all at the site. Under these no action alternatives, no immediate impacts on the existing environment in the vicinity of the STM site would occur. However, this alternative does imply adverse environmental impacts that could occur from a reduced renewable energy program associated with continued development of fossil fuel energy resources rather than alternative renewable energy sources.

Alternative Sites. Other alternative sites did not meet the purposes and needs of the proposed action. The STM site, which is owned by DOE, would not require additional land acquisition. NREL's previous experience in using other local facilities also owned by DOE, such as Rocky Flats, has resulted in significant operational inefficiencies. It would be difficult to achieve NREL's congressionally-mandated goal to stimulate public interest in renewable energy technologies through demonstrations, tours, seminars, and public meetings without research facilities consolidated on one site.

Subcontracting Research and Development Work to Outside Consultants.

There are no known potential contractors who have the scientific and technical knowledge and facilities to perform the work assigned and undertaken by NREL. This alternative would require not only duplication of facilities but also duplication of staff, and consequently was dropped from further consideration.

Leasing Facilities at Other Off-Site Locations. As no adequate facilities are known to be available for lease and this alternative has all the disadvantages of the current situation represented by the No Action alternative, this alternative was not developed in detail.

DETERMINATION: Based on the information in the EA, DOE determines that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment, within the meaning of the National Environmental Policy Act. Therefore, the preparation of an environmental impact statement is not required, and DOE is issuing this FONSI.

Issued in Washington D.C., this 19th day of June, 1993.

Peter N. Brush
Acting Assistant Secretary
Environment, Safety and Health

PROPOSED FUTURE BUILDING

TEMPORARY FACILITY

PERMANENT FACILITY

UNPAVED ROAD

PAVED HIGHWAY, ROAD OR STREET

NREL'S BOUNDARY OF SOUTH TABLE MOUNTAIN SITE

LEGEND

BOUNDARY OF SOUTH TABLE MOUNTAIN SITE
HIGHWAY, ROAD OR STREET
ED ROAD

NENT FACILITY
RARY FACILITY
SED FUTURE BUILDING

SOLAR INDUST
MESA TEST AF

DENVER WEST
PARKWAY
EXTENTION

MAINTENANCE

INDUSTRIAL
THERMOCHEMICAL
USER TEST
FACILITY

METROLOGY
THERMAL TE

TEMPORARY FACILITY

PROPOSED FUTURE BUILDING

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(ON 22"x 34" DRAWING)

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Revisions

G. PEARMAN

Drawn By

2/8/93

Date

Engineer

Checked By

Approved By

5-4-93

NREL

National Renewable Energy Laboratory

1617 Cole Boulevard
Golden, Colorado 80401

Operated for the
U.S. Department of Energy
by Midwest Research Institute

Sheet Title

5 YEAR SITE
DEVELOPMENT PLAN
CIVIL PLAN VIEW

WR#

W13459

Drawing Number

C-PV-000-24

Sheet Number

FIG. 2.1

Table 2.2. Facility Uses

BUILDING (acronym/number/size in gross square meters [gsm])	EXISTING OR PROPOSED	PRESENT USE	PROPOSED USE	PROPOSED ACTIONS
Field Test Laboratory Building (FTLB/5308/7,898 gsm)	Existing 7,592 gsm Proposed 306 gsm addition	Wet Chemistry Labs, Offices, High-bay space, Shops, Ship- ping & Receiving and Ware- housing.	High-bay research & develop- ment space for mechanical and industrial technology.	Reconfigure existing wet che- mistry labs, remove shipping & receiving and warehousing, reconfigure building for high- bay research & development, expand utility center. See Note 1.
Field Experimental Test Area (FETA) Main Distribution Center (MDC) (FETA MDC/6905/12 gsm)	Existing	Electric Power Distribution	Same	Relocate as part of Outdoor Test Facility project.
FETA Storage Shed (-/7004/9 gsm)	Existing	Equipment Storage	None	Demolish as minor construc- tion project.
High Flux Solar Furnace (HFSF/7119/99 gsm)	Existing	Laboratory Space	Same	No action required.
FETA Storage Shed (-/7204/15 gsm)	Existing	Equipment Storage	Same	No action required.
Solar Radiation Research Lab (SRRL/7315/46 gsm)	Existing	Metrology Lab	Same	No action required.
Modular Industrial Solar Ret- rofit (MISR) Power Distribution (-/7603/225 gsm)	Existing	Equipment Storage	Same	No action required.
Open-Cycle Thermal Energy Conversion Building (OTEC/8504/176 gsm)	Existing	Not currently in use. Program relocated.	Same	To be demolished to make land available for Alternative Fuels User Facility (AFUF) project.

Table 2.2. Facility Uses (Continued)

BUILDING (acronym/number/size in gross square meters [gsm])	EXISTING OR PROPOSED	PRESENT USE	PROPOSED USE	PROPOSED ACTIONS
Solar Industrial Mesa Test Area (SIMTA/7421;7521/180 gsm)	Existing	Outdoor testing	Same	No action required.
Biotechnology Research Facility (BTRF/8606 and 8806/808 and 204 gsm)	Existing 808 gsm and 204 gsm Pro- posed 149 gsm addition	Biofuels Pilot Plants and Of- fices	Same	To be expanded by 144 gsm to house Biofuels Process Development Unit (PDU) as part of AFUF project. See Note 2.
Bulk Storage Facility (-/9304/353 gsm)	Existing	General Storage	Metrology and Instrumenta- tion Laboratory	Proposed FY 1994 General Plant Project (GPP) item. Interior, heating, ventilation, air conditioners, and electri- cal modifications only, struc- ture is adequate. See Note 3.
Facilities Building (-/9306/346 gsm)	Existing	Maintenance Shops	Same	None. Adequate as is.
Waste Handling Facility (-/4716/91 gsm)	Existing	Handling and shipping of haz- ardous materials wastes.	Same	None. Adequate as is.
Solar Energy Research Facility (SERF/Note 4/10,590 gsm)	FY 1992 Line Item Construction Pro- ject	N/A	Materials Research, including Laboratories.	Design completed. Construc- tion began in April 1992 with completion in September 1993.
Chemical and Biological Research Facility (CBRF/Note 4/12,542 gsm)	Proposed FY 1995 Line Item Con- struction	N/A	Biofuels Research, Chemical & Biological Research.	Programming, see note 5.

Table 2.2. Facility Uses (Continued)

	BUILDING (acronym/number/size in gross square meters [gsm])	EXISTING OR PROPOSED	PRESENT USE	PROPOSED USE	PROPOSED ACTIONS
15	Alternative Fuels User Facility (AFUF/Note 4/1,394 gsm)	Proposed FY 1993 Line Item Con- struction	N/A	Biofuels research, Biotech- nology Research.	Design to be completed in May 1992. Construction to be completed in September 1993. See Note 6.
	Outdoor Test Facility (OTF/Note 4/910 gsm)	FY 1992 GPP Project	N/A	Generic Test Facility for Out- door Testing.	Design to be completed in May 1992. Construction to be completed in June 1993.
	Building 251 (NWTC) existing building to be modified for testing wind blades.	Proposed FY 1994 GPP Project	N/A	Materials Research and Test- ing Facility for Wind Energy Programs.	See Note 7.
	Thermal Test Facility (TTF/Note 4/1,412 gsm)	Proposed FY 1994 GPP Project	N/A	Test Facility for Buildings Re- search Programs.	To be completed in FY 1996. See Note 8.
	Industrial Thermochemical User Test Facility (ITUTF/Note 4/1,115 gsm)	Proposed FY 1994 Line Item Con- struction	N/A	Pilot Plant Test Facility for Pyrolysis Research and Indus- trial Technology.	To be completed in FY 1996. See Note 9.
	Shipping, Receiving, and Warehouse Facility (-/Note 4/1,300 gsm)	Proposed FY 1994 GPP Project	N/A	Shipping, Receiving, and Wa- rehousing.	To be completed in FY 1997. See Note 10.
	Industrial Scale Solar Furnace (ISSF/Note 4/size to be determined)	Proposed FY 1995 GPP Project	N/A	Pilot Scale Test Facility	To be completed in FY 1997.
	Research Support Building (RSB, Note 4/26,106 gsm)	Proposed	Offices and Research Support Space	Offices and research support space would replace offices and research support space currently leased in the Denver West Office Park and to house programmed growth.	Include in funding actions.

Table 2.2. Facility Uses (Continued)

BUILDING (acronym/number/size in gross square meters [gsm])	EXISTING OR PROPOSED	PRESENT USE	PROPOSED USE	PROPOSED ACTIONS
Visitor's Center	Proposed FY 1993 to be constructed by MRI	N/A	Center open to general public for information on renewable energy technologies.	To be completed in FY 1993.
Building 15, DWOP	Existing	Office and research support space	Release to owner.	Restoration as may be re- quired by the lease.
Building 16, DWOP	Existing	Wet and dry laboratory re- search and research support space	Release to owner.	Restoration as may be re- quired by the lease.
Building 17, DWOP	Existing	Office and research support space.	Release to owner.	Restoration as may be re- quired by the lease.

Notes:

1. The building was originally designed for high-bay research and is currently used for a variety of other uses.
2. Expansion of the BTRF provides additional pilot plant space for a high-growth program. Provides a safe, efficient space for this research program. Adequate space does not currently exist to house the pilot plant (Process Demonstration Unit or PDU).
3. Currently the Metrology Lab is located in Denver West Building 16 and supports the entire laboratory. However, when the Solar Energy Research Facility (SERF) is completed and other permanent site research facilities constructed, the Metrology Lab would be relocated on the permanent site to provide efficient support to the research operations.
4. Building number to be determined.
5. Provides additional space for several high-growth program areas, frees up space in the FTLB for high-bay research programs.
6. Provides additional space for Biotechnology Research, a high-growth program. Currently there is not enough BL-1 and BL-2 (National Institute of Health biological containment, see Appendix B for definitions) to support the rapid growth in this program. Also, this frees up space in the FTLB for high-bay research programs.
7. Provides additional space for Wind Energy which is a high-growth program area, frees up space in the FTLB for other high-bay research programs. Will require minor modification of Building 251 at NWTC.
8. Provides space for a research program that is currently conducted in a marginal rental building located off-site.
9. Provides additional space for the pyrolysis research programs, and frees up space in the FTLB for high-bay research programs. The pyrolysis programs require a H-2 (Uniform Building Code high-hazard) occupancy building with explosion-proof electrical and explosion venting. Currently there is not enough of this type of space available to support the growth in these programs. Location of building and design concept yet to be determined.
10. Free up space in the FTLB for high-bay research activities.

Table 2.3. Proposed 5-Year Construction Program

Fiscal Year 1992	Fiscal Year 1993
Outdoor Test Facility	Denver West Parkway Extension
Service Road Extension	FETA Utility Upgrades
Water/Fire Line Extension	Visitor's Center
Solar Industrial Mesa Test Area	Process Demonstration Unit and Alternative Fuels User Facility
Solar Energy Research Facility	Site Access/Security Control building
	Upgrade building 251 at NWTC
Fiscal Year 1994	Fiscal Year 1995
Widen Denver West Parkway	STM Site Infrastructure Improvements (water and sewer to mesa top)
Convert Bulk Storage to Metrology Laboratory	Chemical and Biological Research Building
Thermal Test Facility	Large Scale Solar Furnace
Industrial Thermochemical User Test Facility	
Shipping, Receiving, and Warehouse Building	
Infrastructure upgrades at NWTC	
Fiscal Year 1996	
STM Site Infrastructure Improvements (water and sewer)	
Research Support Building	

Figure 2.2 is a photograph of the model used to conceptualize the general architectural appearance of the STM Site. Buildings would be purposefully controlled in size, mass, height, and color to complement the South Table Mountain vista and existing developments of the STM Site and Denver West Office Park.

Xeriscape landscaping between paved parking areas, lanes, and drainage ways is proposed. Figure 2.3 is a generalized land use map of proposed site activity. Proposed land use restrictions include a 61-meter building setback from the south property line, a 46-meter setback from the east property line, and a 122-meter setback from the rim of the mesa. The rockfall zone, steep slopes (Figure 2.4), and major drainage ways would be preserved as open space.

Buildings would be designed specifically for research and development or office and research support activities that would meet or exceed DOE environmental, safety, and health requirements. Centralized ventilation and full building fire detection and suppression systems, service corridors to separate research and administrative personnel, and designated loading docks and freight elevators for chemical, waste product, and equipment handling would be provided, as appropriate. Buildings would be designed with

CONCEPTUAL MODEL

February 1993

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FIGURE 2.2

STM Site Plan

Existing Land Use

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NREL

National Renewable Energy Laboratory

STM SITE PLAN

EXISTING LAND USE

PAGE 19

FIGURE 2.3

STM Site Plan

Site Slopes

caisson or other foundation systems appropriate to site-specific soil conditions. Buildings would be designed to take advantage of the region's relatively mild, dry climate and abundant sunshine to reduce building energy consumption through extensive use of natural daylighting and evaporative cooling. Specific descriptions for major buildings is provided below.

2.1.1.1 Alternative Fuels User Facility

As a result of NREL's increased biotechnology research activities, a biomass-to-ethanol pilot plant is proposed for construction and operation to demonstrate the effectiveness of the conversion process as developed by NREL. The Alternative Fuels User Facility (AFUF) would be a 1,394 gross square meter state-of-the-art biotechnology and biofuels user facility. The building would be a permanent structure designed to consolidate existing laboratory facilities, as well as provide for the expansion of CRADA activities. This project would also include the design and construction of an extension to the existing Biotechnology Research Facility (BTRF) and an "in-fill" of the open area between the BTRF and the storage building. This in-fill would be used to house a portion of the proposed biofuels pilot plant or Process Demonstration Unit (PDU).

2.1.1.2 Chemical and Biological Research Facility

The Chemical and Biological Research Facility (CBRF) is proposed as a 12,542 gross square meter research laboratory building and technical conference center on the NREL STM site. This facility would accommodate 180 employees, serving research and support functions. The CBRF would be a replacement of specific research functions currently housed in inadequate, overcrowded space in the Field Test Laboratory Building and would serve to meet expanding research needs. The CBRF would be a two-story concrete building constructed on a 5,400 square meter footprint designed to compliment the natural land features of the STM site. The technical conference center would be a one-story concrete structure connecting the CBRF and the Solar Energy Research Facility (SERF). Construction of the buildings would be scheduled to begin early in 1995 with completion in fall of 1996. The CBRF project represents implementation of Phase D of the planned STM development as described in the 1987 SERI SDP and the 1991 NREL SDP.

2.1.1.3 Research Support Building

The proposed Research Support Building (RSB) would be a 26,106 gross square meter building on the STM site. This facility would initially accommodate 745 employees, serving administrative and research support functions, and would include the DOE Golden Field Office and NREL's Director's Office. The RSB would be a replacement for office space currently in use in off-site leased facilities and would serve to meet expanding research needs. The RSB would consist of multi-level modules constructed to a maximum height of three stories plus penthouses. The facility would be designed to compliment the natural land features of the STM site. Construction of the building would be scheduled to begin early in 1996 with completion in fall of 1997. The RSB project represents implementation of Phase C of the planned STM development as described in the 1987 SERI SDP and the 1991 NREL SDP.

2.1.1.4 Industrial Thermochemical User Test Facility

The proposed Industrial Thermochemical User Test Facility (ITUTF) would be a 1,115 gross square meter building on the west end of the STM site. This facility would accommodate high-bay research activities required to support cooperative research agreements with industrial partners for commercialization of technology. This would be a two-story concrete building designed to compliment the natural land features and would serve as a replacement of specific research functions currently housed

in inadequate, overcrowded space at the Field Test Laboratory Building. The ITUTF project represents implementation of the Industrial Support Pilot Plant Area of the planned STM development as described in the 1987 SERI SDP and the 1991 NREL SDP.

2.1.2 Operations

A number of existing operational procedures and controls developed at NREL are included as part of the proposed action. These items include safe operating procedures, safety analysis reviews, internal audits, safety meetings, etc., to protect the health and safety of employees and visitors in laboratories, ensure the safe handling of toxic and hazardous materials, and address other unique, specific, and general aspects of facility operations.

NREL's work is accomplished in research laboratories and at small scales of activity. Occasionally, a small-scale pilot process piece of apparatus may be tested to demonstrate a proof-of-concept. NREL does not propose to construct or operate production-sized energy plants at the STM Site. Research activities at NREL involve the use of small amounts of gases, acids, bases, solvents, and metals. Extremely small amounts of radioisotopes are used as biological tracers. All chemicals and gases are covered by Material Safety Data Sheets (MSDS) which describe the hazards associated with use of a particular substance, as well as required safety precautions for handling, storage, and use. Any new material generated during the course of research activities will have a new MSDS developed. The MSDSs are public documents and are made available for review at NREL. Safe Operating Procedures (SOPs) are developed and used for all laboratory and equipment operations. These SOPs are required to be reviewed and updated annually, or as operating conditions change.

NREL's research activities in conservation and renewable energy technologies are diverse. In Sections 2.1.2.1 through 2.1.2.15, which extend through page 29 of this document, are brief descriptions of the program activities. Table 2.4 provides an additional reference to these activities and the facilities which support each research effort.

2.1.2.1 Biobased Materials Program

Biobased materials are broadly defined as polymeric materials derived from renewable resources by chemical or mechanical methods or renewable materials produced in biological (biogenic) processes. The objective of this work is to explore the potential to make polymers from biomass and to biologically produce polymeric materials to replace petrochemical plastics at substantial overall energy savings.

The initial focus has been to formulate a research program plan for biobased materials. Two main components have been identified: (1) biomass-derived plastics to replace, in part or totally, fossil-fuel-derived plastics; and (2) innovative processing that will lead to new materials and processing technologies.

Work in biobased materials involves primarily laboratory and high bay research activities. These activities currently take place in the Field Test Laboratory Building (FTLB) at the STM site. As site development progresses and construction activities are completed, it is expected that work in biobased materials research will be conducted in the Chemical and Biological Research Facility (CBRF). Approximately 50 percent of the work conducted in biobased materials is subcontracted to private industry, universities, and Cooperative Research and Development Agreements (CRADA) partners. Biobased materials research uses acids, bases, organics, and solvents. Some physical hazards are present because of reaction equipment that can operate at high temperatures and pressures.

2.1.2.2 Analytic Studies

The ultimate result of federal investments in renewable energy R&D programs will be industry use of the technologies developed under these programs to provide various energy forms in a competitive marketplace. Insights into the nature of current and projected energy markets can help to ensure that the technologies being developed are compatible with and competitive in these markets.

Work in analytic studies involves only office and computer activities. These activities currently take place in Building 15 of the Denver West Office Park. As site development continues, this work will move to the Research Support Building (RSB). There are no physical or chemical hazards associated with this work.

2.1.2.3 Biofuels

This is potentially the most diverse and widely available renewable energy resource. Unique among renewable energy resources, biofuels can substitute for liquid transportation fuels and pipeline-quality gaseous fuels. As such, biofuels are the only renewable alternatives to petroleum and natural gas resources. These fuels can be produced from relatively abundant plant materials and from waste products such as municipal waste. The primary use of biomass for energy today occurs in the highly integrated forest products industry.

The objective of NREL's biofuels research is to provide technology innovations and advances from which economic fuel processes can be developed from biomass and wastes. This directly supports DOE programs that focus on five fuel pathways for biofuels production to produce alcohols, biocrude-derived and plant-oil-derived gasoline and diesel, biogas, and syngas.

Work in biofuels involves primarily laboratory and high bay research activities. These activities currently take place in the FTLB and in the Biotechnology Research Facility (BTRF) on the STM Site. As site development progresses and construction activities are completed, it is expected that work in biofuels will continue to operate in the FTLB and in the Alternative Fuels User Facility (AFUF). Approximately 50 percent of the work conducted in biofuels is subcontracted to private industry, universities, and includes CRADA partnerships. Biofuels research uses acids, bases, organics, and solvents. Biohazards may be present because of microorganisms in the biomass digestion processes. In addition, some physical hazards are present because of the nature of the equipment used, such as grinding and milling equipment.

2.1.2.4 Biomass Power

The primary goal of the Biomass Power Program is to produce low-cost electricity from U.S. biomass resources. Another program goal is to develop the ability of the United States to compete in the expanding power markets of developing countries. These markets are expected to grow significantly in the next decade in a number of biomass-rich countries (e.g., Brazil).

Producing electricity from biomass is an attractive option because biomass is low in sulfur, it contributes no net carbon dioxide to the atmosphere, and the use of "energy" biomass will bring needed revenues to the depressed agricultural sector. Also, the export of biomass-to-electricity technology to developing countries can potentially reduce foreign country subsidies.

Currently, this work at NREL is conducted in the FTLB on the STM Site; administrative offices are located in Building 15 in the Denver West Office Park. NREL plans to move this work to the CBRF. A portion of this work is currently performed by subcontractors. Some environmental and safety hazards

are present because of the pyrolysis process used to break down the biomass feedstock, and from the operation of gas turbines.

2.1.2.5 Building Energy Technology

The buildings sector has made progress over the last decade in energy conservation and in introducing the use of the solar resource to reduce fossil-energy dependence, reduce energy costs, and to minimize utility needs for new peak generating capacity by the widespread use of solar building technologies.

NREL's continuing role is to conduct energy research on new and existing buildings through the integrated use of renewable energy and energy conservation. Methods developed at NREL are used to create advanced and simplified design tools for engineers and architects, identify research needs for advanced building components, and improve the state of thermal performance simulations.

Work in building energy technology involves bench scale, high bay, and outdoor research activities. These activities currently take place in the FTLB, in Building 17 in the Denver West Office Park, and in off-site leased facilities. It is anticipated these activities will continue in the Research Support Building, to be completed in the late 1990s, and the Thermal Test Facility as site development proceeds. Approximately 40 percent of the work conducted in solar buildings is subcontracted to private industry and universities. Solar buildings research involves primarily physical hazards due to use of large equipment for measuring simulated weather conditions.

2.1.2.6 Energy Research

2.1.2.6.1 Materials Sciences. Basic research in theoretical and experimental solid-state physics is leading to a better fundamental understanding of the optoelectronic properties of semiconductor materials and synthesis and characterization of novel semiconductor materials and alloys. The work in the theoretical area focuses on a fundamental understanding of novel, hitherto unprepared semiconductors as well as on their electronic, structural and thermodynamic properties. As such, this effort is aimed at complementing the empirical trial-and-error approaches to synthesis and characterization of potentially useful new materials. The work in the experimental area is concentrated on the growth and characterization of novel semiconductor alloys.

Work in the theoretical area involves the use of sophisticated computer modeling developed at NREL using internal and external computation facilities. These activities currently take place in Building 16 and are currently scheduled to move to the Solar Energy Research Facility (SERF). Approximately 20 percent of the work conducted in materials science is subcontracted to universities. Materials science research involves use of toxic gases, acids, bases, and solvents. In addition, some physical hazards are present due to the nature of the equipment used.

2.1.2.6.2 Chemical Sciences. NREL's activities are directed toward research in artificial photosynthesis, basic photoelectro-chemistry, modified semiconductor electrodes, and synthesis of novel organometallic compounds useful as catalysts for photoconversion processes. These studies have a goal of producing useful fuels and chemicals using direct sunlight-driven chemical reactions. These photoconversion processes differ from biomass conversion in that they are single-step, solar-radiation-driven processes that generally use simple starting materials and can involve a variety of artificial or man-manipulated systems.

Work in chemical sciences involves primarily bench scale research activities. These activities currently take place in the FTLB on the STM Site. Eventually, it is anticipated that this work will move to the CBRF. Approximately 40 percent of the work conducted in chemical sciences is subcontracted to private

industry and to universities. Chemical sciences research involves use of acids, bases, and solvents. In addition, some physical hazards are present due to the nature of the equipment used.

2.1.2.6.3 Energy Biosciences. One of NREL's roles is to conduct basic research aimed ultimately at developing a solar energy conversion system that uses sunlight directly to produce fuels and chemicals at high conversion efficiency and low cost. Examples of solar-driven chemical reactions under long-term investigation include water splitting, hydrogen production, reduction of carbon dioxide to hydrocarbons and carbohydrates, and fixation of nitrogen to produce ammonia. These photoconversion processes differ conceptually from biomass production and conversion in that they are single-step, solar-driven processes. They generally use simple starting materials and can involve a variety of natural or synthetic components in man-manipulated systems.

Work in energy biosciences involves primarily laboratory research activities. These activities currently take place in the FTLB on the STM Site. Eventually, it is anticipated that this work will move to the CBRF. Approximately 30 percent of the work conducted in energy biosciences is subcontracted to private industry and to universities. Energy bioscience research involves use of acids, bases, and solvents. In addition, some physical hazards are present due to the nature of the equipment used.

2.1.2.6.4 Engineering Sciences. The objective of this research is to study the combined effect of mass and heat diffusion, natural convection caused by bottom heating, and a superposed shear flow on convective and entrainment characteristics in a double-diffusive, thermohaline system, with application to energy systems.

Work in engineering sciences involves primarily bench scale research activities. These activities currently take place in the FTLB on the STM Site, and it is anticipated that this work will remain in the FTLB throughout site development. Approximately 35 percent of the work conducted in engineering sciences is subcontracted to private industry and to universities. Engineering sciences research involves use of gases, acids, bases, and solvents. In addition, some physical hazards are present due to the nature of the equipment used.

2.1.2.7 Fuels Utilization

Researchers throughout the United States are working on economic and efficient methods for producing alternative transportation fuels from the nation's abundant natural resources such as wastes and biomass. Technologies for producing these fuels have come a long way; however, if alternative fuels are to enter the competitive marketplace on a large scale, it is necessary to study not only production, but also *utilization* of these fuels in the existing transportation infrastructure.

Fuels utilization contains two components: the Alternative Fuels Data Center (AFDC) and the Alternative Fuels Research and Development Program (AFRD). The AFDC, which is a database, supports the Alternative Motor Fuels Act demonstration efforts by acting as a repository for information on alternative-fuel vehicle reliability, performance, and operating costs. The center also supplies modern data base management software and statistical software to users. The AFRD carries out research on alternative fuels. Researchers evaluate the merits of various fuels (often using AFDC data) to identify and fulfill research needs.

Subcontracted research accounts for 50 percent to 75 percent of the Fuels Utilization Program. The program operates from Building 15 in the Denver West Office Park. There are no physical or chemical hazards associated with this work.

2.1.2.8 Hydrogen Program

The Hydrogen Program focuses on the production of hydrogen through chemical processes, cost-effective hydrogen storage and utilization, and hydrogen safety analysis. The program supports the development of direct solar- or renewable-based hydrogen production methods with few or no emissions that do not include electricity as an intermediate step. These methods include direct photoconversion and biomass growth, harvesting, and conversion to hydrogen, and can result in energy pathways that are virtually emission free.

Approximately 65 percent of the work conducted in the Hydrogen Program is subcontracted to private industry and universities. Work in hydrogen production involves primarily bench-scale research activities. These activities currently take place at the FTLB and in Building 16 in the Denver West Office Park. As site development progresses and construction activities are completed, it is expected that work in hydrogen production will be conducted in the SERF. The photoelectrochemical hydrogen task uses semiconductors in aqueous solutions to split water into hydrogen and oxygen. Solutions used include dilute acids and bases. Hydrogen research involves the use of minimal amounts of acids, bases, organics, solvents, and some hazardous gases. Physical hazards are present because of the nature of equipment used.

2.1.2.9 Photovoltaic Energy

Research on photovoltaics (PV), the direct conversion of sunlight into electricity, is continuing to expand the nation's opportunity for this energy resource to supply utility-scale electricity. Research is providing basic knowledge on solid state devices, semiconductors, and other new high-technology materials and their processing. Throughout the country, electric utility demonstration plants are verifying the practical field performance of PV. On behalf of DOE, NREL is assigned significant responsibility for day-to-day management and implementation of the federal government's effort to advance the photovoltaics technology base.

Primary activities are conducted in advanced PV material technologies including amorphous thin-film silicon materials; polycrystalline thin films; and high efficiency crystalline cells. The results are used by industry to develop single junction and multi-junction PV modules.

Work in photovoltaics involves both bench scale and outdoor research activities. These activities currently take place in Building 16 of the Denver West Office Park, at the Solar Radiation Research Laboratory (SRRL), and the Field Experiment Test Area (FETA) on the STM Site, and at the recently leased Joyce Street Facility. As site development progresses and construction activities are completed, it is expected that work in PV will occur in the SERF, currently under construction, and at the Outdoor Test Facility (OTF) to be constructed late in 1993. Approximately 50 percent of the work conducted in PV is subcontracted to private industry and to universities. PV research involves use of toxic gases such as phosphine and germane and minor amounts of solvents that are used to clean the equipment. In addition, some physical hazards are present due to the nature of the equipment used.

2.1.2.10 Resource Assessment

Resource assessment contributes in three major ways to a successful national energy research and development program. First, it represents the essential initial step toward defining an overall energy security strategy for the United States. Second, resource assessment is critical to energy system design and deployment. For the renewable energy technologies, the financial impact of adequate resource assessment can be significant. Finally, resource assessment guides the development of energy technology.

Accurate assessment is an important element for assessing the potential value of any of the renewable resources, which consists of wind, ocean, hydro, geothermal, biomass, or solar radiation, or any combination of these.

Resource assessment in general has no associated hazards. This research primarily involves use of computers and generation of reports. Some data are gathered from the SRRL, but the majority of work is done in Building 16 of the Denver West Office Park. Completion of the Research Support Building will eventually result in relocation of staff to the STM Site. Approximately 40 percent of this activity is contracted to consultants and technical support organizations.

2.1.2.11 Solar Industrial Applications

The Solar Industrial Program is developing several very attractive technologies that could significantly benefit the U.S. industrial sector in the near future.

The new technologies being developed include new ways to destroy hazardous waste in water and soil. A successful field test destroyed chlorinated solvents to below EPA standards. This low-temperature process works by subjecting the water to the combined forces of sunlight and a catalyst to break down the chemical bonds of the contaminant. NREL is also developing the technology to detoxify soils with solar energy. This is a two-part process. In the first part, the hazardous compounds are removed from the soil. The second part entails exposing the extracted compounds to highly concentrated sunlight. The ultraviolet component of the solar spectrum breaks the bonds holding together the toxic compounds.

The program is also funding research in concentrated sunlight. This research, conducted at NREL's high-flux solar furnace located on the mesa top at the STM site (see Figure 1.2), has achieved concentration levels up to 50,000 suns. Researchers are refining ways to use this concentrated solar energy to produce advanced thin-film surface treatments and sinterable ceramic powders, along with processes critical to a number of technologies including hardening, cladding, materials joining, welding, fabricating, repairing, and surface cleaning. These operations should find application in a broad segment of U.S. industry.

Work on these two technologies involves both laboratory and outdoor research activities. These activities currently take place in Building 16, the FTLB, the high-flux solar furnace, and the Solar Industrial Mesa Test Area (SIMTA). As site development proceeds, some of these activities will be relocated to the SERF.

This work involves handling hazardous chemicals, high temperatures, laser light, compressed gases, and a variety of other common laboratory and industrial hazards. Although some of this research is hazardous, every precaution has been taken to ensure the safety of personnel and the environment.

The program is also actively pursuing the use of solar energy in process heat applications. Typically, industries use conventional fuels such as gas, coal, or oil to generate heat to drive their operations. The program is working directly with the solar industry to develop process heat projects for near-term systems, to design strategies for broader, mid-term market penetration, and to improve solar process heat technology. The goal is to make solar process heat commercially competitive by reducing system costs and increasing performance and reliability. By the nature of this program, very little of this effort currently takes place on site at NREL. Approximately 40 percent of the work conducted in the Solar Industrial Program is subcontracted to private industry and universities.

2.1.2.12 Solar Thermal Electric

Solar thermal electric energy systems use concentrated solar radiation to provide high-temperature thermal energy that is then converted into electricity. Solar thermal electric systems can be designed in sizes ranging from several kilowatts for distributed power applications to hundreds of megawatts for utility applications. These systems can also be integrated with thermal energy storage systems to deliver energy after daylight hours.

The principal objective of this program is to conduct research and development activities leading to the development of economically viable solar thermal power systems. NREL accomplishes this objective through innovative research aimed at increasing the performance and decreasing the cost of the technology, and through development activities carried out in collaboration with industry.

Work in solar thermal energy involves bench-scale and outdoor research activities. These activities currently take place at the FTLB, the high-flux-solar furnace (on the mesa top of the STM Site), and in Building 16 in the Denver West Office Park. As site development proceeds, these activities will eventually be conducted in the SERF, the SIMTA, and at the Large Scale Solar Furnace. Approximately 40 percent of the work conducted in solar thermal electric energy is subcontracted to private industry and universities; CRADA partners are also contributing to the research. Solar thermal energy research involves primarily physical hazards during the limited use of the high-flux solar furnace and laser measurement equipment.

2.1.2.13 Superconductivity

The Superconductivity Program is developing electric power applications of high-temperature superconductors, with the near-term goal to develop electrical conductors that can be incorporated into applications including energy storage, power transmission, and motors. Long-term applications such as energy storage will benefit the deployment of renewable, intermittent, electric-generation technologies such as photovoltaics and wind energy.

NREL has a modest subcontract program with private industry and universities. Superconductivity work currently takes place in Building 16 in the Denver West Office Park. The program will be moved into the SERF once construction is complete. Hazards associated with this research involve use of certain chemicals used in various deposition processes. In addition, some physical hazards are present because of the equipment used.

2.1.2.14 Waste Management

DOE's Waste Management Program looks for better ways to convert waste materials into useful products and advanced methods to convert waste to energy.

2.1.2.14.1 Biomass Adhesives Project. There is a growing need for wood adhesives. As high-quality timber resources are depleted, most construction materials will be made of particle boards or high-quality composite boards that employ a sizable amount of high-performance adhesives in their manufacture.

Novel routes are being explored to producing inexpensive, high-performance adhesives. The available resources under consideration are sawdust from timber-related operations, bark, and waste kraft lignins from pulping operations. These resources can be converted into phenolic compounds, which can replace petroleum-derived phenol in phenol-formaldehyde thermosetting resins.

Work in adhesives involves primarily laboratory and high bay research activities. These activities currently take place in the FTLB on the STM Site. As site development progresses and construction activities are completed, it is expected that work in adhesives research will be conducted in the CBRF. Approximately 50 percent of the work conducted in adhesives is subcontracted to private industry, universities, and CRADA partners. Adhesives research uses acids, bases, organics, and solvents. Some physical hazards are present due to use of grinding equipment as well as reaction equipment that operates at high temperature and pressure.

2.1.2.14.2 Municipal Solid Waste Program. The Municipal Solid Waste Program is helping DOE find better ways to manage the country's municipal solid waste (MSW) disposal problems. MSW is generated by the residential, commercial, industrial, and institutional sectors of our economy at increasing rates. The program's goal is to make productive use of MSW as an energy resource. Three objectives will help meet this goal: 1) ensure that a broad range of waste management options are available, 2) provide impartial and complete information, and 3) promote integrated waste management.

Work in the Waste Management Program involves primarily laboratory and high bay research activities. These activities currently take place in the FTLB on the STM Site. As site development progresses and construction activities are completed, it is expected that work in waste management will be conducted in the CBRF. Approximately 30 percent of the work conducted in waste management is subcontracted to private industry. Hazards associated with this research involve use of certain chemicals for conversion of MSW into usable substances.

2.1.2.15 Wind Energy

The objective of NREL wind energy research is to establish a technology base and to support industry in confirming the viability of wind energy as an energy source. This research supports and complements private sector efforts to develop wind systems that are safe, reliable, and cost effective. The research plan strategy being pursued has three major elements. The first is to conduct basic research in the science of wind turbine dynamics. The second element is to conduct research on advanced components, subsystems, and systems to establish the feasibility of technological advances such as high performance airfoils; variable-speed, constant frequency generators; and controls. The third element is to perform cooperative research programs in partnership with the wind industry.

Wind energy involves both bench-scale and outdoor research activities, although most of the testing takes place outdoors. These activities currently take place in Building 15 in Denver West Office Park where much of the computer modeling work is done, and at the 340-acre National Wind Technology Center (NWTC) located north of Golden on Highway 93. As this program expands in the future, activities will continue at the NWTC. Some minor modification of existing facilities at the NWTC is anticipated to accommodate research support activities. Approximately 45 percent of the work conducted in wind energy is subcontracted to private industry, state research organizations, and to universities. The majority of work associated with the wind program is physical hazard only, due to stress testing of the airfoils and climbing of the turbine towers. A minor amount of solvents are used to clean the blades and other equipment and research activities require occasional use of epoxies.

2.1.2.16 Operation and Maintenance of Facilities

NREL proposes to operate and maintain existing and proposed facilities so that they fulfill their design purpose, sustain appropriate levels of safety and security, and protect the government's real property investments. NREL proposes to accomplish these tasks with well-trained and equipped in-house staff, supplemented by contract services when deemed more efficient or effective.

NREL proposes to continue to receive facility utility services for existing and expanded facilities from the following established sources: water, Consolidated Mutual Water Company (CMWC); sewer, the Pleasant View Water and Sanitation District; electricity and natural gas, the Public Service Company of Colorado (PSCC); and electronic communications, U.S. West. Fire protection and emergency medical services would continue to be obtained by contract.

2.1.3 Distribution of Research Activities

The locations of NREL activities are shown in Table 2.4.

Table 2.4. Location of NREL Research and Development Activities

RESEARCH FACILITIES	RESEARCH & DEVELOPMENT ACTIVITIES				
	CURRENT	FY 1993	FY 1994	FY 1995	FY 1996
STM SITE FACILITIES					
FTLB	A,C,E,G,H,I, K,N,O,Q,R	A,C,E,G,H, I,K,N,O,Q,R	A,C,E,G,H, I,Q,R	A,C,G,H,I, Q,R	C
BTRF	C	C			
Solar Furnace	N,O	N	N	N	N
FETA Buildings	L	L			
SRRL	L,M	L,M	L,M	L,M	L,M
SIMTA	N	N,O	N,O	N,O	N,O
NWTC	S	S	S	S	S
AFUF-PDU			C	C	C
SERF			F,K,L,N,O,P	F,K,L,N,O,P	F,K,L,N,O,P
OTF			L	L	L
TTF				E	E
CBRF					A,D,G,H,I,Q,R
Large Scale Solar Furnace					O
ITUTF					Q,R
RSB					B,E,M P,Q
LEASED FACILITIES					
Building 15 - DWOP	B,D,J,S	B,D,J,S	B,D,J	B,D,J	J
Building 16 - DWOP	F,K,L,M,N,O,P	F,K,L,M,N,O, P	M	M	M
Building 17 - DWOP	E	E	E	E	
Joyce Street Facility	L	E,L	E,L	E	
44th Street	E	E	E		

See Table 2.4 (Cont.), next page, for explanation of acronyms and codes.

Table 2.4 Location of NREL Research and Development Activities (Concluded)

Key to Building Acronyms

AFUF: Alternative Fuels User Facility	NWTC: National Wind Technology Center
BTRF: Biotechnology Research Facility	OTEC: Open-Cycle Energy Conversion
CBRF: Chemical and Biological Research Facility	OTF: Outdoor Test Facility
DWOP: Denver West Office Park	PDU: Process Demonstration Unit
FETA: Field Experimental Test Area	SERF: Solar Energy Research Facility
FTLB: Field Test Laboratory Building	RSB: Research Support Building
ITUTF: Industrial Thermochemical User Test Facility	SIMTA: Solar Industrial Mesa Test Area
TTF: Thermal Test Facility	SRRL: Solar Radiation Research Laboratory

Key to Research Activities

(Detailed descriptions of these activities are provided in Paragraph 2.1.1 through 2.1.22 as indicated)

A. Biobased Materials Program (2.1.2.1)	K. Hydrogen Program (2.1.2.8)
B. Analytic Studies (2.1.2.2)	L. Photovoltaic Energy (2.1.2.9)
C. Biofuels (2.1.2.3)	M. Resource Assessment (2.1.2.10)
D. Biomass Power (2.1.2.4)	N. Solar Industrial Applications (2.1.2.11)
E. Building Energy Technology (2.1.2.5)	O. Solar Thermal Electric (2.1.2.12)
F. Materials Sciences (2.1.2.6.1)	P. Superconductivity (2.1.2.13)
G. Chemical Sciences (2.1.2.6.2)	Q. Biomass Adhesives Project (2.1.2.14.1)
H. Energy Biosciences (2.1.2.6.3)	R. Municipal Solid Waste Program (2.1.2.14.2)
I. Engineering Sciences (2.1.2.6.4)	S. Wind Energy (2.1.2.15)
J. Fuels Utilization (2.1.2.7)	

NOTE: Construction activities on new facilities would begin approximately one year (on average) prior to the start of research activities in that facility.

2.2 No Action

The no action alternative addresses two courses of action: continue the present course of action without substantial new proposals, i.e., no change in status quo (No Action Alternative 1); and discontinue the present course of action by phasing out operations in the near term and embarking upon decommissioning the site; i.e., no research activities at the site (No Action Alternative 2). The no action alternative (both aspects) would not consolidate operations as a means of enhancing NREL's effectiveness. It would not promote the interchange of ideas and the creativity resulting from interdisciplinary exchanges with NREL staff and would not provide closer coordination of environmental, safety, and health programs for greater efficiency of operations. It would not provide for development of government-owned facilities on government-owned property. It would not allow efficient accomplishment of NREL's congressionally mandated goal to stimulate public interest in alternative energy technology through demonstrations, tour, seminars, and public meetings. It would not provide an opportunity to reduce utility costs, building operating and maintenance costs, and costly lease payments. The government would increase costs associated with leased building improvements due to the aging of existing (and already inadequate) facilities. Building modification and restoration costs would continue to divert increasing portions of limited resources from research activities.

2.2.1 No Action Alternative 1

No Action Alternative 1 would be to continue the present course of action. Existing NREL operations (research, development, staff support, and maintenance) would continue in leased facilities, including Denver West Office Park buildings, and at the STM Site at existing levels of activity (a staff of approximately 700 people). The current environmental impacts as described in Tables 4.1 and 4.2 would continue, but there would be no change in impacts as no research expansion or construction activities would occur. Other existing and substantial new proposals would be accomplished in leased facilities, government-owned facilities at other locations, and by contract.

2.2.2 No Action Alternative 2

No Action Alternative 2 would be to discontinue the present course of action, phase out operations at the STM Site, and embark upon decommissioning the site. Current activities and new proposed activities for the STM Site would be accomplished in leased facilities, government-owned facilities at other locations, and by contract. Government-owned equipment and supplies, including flammable and hazardous materials in storage, would be relocated. Environmental impacts from operations at the STM Site would be reduced to none. There would be no additional environmental impacts due to additional research or construction activity at the site. Existing STM Site facilities could be secured as they are, or demolished and the site returned to near pre-development conditions. A more likely scenario would be the continued use of permanent STM Site facilities by other federal agencies or, should the site be returned to the State of Colorado, by state agencies (the State donated the land to the federal government specifically for a permanent home for NREL). Temporary and semi-permanent facilities would likely be removed, and the site restored to open-space conditions. Public services would likely retain easements for existing improvements, such as the CMWC's 12-inch water main to its South Table Mountain water storage tank. Demolition and removal of buildings and other improvements would be routine to clearing activities. The site would be subject to short-term facility demolition noise, dust, and debris removal traffic and land, drainage, and vegetation restoration work. There would likely be relocation socio-economic impacts on public and governmental services, housing, etc., and on NREL staff affected by the move. The land would revert back to the State of Colorado. Impacts due to such relocations would be the subject of plan-specific NEPA documents.

Operations would also be phased out in Denver West Office Park and other leased facilities. NREL would cease to exist as a center of renewable energy research, and the research activities (if continued) would be distributed to other agencies or organizations. NREL staff would follow the distribution of work as appropriate or seek opportunities with other agencies. Leased facilities would be decontaminated, restored as necessary, and released to owners. All government property would be transferred with work or declared excess for redistribution or sale.

2.3 Other Alternative Actions Considered and Eliminated From Detailed Study

All other alternative actions include the type of operations described under Paragraph 2.1.1.

2.3.1 Alternate Configuration on the STM Site

A number of alternate configurations and types of facilities have been studied and proposed for the site, with a maximum population ranging from 2,400 to 4,800 people (1,2). "The buildable" area of the site is limited by topography and further restricted by practical cost limitations. Previous options were based essentially on high-density developments. One original concept for development of the site had NREL facilities occupying a "bowl" on the steep slopes of South Table Mountain. However, the staffing supported by these previously proposed actions is not currently considered appropriate to NREL's current mission or realistic in terms of projected resources or requirements.

2.3.2 Leasing Facilities at Other Off-site Locations

This alternative would involve leasing additional facilities as the need for more space developed. This would fail to meet a number of the purposes and needs of the proposed action. It would not consolidate all NREL activities at the STM Site and draw NREL staff together for enhanced communication. It would not invest in government-owned real property improvements on government-owned land. It would not consolidate facilities and operations to efficiently stimulate public interest in solar technology. It would require duplication of existing facilities and services, and incur inefficiency due to staff commute requirements and isolation. No facilities have been identified in the Denver metropolitan region that could accommodate the proposed activity. If, however, temporary leasing of off-site facilities would be required due to program requirements and schedules, individual EAs would be developed to evaluate the appropriateness of each such action.

2.3.3 Subcontracting Research and Development Work to Outside Consultants

A substantial portion of NREL research is accomplished by contract to universities, laboratories, and other research and support activities. This course of action for all proposed activities, however, fails to meet a number of the objectives and needs of the proposed action. It would not contribute to the development of NREL as the nation's primary laboratory for the development of the renewable energy technologies necessary to advance the nation's goal of improving the environment, maintaining economic competitiveness, and achieving energy security. It would not draw NREL staff together for enhancement of communication. It would not invest in government-owned real property improvements on government-owned land. It would not consolidate facilities and operations to efficiently stimulate public interest in alternative energy technology. No potential contractors are known who have the scientific and technical knowledge and facilities to perform the work assigned and undertaken by NREL. This alternative would require not only duplication of facilities, but duplication of staff as well.

3.0 Existing Environment

3.1 Climate/Weather

The climate of the geographic region of NREL operations is classified as semi-arid, typified by sparse precipitation, low relative humidity, abundant sunshine, and large daily and seasonal temperature variations. Tables 3.1 and 3.2 present local temperature and precipitation data from the climate station located approximately 4.8 kilometers southeast of the STM Site in the adjacent city of Lakewood (7).

The temperatures are seasonably moderate; however, daily variations can be extreme. Balmy warm days can be expected in any season, while severe cold spells can occur from late fall through early spring. Temperatures in the spring range from the high teens (degrees Centigrade) to the low 20s for average daily highs and from sub zero to the low single digits for average daily lows. Freezing temperatures may continue into May. Summer is characterized by predominantly warm days with relatively low humidity (37 percent average), clear skies in the morning hours, and late afternoon showers. Though summer is generally considered to be from June through August, similar conditions may extend well into September at the STM Site. Summertime maximum temperatures are generally in the low 30s with periods when the daily high temperature will occasionally approach 40°C. The average daily lows are generally in the teens, with a slight risk of frost in early June. Autumn is a season of consistently warm days, cool nights, and continuous, abundant sunshine. The average high temperatures vary from the mid 20s in September to the low teens in November. Average low temperatures range from the mid teens to sub zero. Winter storms are generally brief, although they can bring periods of extreme cold, interrupted by warmer, sunny days. Temperatures range from the high single digits for average daily highs to -10°C to -15°C for average daily lows. Winter is the season of extreme temperature ranges. High daily temperatures in the 20s have been recorded, while low temperatures have reached -32°C. Unseasonably warm temperatures during winter months are usually attributed to frequent chinook winds.

The area experiences moderate precipitation, with average annual rainfall less than 500 millimeters. Almost half of the annual precipitation occurs from March to June. Summer showers contribute 33 percent of the annual precipitation total. Precipitation begins to decrease significantly in the fall, and reaches the minimum during winter. Winter is the driest season, contributing less than 10 percent 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 Site can generally expect to experience at least one heavy snowstorm with snowfall totals exceeding 150 to 250 millimeters.

Figure 3.1 depicts a wind rose for STM Site wind frequencies. Data was collected from monitoring stations located on the STM site and correlates well with regional information established by the National Weather Service. Average wind speed is approximately 16 kilometers per hour. Very strong gusty winds are occasionally experienced, especially in the spring and fall, and can reach in excess of 160 kilometers per hour.

The solar radiation (sunlight energy) climate 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. The percentage of monthly and annual sunshine (64-year record) is shown in Table 3.3 for Golden (STM Site) and for other cities. The Golden area is especially suitable for solar energy research as high insolation rates and seasonal changes make the site ideal for outdoor research, and test results are nationally applicable.

Table 3.1. Lakewood Temperature Summary 1962-1990

Month	Mean Monthly Maximum (degrees Centigrade)	Mean Monthly Minimum (degrees Centigrade)	Monthly Mean (degrees Centigrade)	Record Daily Maximum (degrees Centigrade)	Record Daily Minimum (degrees Centigrade)	Mean Number of Day Temperatures	
						Equal to or above 32°C	Equal to or below 0°C
January	7.2	-7.9	-0.3	22.2	-32.2	0.0	28.0
February	9.1	-6.2	1.4	24.4	-30.5	0.0	24.8
March	11.8	-3.6	4.1	28.9	-23.9	0.0	24.2
April	17.5	1.3	9.4	30.0	-18.3	0.0	13.2
May	22.8	6.2	14.5	33.3	-11.1	0.1	2.6
June	29.2	10.9	20.1	37.2	-2.8	4.4	0.0
July	32.7	14.2	23.4	38.3	2.8	9.9	0.0
August	31.5	13.4	22.5	36.7	5.0	5	0.0
September	26.8	8.8	17.5	35.5	-8.9	1	1.3
October	20.4	2.5	11.4	31.7	-13.9	0.0	8.9
November	12.6	-3.5	4.5	31.1	-20.5	0.0	22.0
December	8.8	-6.2	1.3	23.3	-31.7	0.0	27.3
Annual	19.0	2.5	10.8	38.3	-32.2	19.7	150.7

Table 3.2. Lakewood Precipitation Summary 1962-1990

RAINFALL						SNOW	
Month	Monthly Mean (millimeters)	Monthly Maximum (millimeters)	Monthly Minimum (millimeters)	Maximum 24-Hour (millimeters)	Mean Number of Days with Precipitation 2.54 millimeters	Monthly Mean (millimeters)	Monthly Maximum (millimeters)
January	11.43	34.29	0.00	26.42	1.5	431	959
February	12.95	27.69	1.02	15.75	1.8	491	1318
March	33.27	102.87	3.56	50.80	3.8	677	2,319
April	41.15	92.46	0.00	59.18	3.8	551	1,660
May	64.77	171.96	5.08	68.58	5.2	72	719
June	55.63	139.95	5.59	70.36	4.1	0.0	0
July	46.23	131.32	0.76	48.51	4.3	0.0	0
August	36.83	106.68	5.84	53.34	3.4	0.0	0
September	35.56	174.50	1.27	56.13	3.4	54	479
October	27.18	146.05	1.27	74.42	2.6	251	1,978
November	24.64	75.44	0.00	34.54	2.8	587	2,157
December	15.24	49.53	1.02	58.75	2.0	551	1,738
Annual Total	408.18	174.50	0.00	74.42	39.2	3,944	2,319

Regional Conditions

Average Wind Direction Frequencies (1990-1991)

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Table 3.3. Percentage of Sunshine

Location	J	F	M	A	M	-J	J	A	S	O	N	D	Annual
Boston, MA	47	56	57	56	59	62	64	63	61	58	48	48	57
Golden, CO	67	67	65	63	61	69	68	68	71	71	65	65	67
Miami, FL	66	72	73	73	58	62	65	67	62	62	65	65	67
North Platte, NE	63	63	64	62	64	72	78	74	72	70	62	58	68
Phoenix, AZ	76	79	83	88	93	94	84	84	89	88	84	77	85
Raleigh, NC	50	56	59	64	67	65	62	62	63	64	62	52	61
St. Louis, MO	48	49	56	59	64	68	72	68	67	65	54	44	61
San Diego, CA	68	67	68	66	60	60	67	70	70	70	76	71	68

3.2 Topography

The complexity and diversity of the region is characterized most dramatically in its physical features. Here, the eastern plains of Colorado meet the foothills of the Rocky Mountains. The grassy, gently rolling hills of the plains contrast sharply with the craggy, steep slopes, forests, and alpine meadows of the mountains. Erosional forces have sculpted deep gorges and gentle valleys in the area. Spectacular "hogback" outcroppings of tilted sandstones, shales, and conglomerates line the interface between mountain and plain. Steep mountains, sharp ridges, mesas, gentle slopes, valleys, and ravines are all found in close proximity.

The STM Site and DWOP are approximately four kilometers east of the Front Range of the Rocky Mountains. The site is situated on the top and south facing slopes of South Table Mountain, an isolated mesa that stands about 150 meters above adjacent valley areas. The mesa top of South Table Mountain slopes gently to the south. A prominent cliff rims the top, ranging from approximately 9 meters high on its south side to over 45 meters high on the north side. Elevations on the STM Site range from 1,743 meters above sea level (near the southeast corner) to 1,844 (northernmost point), a difference of 97 meters (Figure 1.4). NREL permanent facility developments are proposed for the base and lower slopes, approximately 60 meters below the mesa rim. Temporary and some permanent experimental sites are proposed for the lower slopes and on top of the mesa. All facilities would be constructed beyond the limits of rockfall zones (Figure 3.2).

3.3 Geology and Soils

The west Denver area, where NREL's owned and leased sites are located, straddles two major areas that differ in geology and landforms. Rolling high plains stretch to the east, underlain by generally flat-lying sedimentary rocks. To the west rise the peaks of the Rocky Mountains, which are cut into igneous and metamorphic rocks. A narrow, northerly trending belt of low foothills (hogbacks) and mesas marks the transition. The town of Golden is built in this transition belt. It is bounded on the west by the Front Range, and on the east by two mesas, North Table Mountain and South Table Mountain. Clear Creek, which heads in the mountains west of Golden, has its valley cut between the Table Mountains.

STM Site Plan

Limit of Rockfall

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The Table Mountains are composed of flat-lying, poorly cemented sedimentary rocks capped with Table Mountain Shoshonite basalt lava flows (part of the Denver Formation) which are quite resistant to erosion. It is the much slower erosion of these lava caprocks which protects the softer rocks underneath and has produced the mesa landforms. Below the lava caprock, the Denver Formation consists of a 131-meter sequence of stratified lenses of claystone, sandstone, and conglomerate from 0.3 to 3 meters in thickness. A 3,650 meter sequence of sedimentary rocks underlies the Denver Formation. Although none have been found on the STM Site, fossils of plants, dinosaurs, fish, turtles, and crocodiles have been found in the Denver Formation. The STM Site occupies portions of the southeast flank of South Table Mountain.

The trace of the Golden fault lies about 3.5 kilometers west of the STM Site (a fault is a plane or zone along which rocks have ruptured and moved.) This fault, a high-angle, west dipping, reverse fault, trends generally N20W and can be traced both north and south of Golden for about 32 kilometers. The fault is more accurately described as a complex fault zone that may be several hundred meters wide in some places. Movement on this fault is thought to account for about 2 kilometers of uplift on the west side of the fault in the last 60 million years. The most recent documented movement on the fault, which produced about 15 meters of displacement, appears to have taken place some 200,000 years ago. During the past decades many microseisms (very small earth movements) have been logged in the region of the town of Golden and are tentatively assigned to the Golden fault. The Golden fault is considered by the Colorado Geological Survey to be a potentially active fault.

Based on drilling done for hydrogeologic characterization, bedrock is known to range from 0 to 11 meters. The upper bedrock is highly weathered and highly fractured, and therefore expected to possess a higher permeability than lower bedrock.

The locations of various soils on the STM Site are indicated on Figure 3.3. The top of South Table Mountain is covered with Lavina Loams, a shallow, well-drained, clayey-alluvium and loess. Soil thickness averages about 12.7 centimeters, underlain by about 17.8 centimeters of clay subsoil. Beneath this layer is the volcanic caprock of the mesa. The caprock is exposed over 5-10 percent of the mesa's surface. This soil has a high shrink-swell potential and excavations necessary for construction would likely expose bedrock.

The upper side slopes of South Table Mountain consist of extremely stony clay loams of the Leyden-Primen-Standley group. These soils are limited in their suitability for development due to steep slopes, depth to bedrock, soil slippage, rockfall, shrink-swell potential, large stones, and low strength. Much of the remainder of the site, including the area designated for major development, has a deep, well-drained soil of calcareous, clayey material referred to as Denver clay loam. On the southwestern portion of the site, in the Field Experimental Test Area (FETA), are two smaller soil areas. Leyden-Primen-Standley cobbly clay loams with 9-15 percent slopes underlay the extreme southwest corner of the site, including about two-thirds of the FETA. This soil group is characterized by slope, depth to bedrock, shrink-swell potential, large stones, low strength, and low permeability. The soils are typical of the area and fall into the Soil Conservation Service (SCS) Hydrologic Soils Group C, which indicates soils with relatively low infiltration and high runoff potential.

Immediately east of this area, underlying the eastern one-third of the FETA, is a small area of Stanley-Leyden-Primen very stony clay loams with 15-30 percent slopes. While somewhat steeper than the cobbly clay loams to the west, this soil group has many of the same characteristics. These include slope, depth to bedrock, soil slippage, rock-fall, shrink-swell potential, large stones and low strength.

Existing Site Conditions

Soil Types

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Finally, on the eastern border of the site, along the ridges east of the main drainageway, is Denver cobbly loams with 5-9 percent slopes. This soil has some of the same characteristics of the other area soils (shrink swell potential, low strength, slow permeability and large stones).

The DWOP is also situated over the Denver Formation. NREL leased facilities are located on the gentle lower slopes of Green Mountain. Residual soils are well developed, and exhibit characteristics similar to those on the lower slopes of the STM Site (expansion and swell), braided silt and sand layers, and heavy clays.

For a discussion of the geologic implications on developing the STM site, see Section 4.1.3, Geology and Soils.

3.4 Hydrology

3.4.1 Ground Water

Portions of the Denver Formation, which is an aquifer, comprise the bedrock of the DWOP and the STM Site. The region is underlain by two other aquifers: the Arapahoe, estimated to lie approximately 245 meters below the mesa top, and the Laramie-Fox Hills, about 215 meters deeper.

A small amount of surface water percolates through the soil cover or the fractured caprock and emerges as seeps on the side of South Table Mountain or finds its way to the Denver Formation. Due to the formation's low vertical permeability, however, infiltration rates are low. Water is sometimes encountered in perched water tables. Ground water movement under the site is away from the top of South Table Mountain, then toward the southeast. There are several wells in the vicinity of South Table Mountain that draw water from the Denver Formation. The wells closest to the STM Site are at lower elevations in the residential areas to the southeast and southwest, across Denver West Parkway, and are used primarily for irrigation purposes.

No groundwater monitoring is required of NREL by other agencies. However, NREL has accomplished baseline ground water studies and has established a ground water quality monitoring program based on data gathered during a 1989 hydrogeologic study. A year of quarterly monitoring has confirmed that groundwater at the STM Site is uncontaminated (10).

The depth to the shallow aquifer that overlies the claystone in the DWOP area ranges from ten to twenty feet. There are no reports of shallow aquifer contamination in this area. Prior to the construction of the Office Park, the area was undeveloped and part of a large ranch. No tenants of the Office Park are engaged in manufacturing operations that raise the potential for groundwater contamination. Additionally, a groundwater survey conducted by the owner of DWOP during a refinancing investigation indicated no contamination as a result of NREL's activities (32).

3.4.2 Surface Water

The STM Site lies between Clear Creek, approximately 1,675 meters to the north, and Lena Gulch, 450 meters to the south. These easterly flowing streams merge approximately 4 kilometers northeast of the site. About 90 percent of the surface drainage off the site is in a southerly direction, toward Lena Gulch. However, a few drainageways extend into the urban area between the site and Lena Gulch.

Surface runoff rates in cubic meters per second (cums) and volumes in cubic meters (cum) were calculated using the Rational Method and are based on the drainage patterns, flow lengths, slope,

precipitation, soil types, and vegetative cover. Two storm frequencies, runoff from the 2-year and 100-year storm events, were used in the analysis. Fourteen hydrologic basins were described for the STM Site (Figure 3.4). The values used for the drainage basin characteristics are listed in Table 3.4. Additionally, Table 3.5 shows the computed runoff rates and volumes for the fourteen basins. The runoff volumes are calculated for a three-hour rainfall event. These runoff rates and volumes for the basins as a whole are generally low, as would be expected given the relatively undeveloped nature of the site. Analysis of the streams and channels on the site showed no evidence of permanent stream flows, although extended periods of low-intensity precipitation or snowmelt cause occasional temporary low flows.

Table 3.4. Drainage Basin Characteristics

SUB-BASIN	DRAINAGE AREA (Square Meters)	AVERAGE SLOPE (Percent)	FLOW LENGTH (Meters)
A	157,829	25	336
B	125,454	31	335
C ₁	48,563	05	274
C ₂	64,750	03	366
D	117,360	11	640
E	97,126	19	518
F ₁	303,518	10	1,006
F ₂	222,580	04	457
G ₁	222,580	11	640
G ₂	449,206	02	914
H ₁	97,126	14	396
H ₂	89,032	02	366
I ₁	80,938	06	762
I ₂	627,270	05	701

Drainage structures have been established on the STM Site to restrict flows off the site to meet Jefferson County requirements. Earth and concrete detention structures and drainage troughs have been constructed in the lower portions of H₂ drainages to control runoff and allow it to flow in prescribed channels through off-site residential areas. A detention inlet near the southeast corner of the STM Site and a 137-centimeter storm sewer drain collects and carries storm water to Lena Gulch.

That portion of the DWOP leased by NREL is fully developed. The owner of the park is responsible for surface drainage, and has developed the Park plans approved by Jefferson County. The DWOP drainage system consists of a number of drainage features, including detained runoff in parking lots and detention structures within Lena Gulch.

No surface water quality monitoring is required of NREL by other agencies. However, NREL is currently conducting a limited surface water quality sampling program to determine whether a formal monitoring program needs to be established (11).

Existing Site Conditions

Drainage Basins

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Table 3.5. Existing Runoff Rates and Volumes

SUB-BASIN	2-YEAR FREQUENCY		100 YEAR FREQUENCY	
	PEAK DISCHARGE (cums)	3-HOUR RUN-OFF VOLUME (Cubic Meters)	PEAK DISCHARGE (cums)	3-HOUR RUN-OFF VOLUME (Cubic Meters)
A	0.48	1,357	1.70	4,194
B	0.42	1,110	1.42	3,330
C ₁	0.08	247	0.31	863
C ₂	0.11	370	0.37	1,110
D	0.23	863	0.71	2,590
E	0.28	863	0.99	2,590
F ₁	0.71	2,590	2.69	8,264
F ₂	0.31	1,234	0.99	3,947
F ₁ + F ₂	0.85	3,824	3.11	12,212
G ₁	0.71	1,974	2.41	6,044
G ₂	0.45	2,960	1.42	9,251
G ₁ + G ₂	0.85	4,934	2.55	15,295
H ₁	0.45	863	1.56	2,590
H ₂	0.17	740	0.57	2,220
H ₁ + H ₂	0.51	1,604	1.70	4,811
I ₁	0.20	740	0.71	2,097
I ₂	1.02	3,947	3.68	12,458
I ₁ + I ₂	1.13	4,687	4.11	13,938

3.5 Air Quality/Visibility/Odor/Noise

The proposed action would be located in a non-attainment area, an area where air pollutant concentrations exceed a National Ambient Air Quality Standard (NAAQS), for carbon monoxide (CO), ozone (O₃), and PM₁₀ (particles less than or equal to 10 microns in diameter). Motor vehicles and residential woodburning are commonly considered to be the primary local sources of air pollution, although the area includes a wide variety of industries.

NREL performed air quality baseline studies prior to initial development of the STM Site and has monitored air quality as the STM Site was developed and occupied.

In 1982, NREL initiated a monitoring program to measure periodically the concentration of organic gases and particulate constituents of the outdoor air at the STM Site. Background levels of total suspended particulate were approximately 75 micrograms (µg)/cubic meter (12). A PM₁₀ monitoring program was

established in March 1992 (13). Recent PM₁₀ data indicates current construction is not creating an impact. All effects seen to date appear to be regional.

There are small quantity emissions from some NREL laboratories. Estimated quantities of such random, intermittent and widely variable emissions from research activities are presented in Table 4.1 and Table 4.2. There have been no complaints of adverse odors from nearby residents from past operations. Deviations may occur with changes in types of research activities undertaken with changes in missions, and would be evaluated on a specific project by project, case by case basis. Anticipated emissions from research and development activities are significantly less than from operations (see Table 4.1). A complete discussion of air quality issues, including potential air emissions from research activities, is presented in Section 4.1.5.

NREL currently operates with emission permits from the Colorado Department of Health for natural gas-fired boilers used for space and hot water heating. Combustion units of research activities to date are exempt from permitting requirements due to their experimental nature and small size.

No industrial noise-generating activities are located in the area. Noise levels are consistent with expected office, light commercial, and residential areas. Noise sources in these areas typically consist of traffic, air conditioning systems, music from automobiles, and vocal expression.

3.6 Flora/Fauna

3.6.1 Vegetation

3.6.1.1 Upland Vegetation

Two primary vegetation types were identified on the STM Site: grasslands and shrublands. A list of species common to these vegetation types on the STM Site is provided in Appendix C. The following is a general description of these vegetation community types.

The DWOP has been fully landscaped with irrigated lawns, flower beds, shrubs and selected ornamental and evergreen trees.

3.6.1.1.1 Grasslands. The most common plant communities on the STM Site are mixed grasslands. They comprise over 80 percent of the vegetation on the site. These communities are generally dominated by short- and mid-grass communities. The open mesa is dominated by short-grasses, primarily blue grama (*Bouteloua gracilis*), buffalo grass (*Buchloe dactyloides*), squirreltail (*Sitanion longifolium*), and red three-awn (*Aristida longiseta*). The adjoining slopes and open meadows are dominated by mixed short- and mid-grasses. Typical grasses can include western wheatgrass (*Agropyron smithii*), green needlegrass (*Stipa viridula*), and needle-and-thread grass (*Stipa comata*). Other common native grasses are quackgrass (*Agropyron repens*) and Kentucky bluegrass (*Poa pratensis*). Introduced species, such as crested wheatgrass (*Agropyron cristatum*), smooth brome (*Bromus inermis*), and Japanese brome (*Bromus japonicus*) are also common.

Many forbs, shrubs, and sub-shrubs are also common in the grassland communities. Scattered shrubs include yucca (*Yucca glauca*), rabbitbrush (*Chrysothamnus nauseosus*), and starvation cactus (*Opuntia polycantha*). The clay soils of the lower slopes also support scattered communities of four-wing saltbush (*Atriplex canescens*). A variety of forb species occur in these grassland communities. The more common species include false dandelion (*Agoseris glauca*), foothills penstemon (*Penstemon virens*), milkvetch (*Astragalus drummondii*), orange paintbrush (*Castilleja integra*), pasture sagebrush (*Artemisia frigida*), plains larkspur (*Delphinium virens*), and Richardson's geranium (*Geranium richardsonii*).

3.6.1.1.2 Shrublands. Two primary upland shrubland communities occur on the STM Site: mountain mahogany shrublands and shrubland occurring in drainages lacking active channels. Riparian shrublands are also found along drainages and are associated with spring-fed channels. The riparian shrublands associated with drainages and wetlands are discussed in Paragraph 3.6.1.2.

The mountain mahogany shrubland is found on the shallow soils of the mesa, particularly in areas of exposed volcanic caprock. These communities form dense to sparse thickets of mountain mahogany and account for more than 15 percent of the vegetation on the site. The understory grass and forb species in this community are similar to those of the adjacent short-grass communities described in the previous section.

The upland shrubland communities occurring along gullies and drainages are dominated by a number of shrubs which can form dense thickets. Common shrubs include choke cherry (*Prunus virginiana*), bitterbrush (*Purshia tridentata*), gooseberry (*Ribes inerme*), hawthorn (*Crataegus erythropoda*), smooth sumac (*Rhus glabra*), skunkbush (*Rhus trilobata*), and wild plum (*Prunus americana*). These shrubs can also be found in drainages with associated wetlands, as described below.

3.6.1.2 Wetland/Riparian Vegetation

The U.S. Fish and Wildlife Service (USFWS) has identified and mapped wetlands for the National Wetland Inventory (NWI) in the vicinity of the STM Site (14,15). Although NWI mapping does not include any wetlands on the STM Site, recent field surveys have identified limited wetland/riparian areas along drainages. Figure 3.5 indicates the location of wetland/riparian vegetation communities on the STM Site. These areas do not meet the criteria for delineation as wetlands and are therefore not regulated. These areas exhibit only some "wetland" characteristics, based on the USFWS guidelines for delineation of wetlands. (When the new guidelines for delineation of wetlands is published, these areas will be re-evaluated.)

The wetland communities identified on the STM Site are a very minor component of the total vegetation cover, accounting for less than 1 percent of the vegetation. All wetlands at the site are considered palustrine/persistent/emergent wetlands and total less than 0.75 acre. They occur in drainages and are associated with intermittent to perennial springs. The narrow, spring-fed drainages support linear, emergent wetland communities in saturated soils adjacent to the channel. The communities are dominated by spike rushes, several sedge species, and wetland grasses. Common species may include baltic rush (*Juncus balticus*), Nebraska sedge (*Carex nebraskensis*), and Canada bluegrass (*Poa compressa*). Wetland forbs include american brooklime (*Veronica americana*), hemlock (*Conium maculatum*), marsh elder (*Iva xanthifolia*), and field mint (*Mentha arvensis*).

Riparian shrub communities also occur adjacent to the emergent wetlands. These shrub communities can form dense thickets within the confines of the drainage. Although plains (*Populus sargentii*) and hybrid cottonwoods (*Populus X acuminata*) and peach-leaved willows (*Salix amygdaloides*) are present in some areas, their distribution is sparse. The most common shrubs in these areas include snowberry (*Symphoricarpos albus*), currant (*Ribes cereum*), wild plum, choke cherry, and smooth sumac. Understory vines can include poison ivy (*Toxicodendron rydbergii*), western virgin's bower (*Clematis ligusticifolia*), and Virginia creeper (*Parthenoassus inserta*). Understory grass and forb species may

Existing Site Conditions

Wetland or Riparian Areas

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include both wetland emergents and upland grassland species, depending on their position in relation to the saturated soils.

Detention ponds within the DWOP support a fringe of wetlands vegetation (constructed wetlands). Among the species present are broad-leaf and narrow-leaf cattails (*Typha angustifolia* and *Typha latifolia*).

3.6.1.3 Threatened and Endangered Plant Species

The USFWS has identified two plant species of special concern that may occur in the vicinity of the STM Site and DWOP: Ute Ladies' tresses orchid (*Spiranthes diluvialis*), a federally listed endangered species; and Bell's twinpod (*Physaria bellii*), a federal candidate species. The Ute Ladies' tresses orchid has the potential to occur in wetland/riparian communities on the site. Although habitat could support the Ute Ladies' tresses, none have been found during previous botanical surveys, and they have never been mapped on the STM Site. The known locations for Ladies' tresses in the state of Colorado are near major streams or along abandoned meanders, where ample subsurface water percolates through the stream gravels underlying lush meadows. As this is not the type of environment found on the STM Site or DWOP, Ladies' tresses are unlikely to occur here. However, in the event this plant is found, USFWS and the Colorado Native Plant Society would be notified immediately. Pursuant to new guidelines published by USFWS, a formal survey for ladies tresses will be conducted on the site in 1993. The Bell's twinpod is known only from the Niobrara limestone and shale outcrops, which do not occur at the STM Site or DWOP. Therefore, the occurrence of this species on the site is unlikely due to the lack of appropriate habitat.

3.6.2 Wildlife

Wildlife occurring on the STM Site is predominantly upland. Very little aquatic habitat occurs in the area; however, all the major wildlife groups are represented. Scientific names of wildlife species mentioned in this section are presented in Appendix D, Table D1. A summary of wildlife resources at the STM Site is provided in Table D2. Although semi-aquatic species are uncommon in the area, they may be found where suitable habitat is present.

A four-season wildlife study was conducted on the STM Site during 1986 and 1987 (3). Based on this study and opportunistic observations made since the study, a variety of wildlife species apparently use the STM Site. The most commonly observed species include the cottontail, coyote, jackrabbit, red fox, mule deer, red-tailed hawk, golden eagle, American kestrel, and small birds. Typical small birds are the horned lark, American robin, European starling, black-billed magpie, and western meadowlark.

Although wildlife species occur throughout the STM Site, most species will occupy areas away from human activities and areas that offer greater horizontal and vertical diversity. Thus, comparatively larger numbers of animals probably concentrate on the north slopes of South Table Mountain, north of the STM Site, and in the riparian areas and wetlands.

The DWOP supports a population of wildlife common to upland, developed urban landscaped and constructed wetland areas. Canadian geese, Mallard ducks, Redwing blackbirds, and cotton tail rabbits have been sighted within the Park.

3.6.1.3 Threatened and Endangered Wildlife Species

The USFWS determined that several species of special concern may occur at the STM Site (17). The bald eagle and peregrine falcon are endangered species that may occasionally occur at the site, foraging during the winter and during migration periods, respectively. The mountain plover, regal prittillary butterfly, and Preble's meadow jumping mouse, all candidate species for listing as threatened or endangered, also may occur on the STM Site. However, surveys conducted during the 1986-87 four-season study and recent informal surveys by NREL staff did not locate any individuals of these five species.

Threatened or endangered wildlife species are not likely to inhabit the irrigated landscape of the DWOP.

3.7 Historic/Archeological Resources

3.7.1 Historical Context

The historical context of the STM Site, the DWOP and surrounding areas is fully described in NREL's historical review (4). In summary, the historical context typifies that of the "America West." Between 5,000 and 3,000 B.C., nomadic hunters and gatherers eventually emerged as an agrarian culture, but dispersed by 1,000 A.D. Ute, Cheyenne, and Arapahoe Indians were the first modern inhabitants of Jefferson County, migrating from Minnesota and Saskatchewan during the mid 1700s. Spanish and French explorers and fur traders entered the region during this same time. In 1858, an estimated 200 settlers lived in that portion of Kansas Territory later to become Colorado. In that year, gold was discovered, and two years later, nearly 35,000 settlers had come to the region to search for mineral riches. Over the succeeding fifty years, mining diminished and industry shifted to railroad and building materials for Denver. Business, farming, logging, and ranching followed. A number of population clusters developed around the STM Site to provide goods and services to prospectors, sod farmers, cattle ranchers, and explorers. Each of these communities has a unique history.

Golden was initially a hub for services to miners. It is now home to the Colorado School of Mines and the Adolph Coors Brewing Company. Lakewood is currently the fourth largest city in Colorado, with a December 1987 population of 130,000. Lakewood developed as a suburban community resulting from post-World War II housing demands. Increased residential housing and commercial activity changed the community character from rural to suburban. Pleasant View developed as an unincorporated residential area. Camp George West was initially used as a National Guard rifle range in 1903, was established between 1903 and 1924 as a Colorado National Guard Training facility, and was the permanent camp site for the Colorado National Guard from 1934 until after World War II. It now supports a number of training activities for the National Guard, the Colorado Military Academy, and the Colorado State Patrol, and houses an Honor Camp for the State Department of Corrections. Some National Guard use of facilities at what is now the STM Site continued until DOE took over ownership of the site in 1982. The DWOP also occupies portions of the original Camp George West.

3.7.2 Archeological Resources

There are 35 outstanding Natural, Historic, and Scenic Landmarks in the Denver area (U.S. Geological Survey, 1976). South Table Mountain, the site of the NREL STM Site, is one of the Natural Landmarks. All others are more than a mile from the DWOP and the STM Site.

There are 200 archeological sites or finds in Jefferson County currently identified by the State Archeologist. Three isolated finds of small artifacts were identified on Section 36, T3S, R70W, the

location of the STM Site (18). These finds were considered insignificant and did not indicate prehistoric use of the site. No archaeological resources are known to exist in the fully developed (re-contoured and disturbed lands) DWOP.

3.7.3 Historical Resources

As of January 1992, 34 sites in Jefferson County were listed in the National Register of Historic Places. Eleven of these sites are in Golden and Lakewood; none are on the STM Site. NREL has prepared the nomination paperwork for an ammunition bunker, amphitheater, and bridge as part of the Camp George West historic assessment. All three features have been nominated for inclusion in the National Register of Historic Places. The Colorado Historical Society (CHS) considers "the entire Camp George West Complex as eligible for inclusion in the National Register of Historic Places" (19). NREL, along with DOE, the Department of Defense, the Department of the Interior (National Park Service), the City of Golden, and Front Range Research has been cooperating with the CHS in the nomination process. These three historic structures on the STM Site are shown in Figure 3.6. The SHPO has advised that the amphitheater and the bridge are of significance (19). The National Park Service will determine whether or not the ammunition bunker is significant. The SHPO has expressed no concerns regarding construction activities impacting any of these features. See Figure 2.1 for spacial relationships to proposed activities. Nomination of any Camp George West features within the Denver West Office Park would be actions undertaken by the owner.

3.8 Infrastructure

3.8.1 Utilities

The Consolidated Mutual Water Company (CMWC) of Lakewood, Colorado, provides water service to the STM Site and the DWOP from the Maple Grove water system. This system relies on Clear Creek for its water supply. The Clear Creek Basin water supply is dependent on annual snowpack, which is variable from year to year and can affect CMWC's ability to supply water to its customers (20). The capacity of CMWC's water treatment plant is currently 43.5 million liters per day. A CMWC 7.6-million-liter water storage tank on top of South Table Mountain, just off the western portion of the site, is supplied by a 30.5-centimeter water main across the southern edge and up the western portion of the STM Site. Distribution lines from this main provide water to STM Site facilities. A CMWC pumping station just off the southeast corner of the STM Site provides pressure to the main.

Based on figures obtained from CMWC, NREL's average monthly water consumption is 542,794 dekaliters. Based on this consumption, NREL is not considered an industrial user.

The Pleasant View Water and Sanitation District (PVWSD) provides waste water service to the STM Site and the DWOP. PVWSD maintains a 38-centimeter trunk line which connects with a Metropolitan Denver Sewage Disposal District (MDSDD) collection system and treatment facility. Eastern STM Site facilities are connected to the PVWSD 38-centimeter collector through a 30.5-centimeter polyvinyl chloride (PVC) pipe. Western facilities are connected to the collector through a 20.3-centimeter PVC pipe. DWOP facilities are collected and connected directly to the main.

Electricity and natural gas are supplied to the STM Site and the DWOP by the PSCC. Electricity to the STM Site is supplied by an overhead 13.2-kilo-volt-ampere (KVA) line that enters the STM Site from the west and runs nearly half way across the site along the southern boundary. The service line then runs underground to Building 5308. A transformer drops voltage from the supplied 13.2 KVA to 270/480

STM Site Plan

Historical Features

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volts for extension to the switch-gear facility, where power is metered and distributed. Underground secondary distribution lines carry power to other structures in the main campus complex. A second feeder line enters from Camp George West at the point approximately 91 meters east of Building 5308. This single-phase, 120/240 line provides power for lights at buildings 4317 and 5923. The line is to be replaced by a feeder from Building 5308 in the immediate future. Up to 8,000 KVA of electrical power is currently available to the site. Existing demand is less than 1,000 KVA, leaving approximately 7,000 KVA available.

Telephone and electronic communication services are supplied to NREL by U.S. West through a government-owned switch located in leased facilities in the Denver West Office Park. NREL lines serve the STM Site from the switch. Telephone cables enter the NREL property from the southeastern corner and proceed westerly below ground along the northern edge of the main access road to Building 5308. The lines continue underground to other site facilities.

NREL currently has a land-mobile very high frequency (VHF) radio network comprised of a base station, repeater, and portable radios. This network is multi-purpose in that it is used for security, maintenance of facilities, emergencies, and deployment of research teams to local area experimental sites.

3.8.2 Transportation System

A well-developed system of streets, roads, and highways provide access to the STM Site. The DWOP is accessed directly off U.S. 40 (West Colfax Avenue) and by a U.S. Interstate Highway 70 (I-70) interchange (Figure 3.7). The STM Site is located 0.2 mile north of I-70 and slightly farther from U.S. Highways 6 and 40 (U.S. 6 and U.S. 40). Denver West Marriott Boulevard provides direct access to I-70 by an interchange and to U.S. 40 by a signalized intersection. Denver West Marriott Boulevard, a short feeder road, connects with Denver West Parkway. Denver West Parkway leads directly to the STM Site and, as extended, is the main road across the southern edge of the STM Site. I-70, together with U.S. 6 and U.S. 40, carry more than half the daily vehicle trips in the immediate area. These high-speed corridors are experiencing near-capacity traffic near the STM Site. Traffic entering and existing locations in the vicinity of the site can be seriously impaired by local traffic congestion during peak rush-hour periods.

A study prepared for the Colorado Department of Transportation (CDOT) (21) indicates that the intersections of U.S. 40 and the two I-70 interchange ramps with Denver West Boulevard will be signalized as increasing traffic warrants, and that the level of service (LOS) at each of these intersections would be "C" or better in the year 2005. (LOS is a somewhat theoretical concept that measures the quantity of traffic a road handles along with the quality of transportation service it provides, such as ease of maneuvering. A LOS of A is best; F is worst and generally considered not acceptable. LOS C is the level commonly used for planning new roads and indicates stable traffic flow with some constraints on maneuverability). An NREL study completed in January 1992 (22) to evaluate traffic conditions and needed improvements determined that traffic at the I-70 ramp intersections with Denver West Marriott Boulevard is at or above existing capacity. The intersections currently operate at LOS E or F during peak traffic periods. They meet at least two of the traffic signal warrants listed in the Manual of Uniform Traffic Control Devices (MUTCD). (A warrant is specific criteria that, when met, suggests a signal light may be appropriate to improve LOS). The Denver West Marriott Boulevard intersection with Denver West Parkway operates at an adequate LOS except the northbound left-turn approach, which operates at LOS E during the morning peak hour. This intersection also meets at least two of the MUTCD traffic signal warrants.

Existing Site Conditions
Road Network in the Vicinity of the STM Site

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Bus service to the DWOP and the STM Site is provided by the Regional Transportation District on four routes.

The existing road network on the STM Site consists of a single paved access road (Denver West Parkway extended), paved service lanes to existing facilities and field test sites, and approximately 5.5 kilometers of unimproved gravel roads. The primary road (less than 7 percent grade) is a two-lane, two-way extension of Denver West Parkway that runs for approximately 1.3 kilometers along the southern boundary of the site and terminates near the western boundary. A gravel road which is a north extension of Quaker Street provides access to the top of South Table Mountain, and a gravel access lane around to the southwest of the Colorado State Highway Patrol pursuit driver-training track provides access to experimental sites on the mesa. Quaker Street is not connected to Denver West Parkway, but it is reached by a circuitous 3.5 kilometer trip from NREL facilities via U.S. 40 and Old Golden Road through business and residential sections of Pleasant View. All other roads on the site are classified as tertiary (unimproved). Some of these tertiary roads connect the base of the mesa to the top of South Table Mountain and are extremely rugged with steep grades. These roads have been blocked to prevent access by four-wheel drive enthusiasts and to control erosion problems caused by their continued use.

3.9 Services

3.9.1 Solid Waste Disposal

Current NREL activities generate approximately 2,118 cubic meters of solid wastes annually from STM Site operations and 4,565 cubic meters from leased off-site facilities. These solid wastes are disposed in landfills by contract with commercial waste handling companies.

Current recycling efforts by NREL include paper, glass, aluminum cans, batteries, toner cartridges from copy machines, and waste oil. Of the 47,955 kilograms of white paper purchased in 1991, 16,545 kilograms was recycled. This recycled paper accounts for saving 293 trees, 457,087 liters of water, 70,725 kilowatt hours of energy and 3,816 liters of oil, and 39.5 cubic meters of landfill space. In addition, NREL has implemented a formal waste minimization program. Before a new project is approved, waste minimization techniques for the project are identified in a Safe Operating Procedure. NREL also has a Waste Minimization Panel which consists of an inter-disciplinary group, formed into working subgroups. Subgroups are addressing administrative procedures (example: reduction of paper copies by use of electronic mail circulation rather than direct distribution, use of recyclable paper), hazardous and process wastes (consideration of alternate chemical processes, alternative forms of reagents), and education (newspaper articles, seminars).

3.9.2 Hazardous Waste Disposal

All activities performed by NREL conform to requirements of the Occupational Safety and Health Administration (OSHA), the Resource Conservation and Recovery Act (RCRA), and DOE/NREL regulations and guidelines for the handling, use, and disposal of hazardous substances. DOE/NREL operate with three RCRA Waste Generator identification numbers. Two of the facilities are classified as small quantity generators; the third is a conditionally exempt generator. NREL collects, packages, and disposes of hazardous waste by contract with a commercial hazardous waste disposal contractor. NREL disposes of approximately 1,307 kilograms of hazardous wastes annually from existing STM Site facilities and another 1,856 kilograms from off-site leased facilities. NREL's formal waste minimization program keeps the generation of hazardous wastes to a minimum. Types of hazardous wastes are shown in Table 3.6.

Table 3.6. Types of Hazardous Wastes

Type of Waste	Percent
Corrosive	32
Flammable	47
Oxidizers	7
Poison	3
Reactive	1
Non-regulated	10

3.9.3 Public Safety Services

Law enforcement services for the DWOP and the STM Site are provided by the Jefferson County Sheriff's Department (JCSD). The department also responds to assist other emergency-response agencies. The JCSD is the designated emergency-response authority for hazardous substance incidents, and coordinates with the County Hazardous Substance Response Team (23).

The STM Site is not located within the boundary of any established fire district; however, a contract has been negotiated with the Lakewood-Bancroft Fire Authority to handle fire and medical emergency and routine calls. The nearest fire station is located 2.6 kilometers east of the STM Site. The Lakewood-Bancroft Fire Authority also provides fire and medical emergency and routine calls to the DWOP. The nearest fire station is located approximately 2.5 road kilometers from NREL leased facilities in the DWOP.

3.10 Socioeconomics

3.10.1 Population, Income, and Services

The great majority of NREL employees' homes are located in the greater Denver metropolitan region. The six-county Denver Metropolitan Area had a 1990 census population of 1,848,319 people. The area has been experiencing steady growth from a 1980 population of 1,618,461 people. Jefferson County's 1990 population was 438,430, an increase of 17 percent over the 1980 population. Jefferson County accounts for nearly 30 percent of the population growth in the six-county metropolitan area between 1980 and 1990, making it the second fastest growing county in the metropolitan area. Population projections by Colorado's State Demographer indicate continued growth for the area. The six-county metro area is expected to increase from the 1990 population of 1,848,319 to approximately 2,093,977 in 2000. Similarly, Jefferson County is expected to grow from its 1990 population of 438,430 to 485,048 in 2000.

The number and characteristics of Jefferson County housing units estimated in the 1990 Census are presented in Table 3.7.

The number of housing units in Jefferson County totals 178,611, an increase of 20,741 housing units from the 1980 total of 157,720 (1990 Census). The Jefferson County Building Department issued 1,872 single-family building permits in Jefferson County in 1990, reversing a downward trend in building permit activity that had been evident since 1983 (Jefferson County Board of Commissioners, 1991). The

Jefferson County School District operates 83 elementary schools, 17 junior high schools, 14 high schools, and 4 district-wide schools (grades Kindergarten-12). Total enrollment in the school district in 1991 was 79,325 students. Jefferson County population projections by age indicate an increase in elementary and junior high school enrollments between 1990 and 2000. Enrollment at the high school level may decrease slightly.

Table 3.7. Jefferson County Housing

	Single Unit	Multi-Unit	Owner Occupied	Homeowner Vacancy Rate (%)	Renter Occupied	Rental Vacancy Rate (%)
Golden	2,678	2,839	2,817	2.2	2,278	10.5
Jefferson Co.	134,445	44,166	116,830	2.5	49,715	8.8

The economic base of the Denver Metropolitan Area is diverse and includes manufacturing, services, government, retail, and various other industries. Those industries that have grown the fastest since 1980 include services, transportation and public utilities, retail, finance, insurance, real estate, and manufacturing. The mining and construction industries employed fewer people in Jefferson County in 1990 than they did in 1980 (Colorado Department of Labor and Employment). Between 1990 and 2000, the projected economic growth is strongest in mining, construction, and wholesale, while agriculture employment is expected to decrease. The median household income in Jefferson County in 1990 was \$54,473.

The area supports a generally stable population and housing, schools, and health services are adequate to meet local needs.

3.10.2 Zoning and Land Use

The STM Site is located in a light commercial/industrial area of unincorporated Jefferson County, 13.5 kilometers west of downtown Denver and 6.4 kilometers east-southeast of the central business district of the City of Golden (Figure 1.2). The STM Site is predominantly bordered by open grassland zoned for recreation and light-commercial activity. Figure 3.8 outlines zoning around the STM Site, and Figure 3.9 indicates current surrounding land use. Figure 3.10 indicates surrounding activities.

A vacant parcel of Camp George West is located adjacent to and south of the central portion of the STM Site. Portions of the community of Pleasant View lie immediately to the south and west of the western portions of the STM Site. Offices, shops, and a tree nursery owned by the Colorado State Forest 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 Site. Jefferson County open space wraps around the northern and the eastern edge of the site. Portions of the Denver West Office Park, currently undeveloped but planned for commercial expansion, lie to the east. The community of Applewood is located 2.4 kilometers to the east.

NREL leased facilities are located approximately in the geographic center of the developed commercial DWOP. The DWOP is bordered on the south by commercial areas (West Colfax strip); on the west by Pleasant View residential, Camp George West and the NREL STM Site; opens space and Applewood residential on the north; and Applewood and Lakewood residential to the east.

Zoning — STM/DW Sites

G-09680-18

- Residential
- Planned Development
- Industrial
- Commercial
- Agricultural
- Open Space

Land Use — STM/DW Sites

G-09680-17

- Residential
- Commercial
- Open Space

3.10.3 Recreation

Walking, jogging, and hiking are the more common recreational activities in the vicinity of the STM Site. A trail from residential areas to Jefferson County open space crosses the extreme southeast corner of the STM Site (near the Welch Ditch). A residential area park is located approximately three blocks south of the western portions of the STM Site in Pleasant View. Numerous recreational activities are located within the Golden and greater Denver metropolitan region.

3.11 Aesthetics

The upper slopes and mesa top of South Table Mountain are mostly undeveloped open space that is visible from many points, both near and far, in the surrounding areas. The lower slopes which currently contain and are proposed to contain most of the future buildings developed on the STM Site, are less visible as the view toward the lower slopes is mostly from short ranges and the site is screened by commercial and residential developments. Views from the STM Site are of the mountains and the surrounding cities. Both the views toward and from the site were analyzed in the 1980 site-wide EA (1). NREL structures constructed between 1980 and 1988 have been visually analyzed in the subsequent EA Addendum (2).

Existing structures on the STM Site were designed to complement the landforms and vegetation of the mesa in size, color, and shape. The site has been developed with a medium-density, open park style. Facilities have been placed to minimize their visual impacts. NREL planted a line of trees along the southern border of the site to screen development from direct view of adjacent residential areas. The undeveloped steep slopes, drainageways, and setbacks enhance the open park image and style of the STM Site.

The DWOP is characterized by widely-spaced, 4-story brick office buildings, with intervening landscaped parking and landscaped open spaces. Detention ponds on Lena Gulch provide a water feature to the irrigated landscaping scheme, and fountains and artificial water courses complement the "park" appearance. NREL requirements have been met in leased facilities without distracting from the architectural plan of the DWOP.

3.12 Existing Structures

Existing structures on the STM Site are illustrated in Figure 1.4 and described in Table 2.1; the location of operational activities are described in Table 2.4. Existing structures leased (in whole or part) by NREL are shown in Figure 3.11, and are described in Table 2.4.

Existing Land Use at NREL Sites

4.0 Environmental Consequences

4.1 Proposed Action

Potential impacts of NREL's development of the STM Site were described in the 1980 EA (1) and the 1988 (2) Addendum. A FONSI was issued on the EA and supported by the Addendum. The conceptual design for the proposed construction activities is well within the parameters of the 1980 EA and Addendum, including fewer people on the site and corresponding reductions in impacts on the environment. Incremental and cumulative operational impacts on the STM Site from the proposed action are identified in Table 4.1, and include current impacts as well as projected cumulative impacts through the year 2012. Data available for current operational and research activities were used to calculate projected cumulative impacts. Individual and cumulative impacts from existing off-site operations are identified in Table 4.2. Some impacts from off-site activities would be transferred to the STM Site, as associated activities would be relocated from leased temporary facilities into permanent facilities on the STM Site. Such impacts are included in the incremental and total loadings presented in Table 4.1. Measures would be incorporated into the proposed action to minimize impacts on sensitive environmental resources recognized on the STM Site.

4.1.1 Climate

Climatic conditions have a direct impact on construction activities and a direct bearing on many of NREL's outdoor experiments. Major earthwork construction activities would need to be scheduled for low-precipitation and frost-free periods. No impact on regional or local climatic conditions are expected due to the passive nature and small scale of the proposed action at the DWOP and the STM Site.

4.1.2 Topography

The proposed action would cause no noticeable impact on the topography of the STM Site. The site is dominated by the volcanic rock capped mesa of South Table Mountain. The proposed action (Figure 2.1) would develop the lower slopes of South Table Mountain and would not change the existing terrain (i.e., no deep cuts or fills). "Stair-stepped," low-rise buildings would conform to the existing terrain, and the character of the topography would be unchanged. The proposed action would have no impact on topography within the DWOP.

Topography, however, would have a significant impact on the proposed action on the STM Site. Steep slopes, rockfall and roll-out areas, and drainage channels limit construction to the lower slopes and top of the mesa. Approximately 1/3 of a square kilometer at the mesa base provides the only suitable location for major buildings. Therefore, the topography of the site would strongly affect siting of buildings and utility services.

4.1.3 Geology and Soils

There would be no impact to geology or soils of the DWOP from the proposed action. Impacts from the proposed actions on the STM Site are discussed in the following sections.

4.1.3.1 Slope Stability

On the basis of slope, the STM site can be divided into four parts (Figure 2.4): (1) the nearly flat mesa top, which slopes to the south about 3 percent; (2) the edge of the mesa, which on the STM site is

Table 4.1. Annual Cumulative Operational Impacts on the STM Site

	AIR EMISSIONS					WATER RESOURCE		WASTE DISPOSAL		UTILITY NEEDS	
	Operations			Research & Development		Usage (hundreds lit)	Sewer (hundreds lit)	Solid (cu yds) (cum)	Hazardous (kg)	Power (kwh) .	Natural Gas (cum)
	CO (kg)	NO _x (kg)	Other (kg)	Organics (kg)	Other (kg)						
EXISTING FACILITY											
FTLB	110	549	129	11	15	125,062	94,241	1,651	1,239	32,000,000	342,635
BTRF	9	44	13	1	0	6,298	4,413	27	68	300,000	27,750
Solar Furnace	0	0	1	tr	0	0	0*	4	0	40,000	0
FETA Buildings	3	14	1	tr	0	1,358	1,025	318	0	100,000	8,495
Solar Radiation Research Lab	0	0	1	tr	0	0	0*	4	0	60,000	0
Facilities Maintenance Building	4	20	5	0	0	5,435	4,095	102	0	20,000	12,176
Bulk Storage Building	3	14	2	0	0	0	0	4	0	10,000	8,495
OTEC	2	10	2	0	0	0	0	0	0	19,000	0
Waste Handling Facility	0	0	0	0	0	0	1,025	4	0	30,000	0
SIMTA	0	0	0	tr	0	0	0*	4	0	20,000	0
EXISTING CUMULATIVE IMPACTS	131	651	154	12	15	138,153	104,799	2,118	1,307	32,599,000	399,551
PROPOSED FACILITIES in FY 1993											
PDU-AFUF	18	89	21	2	0	22,061	18,291	165	165	300,000	55,501
SERF	333	1,665	299	16	0	240,588	180,442	1,192	1,284	40,000,000	1,039,233
OTF	33	164	29	1	0	14,414	10,860	458	363	100,000	102,399
CUMULATIVE IMPACTS as of FY 1993	515	2,569	503	31	15	415,216	314,392	3,933	3,119	72,999,000	1,596,684

*Sanitary wastes are collected from portable toilet facilities by contract.

Table 4.1. Annual Cumulative Operational Impacts on the STM Site (Continued)

	AIR EMISSIONS					WATER RESOURCE		WASTE DISPOSAL		UTILITY NEEDS	
	Operations			Research & Development		Usage (hundreds lit)	Sewer (hundreds lit)	Solid (cu yds) (cum)	Hazardous (kg)	Power Kwh	Natural Gas (cum)
	CO (kg)	NO _x (kg)	Other (kg)	Organics (kg)	Other (kg)						
PROPOSED FACILITIES in FY 1994											
TTF	51	254	44	2	0	22,360	16,848	19	0	300,000	158,824
Shipping, Receiving, and Warehouse Building	47	235	41	2	0	0	0	0	0	20,000	146,285
ITUTF	40	201	35	2	0	17,651	13,301	496	90	400,000	125,387
Metrology Lab	13	64	11	1	0	5,591	4,213	19	9	200,000	39,706
CUMULATIVE IMPACTS as of FY 1994	666	3,323	634	38	15	460,818	348,754	4,467	3,218	73,559,000	2,066,886
PROPOSED FACILITIES in FY 1995											
CBRF	333	1,665	299	15	0	240,588	180,442	550	90	40,000,000	1,039,233
Large Scale Solar Furnace	0	0	1	tr	0	0	0	11	0	10,000	0
CUMULATIVE IMPACTS as of FY 1995	999	4,988	934	53	15	701,406	529,196	5,028	3,308	13,569,000	3,106,119
PROPOSED FACILITIES IN OUT-YEAR 1996 - 2012											
Phase C, RSB	100	499	163	20	0	66,694	50,020	1,789	0	20,000,000	311,770
Phase E, Laboratory Building	109	458	107	8	2	106,100	75,586	313	145	24,000,000	339,804
Phase F, Laboratory Building	333	1,665	299	16	0	240,588	180,442	550	90	40,000,000	1,039,233
TOTAL STM SITE CUMULATIVE IMPACTS	1,541	7,610	1,503	97	17	1,114,788	835,244	7,680	3,543	97,569,000	4,796,926

Table 4.1. Annual Cumulative Operational Impacts on the STM Site (Concluded)

Abbreviations Used:

kg	kilogram	FTLB	Field Test Laboratory Building	SERF	Solar Energy Research Facility
hund lit	hundreds of liters	BTRF	Biotechnology Research Facility	OTF	Outdoor Test Facility
		FETA	Field Engineering Test Area	TTF	Thermal Test Facility
kwh	kilowatt hours	OTEC	Open Cycle Thermal Energy Conversion	CBRF	Chemical and Biological Research Facility
cum	cubic meters	PDU	Process Demonstration Unit	ITUTF	Industrial Thermal User Test Facility
		AFUF	Alternative Fuels User Facility		
tr	Trace	SIMTA	Solar Industrial Mesa Test Area		

Table 4.2. Annual Impacts From Current Operations Conducted in Leased Facilities

	AIR EMISSIONS					WATER RESOURCE		WASTE DISPOSAL		UTILITY NEEDS	
	Operations			Research & Development		Usage (hundreds lit)	Sewer (hundreds lit)	Solid (cum)	Hazardous (kg)	Power kwh	Natural Gas (cum)
	CO (kg)	NO _x (kg)	Other (kg)	Organics (kg)	Other (kg)						
EXISTING OFF-SITE LEASED FACILITIES											
Denver West Building 15	21	105	37	0	0	139,390	28,406	1,560	13	1,500,000	90,614
Denver West Building 16	108	540	97	15	0	278,117	180,442	1,560	1,275	4,300,000	410,596
Denver West Building 17	21	108	38	0	0	91,678	28,716	600	13	1,500,000	141,585
Joyce Street Facility	33	164	58	0.5	0	6,208	6,208	500	328	2,000,000	339,804
National Wind Technology Center (Rocky Flats)	0	0	1	0.5	0	1,787	sss	10	227	250,000	0
44th Street	0	0	0	0	0	0	0	5	0	50,000	0
CUMULATIVE OFF-SITE IMPACTS	183	917	231	16	0	517,180	243,772	4,235	1,856	9,600,000	982,599

Abbreviations Used:

kg	kilograms
hundreds lit	hundreds of liters
cum	cubic meters
Kwh	Kilowatt hours
sss	septic tank system

approximately 1,828 meters in elevation and forms an essentially vertical rim about 6 meters high; (3) steep slopes of 20–30 percent extending approximately 46 meters below the mesa rim; and (4) gentle slopes of about 5–10 percent in the southernmost portion of the site.

On the STM Site, the proposed action would develop the lower reaches of relatively gentle slopes with no known instability. As proposed developments follow the contour of the land, cuts and fills would be minimized and potential slope stability problems avoided. Slope cut-fill sections that could not be avoided would be designed within engineering soil-strength limitations.

Top-soils would be removed and surface soils disturbed by building, parking lot, road, and trenching construction activities. These soils would be replaced for trenching and stabilized by revegetation. Other exposed soils would be covered by building footprints, pavement, or landscaping. Soils surrounding construction sites are subject to overcompaction and rutting by construction traffic and activity, as well as subject to moisture change due to modification of natural drainage.

4.1.3.2 Landslides

The poorly consolidated Denver Formation, which forms all slopes on South Table Mountain, has a history of slope failure. Several landslide deposits are mapped on the north-facing slopes of South Table Mountain. Although no major landslide deposits are mapped on the south face of South Table Mountain, where the STM Site is located, these slopes are considered to be potential landslide areas and are so mapped by the Colorado Geologic Survey. The STM site lies in an area mapped as a "Potential Landslide" area. It does not, however, lie within a "Geologic Hazard" zone as defined by the Jefferson County Planning Department.

NREL has investigated the question of landslide risk and does not consider landslides to be a significant threat. While most of the northern side of South Table Mountain in this area has been affected by landslides, and a small landslide has been located in the eastern part of the site along the mesa slope, none of these landslides shows signs of present activity. Much of the construction in the Table Mountains regions (residential and commercial) has occurred, and is occurring, within areas mapped as potential landslide areas. Any potential problems would be mitigated with careful design of foundations and site preparation that minimizes the likelihood of activating mass movement on the slopes. In addition, restriction of building activities to non-landslide prone areas would further minimize the risks.

4.1.3.3 Swelling Soils

The landslide-prone areas on South Table Mountain correspond in a general way to areas that contain swelling clays. Swelling clays are a class of clay minerals that normally contain some water and that, when thoroughly wetted, can absorb considerably more. Wet swelling clays are more prone to shear failure, and their volumetric expansion (and later contraction, as the clay loses water while drying) is very effective at damaging foundations not built to accommodate this shrink/swell characteristic. The steep upper slopes on South Table Mountain, including those on NREL's STM Site, are mapped by the Colorado Geologic Survey as having a "very high" potential to swell. Intermediate slopes are mapped as having a "high" potential to swell; lower slopes on the STM site are mapped as having "moderate" potential to swell. The region of the STM site that would contain major permanent buildings contains soils mapped in the "moderate" swelling category. Many built-up areas in Jefferson County share this designation. The problems posed by swelling clays would be mitigated by careful design of foundations and careful design and maintenance of landscaping that limits variations in soil-moisture content.

Excavations necessary for construction of the CBRF and RSB would require removal of 22,936 cubic meters of dirt. This excess soil would be removed from the STM Site by the contractor for redistribution. Construction of the AFUF would not require removal of existing soils, as the area of proposed development for this facility is already paved.

4.1.3.4 Rockfall

The nearly vertical basalt (lava rock) that rims the mesa top is highly jointed. Erosion of the softer, underlying Denver Formation, which removes support from beneath the lava rock, and repeated freezing and thawing of water in the joints serve to make joint blocks unstable. The rockfall limit has been mapped and is shown in Figure 3.2. Although some existing buildings in the western part of the STM site lie close to this mapped lower limit, all of the current proposed and under-construction STM facilities lie beyond the mapped downhill limit of rockfall. Therefore, proposed development of the STM site would not aggravate the potential for, or cause, increased rockfall from the South Table Mountain rim.

4.1.3.5 Seismic Activity

The Denver region has experienced perhaps five earthquakes larger than 2.5 Richter in the last 100 years (these are unrelated to earthquakes triggered by deep-well injection of hazardous wastes northeast of Denver in the 1960s). The epicenters closest to the STM Site, 8 to 24 kilometers away, were recorded as having Modified Mercalli intensities of III to IV and Richter intensities of 4.0 - 4.9. The largest earthquake in the Denver metro area, which occurred in 1882, registered Modified Mercalli VII and Richter 5.0-5.9. (The Modified Mercalli Intensity Scale, which estimates reactions to and damage felt by ground motion, contains 12 divisions; 1 is "not felt" and 12 is "damage nearly total." The Richter scale, which measures releases of energy, is open ended; the largest earthquake ever recorded is 9.5. Each whole number on the Richter scale represents a 33-times greater release of energy than the next lower whole number.)

Several different agencies have addressed the degree of risk from earthquakes in the vicinity of the STM Site. The degree of risk is based on the expected frequency and intensity of earthquakes. An important intensity parameter is the expected maximum ground acceleration, measured as a percent of the acceleration of the force of gravity.

The National Earthquake Hazards Reduction Program recommends building design to meet a maximum ground acceleration of 0.05 gravity (5 percent of gravity) for this region in its recommended provisions for the development of seismic regulations for new buildings, prepared in 1988 by the Building Seismic Safety Council for the Federal Emergency Planning Agency.

The 1992 Uniform Building Code recommends building design to meet a maximum ground acceleration of 0.075 gravity for this region. This places the STM Site in Seismic Zone 1. The United States is divided into five seismic zones, 0 to 4. Seismic zone 1 is a zone of low seismic risk in which earthquakes of Modified Mercalli VI and smaller may occur.

All buildings completed or under construction on the STM Site in September 1992 are designated to meet Seismic Zone 1 code requirements. Buildings constructed after 1994 would be designed to meet whatever the 1994 Building Code requires. The proposed action would not cause, or increase, the potential for seismic activity.

4.1.4 Hydrology

No impacts to ground water or surface water would be expected from continued activities in DWOP. Potential impacts on the STM site from the proposed action are discussed below.

4.1.4.1 Ground Water

No impact on ground water resources is anticipated as a result of the proposed action. The characteristics of the site, including geologic formations, impervious formation members and soils, and steep slopes tend to restrict infiltration of surface waters into the Denver Formation. Risk of spills which may contaminate ground water is minimal as outdoor research with the potential for such spills is limited. Spill catch basins and other deliberate design features associated with experiments with potential for fluid leaks would minimize the potential for ground water contamination from accidental or equipment failure spills. Strategically located monitoring wells were driven to define local baseline water quality and to increase the probability of spill detection. NREL ground water monitoring programs should identify any inadvertent ground water pollution that may develop from an activity. Sewer and waste line connections would be engineered to accommodate swelling soils. No underground storage tanks are proposed, therefore the potential for groundwater contamination from failed or leaking tanks is avoided.

Drilled holes may require de-watering prior to placement of cast-in-place caissons for structure foundations. Pollution of groundwater from these holes during construction is unlikely, as no research experiments would be active at such times.

4.1.4.2 Surface Water

No impact on surface water quality is anticipated from the proposed action. Risks of spills which may contaminate surface water is minimal as outdoor research with the potential for such spills are limited. All uncontaminated effluent from proposed research activities would be eventually discharged into the sanitary sewer system, and spill containment systems would be employed to control accidental or equipment failure spills. NREL's wastewater effluent flows into the PVWSD system, then to the Metro Wastewater Reclamation District (MWRD) treatment plant. As NREL is not considered a significant industrial user by PVWSD or MWRD, no wastewater pretreatment is required. No emissions are anticipated that would affect surface water quality. Natural drainages would be protected by setbacks from developments, and bridges or box culverts would be used to cross drainages where required. Storm water drainage systems, including detention parking lots and basins, would restrict offsite outfalls to historic or regulated rates in established drainage basins. A significant amount of work on drainage structures assures that runoff from existing developments meets applicable regulations.

NREL would apply for National Pollutant Discharge Elimination System (NPDES) permits from the Colorado Department of Health or Environmental Protection Agency, as appropriate, as may be required for storm water discharges from outside material storage and industrial sites.

Phased construction activities could disturb more than 20,235 square meters of land at a time. Storm water discharge permits would be obtained as required for proposed construction activities from the Colorado Department of Health or Environmental Protection Agency, as appropriate, under the NPDES provisions of the Water Quality Act (WQA) of 1987. Potential siltation of drainage ways would be controlled during construction by use of appropriate control measures. These temporary measures would be used until permanent project erosion control features were established.

Spill prevention measures employed during the temporary use of fuel storage tanks for refueling of construction equipment would include containment within a bermed and polyethylene-lined pit. A designated concrete washout area would also be bermed to prevent inadvertent contamination to the soils.

Proposed construction activities would not disrupt existing drainage channels, except for box culvert or bridge construction. The RSB would span the eastern-most intermittent drainage channel on the site, where the channel flattens out as it approaches the STM Site boundary. Most flow is dispersed prior to reaching the proposed area of construction. Engineering controls to be designed into the building, as well as construction of box culverts or bridges where appropriate, would significantly reduce impacts to these channels. As the drainage channels are heavily clogged with vegetation, construction of box culverts would, in fact, improve stream flow during periods of storm runoff. The Army Corps of Engineers would be contacted if it appears during design that a proposed activity would have potential impacts to wetlands or Lena Gulch tributaries (24).

4.1.5 Air Quality/Visibility/Noise/Odor

No impacts are expected from continued operations in DWOP. Impacts from the proposed actions on the STM site are described below.

Dust and windblown soil from disturbed areas and heavy equipment activity constitute the most significant air quality and visibility concerns during construction activities. Disturbed semi-arid soils are often slow to return to their original state of stability with respect to wind erosion potential; however, disturbed soils would be exposed to winds only during the construction period. NREL proposes to monitor air quality for dust (PM_{10}) during significant periods of construction on the site. Large areas of disturbed soils would be rapidly covered by building floor slabs or parking and road pavements, and other disturbed areas would be landscaped and revegetated. The impact from dust would be limited by construction fugitive dust control plans. Diesel exhaust from construction equipment would be visible and may occasionally cause mild odors at nearby residences. Back-up alarms on construction equipment would add to the general clamor associated with construction activity. The larger elements of proposed construction, however, are more distant from residential areas, and construction noise has not proven to be a regional distraction.

Once construction and landscaping are complete, the sources of air pollution would include emissions and odors from heating plant boilers, research activities, and vehicular traffic. NREL proposes to obtain permits as applicable for all heating plant boilers and operational activities. Cumulative heat input is estimated at 14,650 kilowatts. Combustion emissions would include carbon monoxide (CO), oxides of nitrogen (NO_x), non-methane hydrocarbons (NMHC), particulates, and probably sulfur oxides (SO_x). NO_x are expected to be the primary emissions of regulatory concern. The concentration of NO_x in the stacks is estimated to be about 20 parts per million (ppm), resulting in a maximum modeled instantaneous air concentration of 0.14 ppm, or 0.13 milligram per cubic meter (mg/m^3). The primary concern for NMHC is its impact on photochemical reactions that lead to formation of secondary pollutants such as ozone; however, the releases would result in an insignificant incremental contribution to area ozone levels. The boilers would be operated in compliance with necessary permit(s) and applicable state and federal air quality regulations. A cumulative total of natural gas boiler-plant combustion emissions for the full build-out of buildings is presented in Table 4.1, and represents the impact to air quality in the vicinity of the STM Site.

Experimental laboratory emissions are not required to be permitted according to state and federal air quality requirements. Experimental facility stack emissions are highly variable, and stack emissions tests generally do not produce a reliable profile of the overall emissions. An emissions analysis from existing

operations is presented at Table 4.1. Projections of the cumulative impact from total emissions for a built-out proposed action are also presented in Table 4.1. Studies in support of the project-specific Solar Energy Research Facility, under construction on the STM Site, indicated that maximum modeled instantaneous ambient air concentrations for all chemicals tested were significantly less than the Immediately Dangerous to Life and Health (IDLH) and Permissible Exposure Limits (PEL). All analyses for existing operations resulted in similar findings. Extrapolations for the built-out facility result in similar safe findings.

Any requirements for monitoring of air emissions is at the discretion of the Colorado Air Pollution Control Division, Chapter 3, Section 3.4.1, 3.4.2, 3.4.5. Monitoring requirements are part of the permit process and are determined on a case-by-case basis. General guidelines for monitoring are based on emissions quantity; type of emissions, particularly with regard to hazardous air pollutants; proximity to commercial or residential areas; and, location of the source in a non-attainment area for the pollutant of concern. The predicted emissions as shown in Table 4.1 are considerably below the general levels for which monitoring is normally required. Since the NREL projects are generally exempt from the permit process because of their minimal emissions, there should be no monitoring requirements, except on a purely voluntary basis. NREL currently monitors for air particulates from construction activities. As part of a Denver metropolitan region-wide program, NREL DWOP buildings are a test area for the Colorado Department of Health's experimentation with a new type of ozone monitoring device.

The Colorado Clean Air Act (CCAA) signed on May 27, 1992, includes a list of hazardous air pollutants (HAP) in Section 25-7-103 (13). As soon as adequate scientific, technical, and emissions information is available, the Colorado Air Quality Control Commission will promulgate regulations for the control of HAPs. NREL would monitor the progress of the HAP program to ensure compliance with any requirements.

NREL does not anticipate tripping the 10,000 lb usage threshold for any chemical on the Emergency Planning and Community Right-to-Know Act (EPCRA) Section 313 list for Toxic Chemical Release Inventory (TRI) reporting. Therefore, no TRI Form R will be required for filing with EPA.

The cumulative total vehicle round trips per day, based on a staff of 1,650 employees and 1,980 parking spaces, has been estimated as 2,000 (there are currently 100 people and 80 parking spaces on the STM Site). Total estimated emissions as a result of this traffic are presented in Table 4.3.

The State of Colorado has established maximum permissible noise levels listed in the Colorado Revised Statutes, Section 25-12-103. Noise levels emanating from a property line at a distance of 7.5 meters or more that are in excess of the levels established for time periods and zones constitutes evidence that such noise is a public nuisance. The following noise levels apply to residences adjacent to NREL: 7:00 AM to 7:00 PM, 55 decibels (dBA); 7:00 PM to the next 7:00 AM, 50 dBA. The dBA is a unit of measurement that indicates the level of sound pressure weighted for the human ear.

Sound levels diminish exponentially as distance from the source increases. The closest residence to NREL is 18 meters from the property boundary. To keep noise levels below statutory limits at the closest residence, the maximum noise produced by NREL facilities would not exceed 80 dBA during the day and 75 dBA at night. Over the distance from NREL, to the nearest residence, noise levels of 80 and 75 dBA would be attenuated to less than 55 and 50 dBA, respectively, for the indicated time periods. At these levels, noise from nearby Interstate 70 becomes the dominating source. It should be noted that wind and deflection can significantly restrict the attenuation of noise propagation, thereby further reducing the possibility of noise impacts from NREL operations.

Fermentation processes associated with biofuels research activities can be odorous. In anticipation of this, sterilizers, filters, and scrubbers have been incorporated into the design for the proposed buildings to ensure that operations comply with all air quality, safety, health, and other public nuisance regulations.

Table 4.3. Estimated Vehicle Emissions

This analysis is based on Office of Mobile Sources, U.S. Environmental Protection Agency Document AP-42, Supplement A to Compilation of Air Pollutant Emission Factors, Volume II: Mobile Sources, January 1991.		
Assumptions: 1) Traffic: 2,000 Vehicles 2) 240 work days per year 3) 3.2 kilometers/day each vehicle on site 4) Temperatures: average maximum: 19°C average minimum: 2.5°C average: 10.7°C 5) 50% cold start leaving site 50% stabilized arriving site 6) Data from High Altitude Tables 7) 90% cars, 10% light trucks 8) Average speed: 48 kilometer/hour 9) 15% lunch hour, errands, etc. vehicle usage modifier		
Pollutant:	grams/mile/vehicle	grams/year
Non-methane hydrocarbons (NMHC)	2.24 car 3.08 truck	2,225,668 340,033
Carbon Monoxide (CO)	30.70 car 40.88 truck	30,503,573 4,513,160
Nitrous Oxides (NO _x)	1.50 car 1.87 truck	1,490,403 206,448
Total		39,279 kilograms/year

It should be noted that there are other odor sources in the immediate vicinity of the proposed research buildings, including a large office park and Interstate 70, which may minimize the effectiveness of proposed mitigation measures. The Coors Brewing Company, located approximately 6 kilometers to the north-north-west, emits a strong yeast odor which can be detected when prevailing winds are to the southeast. Therefore, the ability of additional mitigation measures to reduce odor levels would be dependent upon ambient conditions.

4.1.6 Flora/Fauna

Continued NREL operations within the DWOP are within existing buildings. There would be no impact to flora or fauna from such continued activities. The following discussions address potential impacts on the STM Site.

4.1.6.1 Vegetation

There would be no impact on wetlands from proposed construction activities, and none are anticipated from proposed operations. An approximate cumulative total of 242,800 square meters of upland vegetation would be removed. Approximately 82,775 square meters of parking lots and 74,328 square meters of building areas, along with roads and fringe areas, are proposed for construction. Such activity would remove approximately 202,350 square meters of upland vegetation. An estimated 40,450 additional square meters of upland vegetation would be replaced with xeriscape landscaping.

4.1.6.2 Wildlife

Potential impacts on wildlife from the proposed development include habitat loss, habitat degradation, and the direct loss or displacement of wildlife. Construction would remove about 242,800 square meters of habitat from wildlife use. However, much of this habitat is disturbed or near existing disturbances. Thus, this loss of habitat is expected to have no perceptible impact on wildlife occurring on the STM Site.

Construction activities would cause the short-term displacement of highly mobile wildlife, such as deer, from construction areas. Some less mobile individuals could be lost. Habitat near the disturbance would be less attractive to wildlife because of the construction activity and would therefore be reduced in quality for the duration of the construction activity. However, following construction and revegetation of disturbed areas around the buildings, wildlife will reoccupy the affected habitats.

Operational activities also would not perceptively influence wildlife because the area is already developed and experiencing a variety of human activities. Wildlife using the STM Site are at least somewhat tolerant of human activity. The incremental increase in human activity would be unlikely to adversely affect local wildlife populations.

The proposed development would also be unlikely to adversely affect federally listed threatened or endangered species of wildlife. Neither the bald eagle nor the peregrine falcon occur at the STM Site with any regularity. Also, development would not affect any important habitat for either species. The proposed development would not be expected to adversely affect the three candidate species identified in Section 3.6.2 because surveys of the STM Site did not locate any of these species.

4.1.7 Historical/Archaeological Resources

Continued NREL operations in the DWOP are within existing buildings. There would be no impact to historical or archaeological resources from such continued activities. The following discussions address potential impacts on the STM Site.

Existing facilities have been, and proposed facilities on the STM Site would be, located to avoid impact on the structures of potential historical significance on the site. The CHS has reviewed the proposed STM Site Development Plan, and has indicated that development of the site would have no impact on any historical features (19). There are no known archeological resources on the STM Site. Any archaeological resources unearthed during construction, or at other times, would be reported to the SHPO. Should construction be in progress when such a find is made, construction activities that might damage the find would cease until clearance is received from the SHPO.

4.1.8 Infrastructure

Continued NREL operations within the DWOP are within existing buildings. There would be no increase in impact on utilities from the continued operations. As operations are relocated to the STM Site, the leased facilities would probably be re-occupied by other tenants with little change to demands. As on the STM Site, electricity is provided by the PSCC, water by the CMWC, and sanitary sewage services by the PVWSD.

The following discussions address potential impacts on the STM Site.

4.1.8.1 Utilities

The PSCC has notified NREL that it has the local capacity to provide power and natural gas to the proposed action (Mike Jones, Senior Engineer, personal communication). There are currently 8,000 KVA available to the STM Site. Existing demand is less than 1,000 KVA, leaving approximately 7,000 KVA for the expansion, sufficient to accommodate present and future (see Table 4.1) operations. The main natural gas line provides 303 cubic meters per hour, which is sufficient to accommodate present and future operations (see Table 4.1).

The CMWC has advised NREL that they do not anticipate any major problems regarding service to the proposed development of the STM Site. However, the CMWC supplies water to NREL from the Maple Grove water system, which relies on Clear Creek for its water supply. Clear Creek's water supply depends on annual snowpack, which is variable from year to year, and could affect the future capability of CMWC to supply water to NREL. In addition, CMWC recommends an independent review of each proposal for future expansion of facilities to determine the extent of on-site water-main extensions required to meet domestic and fire protection needs. CMWC has indicated that the addition of any major facilities beyond construction of the Solar Energy Research Facility of the current Site Development Plan may require upgrading of their downstream pump station to meet increased NREL demand.

Existing sanitary sewer system capacity may not be able to handle the projected increase in effluent. The PVWSD has indicated an intent to provide sanitary sewer service, but an engineering study would be required to determine if improvements are required. NREL proposes to work with the PVWSD and to participate in planning and implementing any necessary improvements.

4.1.8.2 Transportation Systems

The additional vehicular traffic associated with the proposed future development of the STM Site would aggravate traffic congestion at peak morning and evening hours at two access points to the STM Site. Should planned and additional improvements not be implemented, unacceptable impacts would be mitigated. The two points are the access ramp on and off I-70 to Denver West Boulevard and 4-way stop signs at the intersection of Denver West Boulevard and Denver West Parkway.

The traffic generated by the proposed action may cause two of the I-70 ramps to operate at LOS F even after the completion of currently proposed improvements by CDOT. These improvements include widening the I-70 overpass and signalizing the ramps. Actions to relieve traffic pressure could include revised interchange design and additional overpass and ramp lanes. Traffic would increase significantly through the intersection of Denver West Parkway and Denver West Drive. Satisfactory LOS at this intersection may require alternate routing to Denver West Parkway onto the STM Site and full development of a signalized, multi-turn and multi-directional intersection.

Intersection improvements would likely be required to maintain adequate LOS at other area roads as well. LOS at the Denver West Drive intersection with Denver West Parkway may deteriorate to low, if not unacceptable, levels. In addition, maneuvers at the Denver West Marriott Boulevard and U.S. 40 intersection would likely incur low LOS.

4.1.9 Services

4.1.9.1 Solid Waste Disposal

Quantities of solid waste would increase from 6,353 (from existing operations at STM Site and leased Facilities) to 7,680 cubic meters annually with a staff increase from 600 to 1,650 employees. Such quantities are well within the capability of contract disposal services.

4.1.9.2 Hazardous Waste Disposal

Quantities of hazardous waste would increase from 3,163 kilograms per year (from existing operations at STM Site and leased Facilities) to 3,543 kilograms per year with full implementation of proposed research operations (see Table 4.1 and 4.2). Such quantities are well within existing NREL staff and contract disposal services capabilities.

4.1.9.3 Public Safety Services

The demands on public safety services from the STM Site are a function of the number of people working at the site and type of activities. The number of employees is expected to increase over the next several years as a result of ongoing operations and proposed projects. The Jefferson County Sheriffs' Department has advised that it is capable of handling the increased demand. The proposed action would require an increase in NREL's internal and contract security services. The Lakewood-Bancroft Fire Authority has indicated that it can provide the increase-over-existing fire protection and emergency medical support. The Fire Authority has requested a primary and secondary access to each facility at the site (a feature that is currently incorporated in the NREL STM Site Development Plan).

4.1.10 Socioeconomics

4.1.10.1 Population, Income, and Services

No new permanent construction work forces would be brought into the area. A temporary increase in the demand for locally available construction workers would be expected as phased construction was scheduled. The steady growth of NREL's stable work population represents a positive long-term socioeconomic impact. The addition of 1,000 people to NREL's staff is within the growth projections for the surrounding municipalities, Jefferson County, and the greater Denver metropolitan region. Wages would be a positive impact on the region. Purchase of operational materials and supplies would create a growth in business over a larger segment of the state. The local housing/rental market can readily absorb the additional households. Demands on social services (schools, police, recreation, etc.) would vary with geographic distribution. Should the new households be distributed similar to existing NREL employees households, no one area or service should experience an adverse impact.

4.1.10.2 Zoning and Land Use

At a meeting with representatives from the Jefferson County Offices, the DOE presented its position that the NREL STM Site is federal land and, as such, is not subject to county zoning rules. Therefore, the proposed action requires no zoning action. NREL is aware of and sensitive to the interface between its master planned activities and its neighbors, and is attentive to nearby industrial and commercial development and land planning in Jefferson County. The proposed NREL development plan is consistent with the established NREL land use plan (Figure 2.3). The proposed action would transform approximately 344,000 square meters of existing open space to planned medium-density, campus-style developments.

4.1.10.3 Recreation

There would be a slight impact from increased use of public recreation facilities by added NREL staff. The impact would be distributed, however, as would be staff residences, and no adverse impact in any one area is expected. On-site recreation opportunities would be expected to minimize work-day traffic to off-site recreational facilities.

4.1.11 Aesthetics

The undeveloped, open space of South Table Mountain has been changing with regional development around the STM Site. South Table Mountain still dominates the skyline, however, and remains a major feature of the area. The elevation of proposed structures would not detract from the steep slopes and mesa rim of South Table Mountain. Real property improvements would be dispersed in the proposed medium-density, campus-style development so that none would be visually prominent. Multi-level, staggered structures would conform to existing topography, and the color of structures would blend with the natural hues of the slopes. Although visible from a number of the higher elevations to the south and southwest (Green Mountain, I-70 foothill grades, etc.), the existing and proposed facilities would not detract from this natural landmark.

4.1.12 Summary of Agency Concerns

Various agencies expressed concern over selected environmental impacts of the proposed action. These issues are discussed below:

Issue and Source	Consideration and Mitigation	See Discussion At
Federally listed threatened and endangered (T&E) species, wetlands and riparian habitats, Ute Ladies' tresses orchid, and candidate species; U.S. Department of the Interior, Fish and Wildlife Service (USF&WS), The Nature Conservancy, Environmental Protection Agency	Field surveys and literature searches were accomplished. No T&E or candidate species, including the Ute Ladies' tresses orchid, is known to exist on the site. Proposed activities avoid wetland and riparian habitats.	Paragraphs 3.6.1.2, 3.6.1.3, 3.6.2, 4.1.6.1 and 4.1.6.2; and Section 6.
Disposal of hazardous materials; USF&WS.	Disposed of by contract.	Paragraph 3.9.2 and Section 6.

Issue and Source	Consideration and Mitigation	See Discussion At
Permits and State coordination; USF&WS and Department of the Army, Corps of Engineers (COE), EPA.	NREL will obtain required permits and has accomplished coordination with the State of Colorado.	Paragraphs 3.9.2 and 4.1.5, and Section 6.
Subsurface archeological resources and historical sites, Colorado Historical Society (CHS), Jefferson County (JEFFCO).	NREL has submitted material for the nomination of three features for the National Register of Historic Places. NREL will report and protect any unknown archeological resources that may be discovered on the Site.	Paragraphs 3.7.2, 3.7.3, 4.1.7 and Section 6.
Traffic congestion, Colorado Department of Transportation (CDOT), JEFFCO.	NREL proposes to work with appropriate agencies to relieve traffic congestion through highway and street improvements as well as take internal actions to relieve congestion.	Paragraphs 3.8.2, 4.1.8.2, Section 6, and paragraph 7.6.
Emergency services, JEFFCO, Jefferson County Sheriff's Department (JCSD), The Consolidated Mutual Water Company (CMWC).	Emergency service agencies have advised NREL that they can accommodate the proposed action.	Paragraphs 3.9.3, 4.1.9.3, Section 6, and paragraph 7.5.
Visual impacts, JEFFCO, Jefferson County Colorado Open Space (JCCOS).	Suggestions were incorporated into the proposed action.	Paragraphs 3.5, 3.11, 4.1.5, 4.1.11, and Section 6.
Trail access, JEFFCO	NREL proposes to work with agencies to maintain access from residential areas to open space.	Paragraphs 3.10.3, 4.1.10.3, and Section 6.
On-site eating and recreational facilities, JEFFCO.	On-site eating facilities are proposed as part of the Research Support Facility. As no need has been identified, NREL proposes no on-site recreational facilities other than walking/jogging incidental to proposed roads, lanes and adjacent facilities.	Paragraph 2.1.2 and Section 6.
Geologic hazards, JEFFCO	NREL facilities would be located outside rock-fall and roll-out zones, and would be designed for swelling soils as may be encountered.	Paragraphs 2.1.2, 3.3, 4.1.3-.1, 4.1.3.2, 4.1.3.3, 4.1.3.4, Section 6, and paragraph 7.1.
Storm water, JEFFCO	Storm water drainage systems, including detention parking lots and basins, would restrict off site discharges to historic or regulated rates in established drainage basins, in voluntary compliance with JEFFCO Storm Drainage Design and Technical Criteria.	Paragraphs 3.1, 3.4.2, 4.1.4-.2, Section 6, paragraph 7.2 and Appendix C.
Enhancement of the Denver West business area, JEFFCO	NREL proposes that the economic benefits and the proposed compatible developments will be a significant enhancement to the Denver West business area.	Paragraphs 2.1, 3.11, 4.1.1-0.1, 4.1.11, and Section 6.

Issue and Source	Consideration and Mitigation	See Discussion At
Zoning regulations, JEFFCO.	Coordination between DOE and JEFFCO concludes that the Federal NREL STM Site is not subject to JEFFCO zoning regulation, and that no zoning action is required to implement the proposed action. However, NREL is sensitive to JEFFCO zoning activity adjacent to the NREL STM Site.	See paragraphs 2.1, 3.10.2, 4.1.10.2, and Section 6.
Domestic water requirements, backflow protection, and water supply, CMWC.	NREL proposes to provide adequate backflow protection to CMWC taps, and to acquire adequate taps and lines to provide domestic service to the proposed action. NREL recognizes that sufficient shares have been procured to provide adequate water supply, but that the entire system is dependent upon regional precipitation, drought, etc.	Paragraph 2.1.2, 3.8.1, and 4.1.8.1, and Section 6.
Sanitary sewer requirements, Pleasant View Water and Sanitation District (PV-W&SD).	NREL would participate in a study to determine system improvements if DOE determines it to be an appropriate and necessary expenditure of funds.	Paragraphs 2.1.2, 3.8.3, 4.1.8.1, and Section 6.
Clean Air Act in non-attainment area, EPA.	NREL proposes to acquire all required permits and to be in compliance with current air quality regulations.	Paragraphs 3.5, 4.1.5, Section 6 and Appendix C.

4.2 No Action

Under the no action alternatives, no additional impacts on the environment would occur from additional development of facilities or expanded operations at the STM Site. Individual EAs or reviews would be accomplished for changes in research activities within the existing level of operations that may be required to meet changes in research programs, or for decommissioning of the STM Site.

4.3 Other Alternative Actions Considered and Eliminated from Detailed Study

4.3.1 Alternate Configuration on the STM Site

EAs of alternate configurations of facilities and developments are fully described in the previous EA (1) and the Addendum (2). In summary, environmental impacts of previous proposals are similar to those of the proposed action, differing, however, in that the higher populations and activity densities incur corresponding increases in the magnitude of such impacts. Options that developed steep hillsides or the mesa top incurred additional impacts. The hill-side option was dropped from consideration due to its impact on aesthetics, construction on potentially unstable soils and geologic formations, costs, and inability to be efficiently adapted to phased construction. Top-of-mesa developments were dismissed due to the costs of infrastructure development and severe impact on the aesthetics of South Table Mountain. Specific alternatives previously considered and selected for their minimum impact on the environment, such as the Quaker Street extension (north) alternative to a top-of-mesa access road (in-lieu-of improvement of an existing 4-wheel-drive road up the center of the STM Site) have been incorporated into the proposed action.

4.3.2 Leasing Facilities at Other Off-site Locations

Individual NEPA documents would be developed for the phased acquisition of leased facilities at off-site locations, based on the proposed activity and the facility options available at the time. Individual NEPA documents would be developed for the interim, temporary leasing of off-site facilities in the event program requirements and schedules demanded, or if conditions were more appropriate for, off-site work.

4.3.3 Subcontracting Research and Development Work to Outside Consultants

A substantial portion of NREL research is accomplished by contract to universities, laboratories, and other research and support activities. NREL would complete NEPA evaluations for each activity proposed for subcontract, as appropriate.

5.0 Assessment of the Risk of Accidents

5.1 Construction

Construction activities associated with the proposed action are common to most light-industrial and commercial facilities. Construction workers would not be more prone to accidents on this project than on any other local construction-related activity. Primary access to the STM Site is via Denver West Boulevard and Denver West Parkway from I-70 (see Figure 3.8). Neither the site nor the access road is directly accessible by vehicle traffic from a residential area south of the STM Site. A cyclone fence provides a barrier between the STM Site and adjacent residential areas, and a boundary fence posted with "government no trespassing" signs surrounds the site. NREL and DOE took measures to eliminate access through a gate in the cyclone fence to further minimize risks to the local residents. After several occurrences of vandalism to the gate, however, access was again permitted to the road area adjacent to the bus stop. Due to use of signage, minimal risk to pedestrians is expected.

All construction activities would be performed in accordance with OSHA regulations. Although construction activities would not be expected to generate hazardous waste, any hazardous waste issues that may arise unexpectedly would be handled in accordance with RCRA, Colorado Department of Health regulations, and all applicable federal, state, and local guidelines, including those specified by NREL and DOE.

Risk of environmental accidents from construction activities is considered to be low. Risk of contamination to groundwater and surface water runoff would be minimized by use and enforcement of Waste Management and Pollution Prevention Plan, Storm Water Pollution Prevention Plan, Spill Management Plan, Erosion Control Plan, and Fugitive Dust Control Permit, all of which must be in place prior to commencement of construction activities. Risk of spills from temporary use of fuel storage tanks for refueling of construction equipment would be minimized by containment within a bermed and polyethylene-lined pit. A designate concrete washout area would also be bermed to prevent inadvertent contamination to the soils.

5.2 Operation

Occupational risk for laboratory personnel would be greater than the risk for administrative personnel due to the type of work and types and quantities of chemicals in use. NREL is required to comply with OSHA and DOE occupational safety and health requirements and complies with other regulations and guidelines (e.g., National Institute of Health). Safety Analysis Reviews (SARs) and Safe Operating Procedures (SOPs) have been developed for existing operations and would be developed for future operations and activities. They assess risks of operations and formalize administrative and technical controls to minimize risks. SOPs are developed for laboratory activities and similar levels of activity. SARs are developed for larger scale activities and facility-level operations. NREL requires the use of material safety data sheets (MSDS) for all chemicals and gases, which describe hazards and safety precautions of use. In addition, all personnel who work in the laboratories are required to take training courses on an annual basis which describe safe procedures for operation. Overall operational risks are expected to be minimal.

Prior to construction of new facilities, modeling studies would be performed to assess the impacts to the general public should an accidental release of a particular substance occur. Recent studies of this type have documented that the risk of exposure to hazardous or toxic substances is extremely low (5,33). Specific discussions related to safety issues are provided in the following sections.

5.2.1 Security

Security measures at NREL are primarily related to protection of government property and sensitive unclassified information. Security measures are also implemented to protect the safety of employees, visitors, and the general public. NREL does not possess or use Special Nuclear Materials or classified matter in its research, and none of NREL's programs or facilities are considered vital to national security. Continued development of the STM Site and continued operations in DWOP as discussed in this document would not result in a change in these existing security measures. Use of identification badges by employees and visitors and exterior building walls and doors designed as physical security barriers to prevent unauthorized access further protect the general public from accident risk due to NREL's operations.

5.2.2 Safety

In a research and office complex such as that which exists at NREL, possible causes of credible operational accidents fall into three major categories: human error, equipment failure, or natural phenomena. Accidents resulting from human error generally involve misuse, mishandling, or misapplication of equipment or material. Equipment failure can occur due to design imperfections, construction flaws, aging, or improper repairs. Natural phenomena such as wind, earthquakes, floods, or lightning can cause accidents through direct or indirect damage to equipment or structures.

Accidents resulting in material damage or personal injury may result from any of the four general types of hazards: chemical spills, structural failures, explosions, or fire. Injury or illness may result from exposure to chemical, physical, or biological hazards. An emergency plan for each facility where a potential hazard exists is required by DOE Order 5481.1A and these emergency plans are in place for all existing NREL facilities, as required. Any new buildings constructed as a part of this action would be assessed for applicability of this Order and a new emergency plan developed for each facility, as appropriate.

5.2.2.1 Chemical Spills

The potential for chemical spills would primarily exist in areas used for handling and storage of chemicals used in the laboratories and the field test programs. Small quantities of chemicals would be present in the laboratories and test areas. Each task conducted in these areas would adhere to the SOPs, designed to minimize risks. NREL has prepared ES&H procedures that establish standards for the safe handling and disposal of chemicals.

Stock chemicals that are held on-site would be stored in specially designed chemical storage areas that incorporate safety equipment commensurate with the materials and potential risks. These measures are intended to protect NREL personnel, the general public, and the environment. Hazardous chemicals are, and would continue to be, disposed of in accordance with EPA regulations.

5.2.2.2 Structural Failures

Structural failure problems would primarily be associated with field test equipment exposed to high winds. Occasional periods of very high winds can be expected in the vicinity of NREL. Placing test equipment on the toe of the slope of the mesa would alleviate some of the wind hazard because of the natural shelter provided by the mesa. Earthquakes would not be a major hazard for the structural integrity of buildings or test equipment because of low seismic risks in the region. All structures would continue to be designed in compliance with the Uniform Building Code, Seismic Zone 1.

5.2.2.3 Explosions

Appropriate precautions to minimize explosion hazards have been employed in building construction and operating procedures in the past and would be utilized for the proposed activities as well. The construction measures would include use of explosion release panels where appropriate to minimize damage to facilities in the unlikely event of an explosion. Procedures for proper storage of explosive and flammable materials would continue to be strictly enforced.

5.2.2.4 Fire

Hydraulic or pressurized sprinkler systems are currently utilized at the FTLB, Facilities Building, Bulk Storage Building, and the BTRF on the STM Site, Building 16 in the DWOP, and at the NWTC. Sprinkler systems were designed and installed in accordance with the requirements outlined in National Fire Protection Association (NFPA) Standards with wet pipe units and anti-freeze legs where necessary. Automatic fire suppression systems (Halon 1301) are installed in high-valued areas. The Waste Handling Facility on the STM Site has a dry-chemical fire suppression system.

A fire alarm system is incorporated in the overall fire protection plan. This alarm sounds local alarms and notifies local fire departments. The system makes use of ionizing, photo sensing, and heat sensing units. Areas not protected by the automatic sprinkler systems, including the computer center, are protected by a suitable automatic fire suppression system designed for the particular hazard or piece of equipment.

NREL obtains fire protection through an agreement with the Lakewood-Bancroft Fire Authority. Fire Station #5, located at 20th and Eldridge in Lakewood, responds to all fire alarms. Back-up service from other local stations is available. Station #5 has a response time to the STM Site of 1 to 1.5 minutes.

All DOE/NREL owned facilities, both those currently in use and those proposed as a part of this action, meet the highly protected risk (HPR) standard, and leased facilities meet HPR where necessary.

5.3 Restoration of Leased Facilities

NREL leased facilities in the DWOP would be restored to degrees of original tenant finish as may be required by the leases upon termination of activities. Such terminations might be the result of a reduction in effort, redirection to work by subcontract, or relocation of activities to the STM Site. Risks associated with restoration efforts would be analyzed on an individual basis for each action.

No specific plan for restoration exists for facilities on the STM Site as they are intended to be permanent NREL facilities.

6.0 Agency Comments

Letters of notification were sent to agencies believed to have an interest in the proposed action. The general notification letter, a mailing list, and copies of agency letters received are included in Appendix F. Comments received are summarized and NREL's responses to concerns are as follows.

- **U.S. Department of the Interior, Fish and Wildlife Service (USFWS)**

The USFWS (17) has provided a list of federally listed endangered and threatened species for the area. The agency recommends that any adverse impacts to wetlands within the project influence be avoided. They stress the importance of determining the presence of wetland and riparian habitats and the possibility of the Ute Ladies' tresses orchid occurring at or near the project site. They express their interest in the protection of candidate (for official listing) species. They indicate that the proper disposal of hazardous materials and the securing of the proper state and federal permits associated with a facility of this type are of environmental concern to them. They recommend contact with the Colorado Division of Wildlife prior to commencement of any of the activities associated with the project regarding possible impacts to native fauna and flora. They advise of the availability of two National Wetlands Inventory (NWI) maps appropriate to the area, and offer further assistance.

No threatened or endangered (or potentially listed) species habitat would be affected by the proposed action, and no known endangered (or potentially listed) species are known to inhabit the area. The potential for any impact on threatened or endangered (or potentially listed) species is thus considered very low. No wetlands or riparian habitats are in the vicinity of, and none within the influence of, the proposed action. NWI maps have been reviewed. No NWI wetlands are located on the STM Site or would be influenced by the proposed action. An on-site survey found other wetlands on the STM Site. The proposed action does not infringe upon these wetlands, and NREL proposes due diligence and care to ensure that these wetlands would not be influenced by the project. Crossings (bridges or box culverts) over some drainages may be proposed as detailed design is accomplished. NREL has established procedures for the disposal of hazardous wastes and would expand these activities to accommodate the proposed action. NREL would secure all applicable state and federal permits associated with the proposed action. The Colorado Division of Wildlife was contacted for comment on the proposed action, and their reply is discussed in this section.

- **U.S. Department of Agriculture, Soil Conservation Service (SCS)**

The SCS (25) has no concerns about soils related to the proposed project.

Response acknowledged.

- **Department of the Army (DA), Corps of Engineers (COE)**

The COE (24) advises that elements of the proposed project that would impact wetlands or drainages would require DA permits as applicable, and advises that other federal, state, and local permits may be required.

NREL acknowledges the COE's review, determination, and consultation. Permits would be obtained as required.

- **The Nature Conservancy**

The Nature Conservancy (26) advises that their data base has no record of rare and endangered species within the area of the proposed project; however, this should not be construed as complete and should not be substituted for field surveys by a qualified biologist during the growing season.

NREL acknowledges The Nature Conservancy review and response, and has determined by survey that no rare or endangered species are within the area of the proposed action. Habitat and observation on the STM Site might support the presence of some underground species and NREL will continue to be observant for them.

- **Colorado Historical Society (CHS)**

The CHS (19) has determined that the proposed action as described would have no effect on historic properties. It advises that, in the event subsurface archeological resources are encountered during ground-disturbing activities, it would be necessary to halt the work until such resources could be evaluated in consultation with its office.

NREL will comply with the proposed development plan as presented and will take due care to avoid the historic features that may be eligible for nomination to the National Register of Historic Place.

- **Colorado Department of Transportation (CDOT)**

CDOT (27) advises that the I-70/Denver West Marriott Boulevard interchange LOS would degenerate due to traffic associated with the Solar Energy Research Facility (a NREL facility currently under construction on the STM Site), and would be compounded by additional traffic associated with other proposed developments. They identify a need to address alternatives to relieve traffic pressure.

NREL recognizes existing and developing traffic congestion and anticipated LOS degradation at the interchange and on nearby local street networks. NREL proposes to continually pursue mitigating actions (Paragraph 7.1) and to work closely with neighboring interests, and local, town and city, county, state, and federal agencies in support of resolution of the long-range (cumulative growth of the region), as well as immediate, traffic congestion at the entrance to the STM Site.

- **Jefferson County**

A coordinated response from Jefferson County (28) addresses a number of issues: (1) traffic impact at Denver West Parkway, the Denver West I-70 interchange and other area roadways. The County recommends a traffic study so that needed improvements can be determined, and that access to Quaker Street be for emergency access only; (2) provision of emergency services; (3) attention to compatibility/visual impacts due to the location of proposed developments. Facilities should work with the topography and blend in with the South Table Mountain backdrop (materials, colors), softened by staggered building facade and heights, screening of outside storage and rooftop mechanical equipment, low intensity and downcast lighting to prevent off-site glow, softening of parking lot mass by breaking up huge expanses and landscaping, and maintaining a buffer between NREL and adjoining neighbor hoods; (4) consideration to trail access across the STM Site between potential public open space and adjoining residential neighbor houses to the south; (5) preservation and public access to the historic amphitheater; (6) ancillary services such as eating and athletic facilities; (7) geologic hazards of the site; (8) storm water destruction; and (9) non-compliance with county zoning regulations.

(1) NREL concurs that traffic impacts could be significant at the Denver West Parkway, the I-70 interchange at Denver West, and other area roads. NREL has provided a copy of its recent traffic study (6) to the County for its use. Access to Quaker Street would be for emergency use and NREL staff only. Staff traffic on Quaker Street is expected to remain constant due to resident demographics, local roadway networks, and the reduction in staff traffic through Pleasant View to the mesa top facilities. (2) Emergency fire and medical services have been coordinated with the Lakewood-Bancroft Fire Authority. (3) NREL believes all of the County's compatibility/visual impacts suggest site planning techniques, which have been employed in the proposed action. (4) NREL would consider trail access in so far as security, safety, and DOE policy permits. (5) The historic sites have been inventoried and are preserved (avoided) by the proposed action. Consideration has been given to providing public access to them, but has been restricted to scientific/historic purposes due to the advanced deterioration of the structures, safety (potential for rattlesnakes and structures in disrepair) and security issues. (6) NREL proposes to provide on-site eating and athletic facilities. (7) Geologic hazards have been identified and their threat minimized by proposed facility siting and design. (8) Storm water would be controlled to limit off-site discharges to historic or regulated flows by use of detention structures (parking lots and basins located along the north side of Denver West Parkway). (9) NREL proposes to maintain its high level of coordination with the affected public, to enhance the Denver West business area, and to respect surrounding residential neighboring houses with its proposed actions. (10) DOE has met with the Jefferson County Attorney's Office to provide additional information regarding zoning issues.

- **Jefferson County Colorado Open Space (JCCOS)**

JCCOS advises (29) that the proposed developments do not impact on their master plan, and that any upslope developments will need to be considered in light of potential visual and preservation impacts.

NREL would evaluate the visual, environmental, and preservation impacts of any mesa-top developments prior to selecting a preferred course of action.

- **Jefferson County Sheriff's Department (JCSD)**

The JCSD (23) advises that they are capable of responding to potential emergency situations regarding law enforcement needs, assistance to other emergency response agencies, and hazardous substance incidents.

NREL acknowledges JCSD comments and support.

- **City of Lakewood**

The City of Lakewood (30) had no concerns with the plan at the time of review.

Response acknowledged.

- **The Consolidated Mutual Water Company (CMWC)**

The CMWC (20) does not anticipate any major problems regarding service to the STM Site and anticipates that water service may be provided at a satisfactory level. They submitted three concerns.

(1) Fire protection requirements for the proposed action should be established by the appropriate fire protection district, expanded facility requirements should be compared to existing requirements, and modifications to existing water service facilities should be accomplished as may be required (at NREL

expense). (2) They need to review the domestic water requirements for the proposed action. (3) Need to carefully consider backflow requirements to protect the CMWC's water system from any potential contamination and upgrade the system as may be required. CMWC also qualifies their ability to supply a satisfactory amount of water due to a number of conditions (i.e., level of snow-pack).

NREL would submit programmatic master plans for the proposed action and concept and detailed plans and designs for each element of the proposed action to the Lakewood-Bancroft Fire Authority for review and comment to help ensure provision of adequate and appropriate protection. Fire water demands would be reviewed with CMWC to determine the adequacy of existing systems, and modification thereto accomplished as required. The domestic water requirement for the proposed action would be determined and existing systems reviewed with CMWC to determine adequacy. Deficiencies would be corrected. NREL recognizes CMWC's qualification of water supply (quantity) based on natural precipitation.

- **Pleasant View Water and Sanitation District**

Pleasant View Water and Sanitation District advises (31) of the need for an impact study on the sanitary sewer facilities.

NREL is not considered to be an industrial water user and NREL's waste streams are primarily sanitary in nature. Although NREL's STM site is located outside of the Denver metropolitan area and is therefore not subject to requirements to minimize water usage, it has always been NREL's policy as a responsible front-range water user to practice resource conservation efforts. All building and equipment systems located on the STM site use recirculating cooling systems; once-through water usage is not permitted. The SERF, AFUF, CBRF, ITUTF and RSB have been or would be designed with use of recycled water for cooling. In addition, resource conservation is included in the Waste Management and Minimization training required of all laboratory staff to further emphasize our commitment to minimize water use. Should the Pleasant View District commission a capacity study, NREL would fully cooperate through provision of information and/or technical assistance where appropriate.

Agencies contacted that did not respond promptly were subsequently contacted by telephone. No response letter was received from the following agencies. Verbal comments, if any, are noted.

- **Environmental Protection Agency (EPA)**

The EPA advises that the EA should acknowledge and respond to the fact that the proposed activity would conform to the Clean Air Act in a non-attainment area and that it would not impact on wetlands (telephone, Robert DeSpain, Chief, EPA Region VIII Environmental Assessment Branch, 293-1603).

NREL has acknowledged location of the proposed action as being within a non-attainment area and has identified anticipated air quality impacts and mitigation within the EA. The EA further demonstrates that there would be no impact on wetlands.

- **Colorado Division of Wildlife**

The opinion of the Colorado Division of Wildlife is that there would be no significant impact on wildlife from the proposed action (telephone, David Weber, Regional Wildlife Biologist, Colorado Division of Wildlife, 291-7231).

Response acknowledged.

- **Golden Planning Department**

The Golden Planning Department has no concerns regarding the proposed facilities at the STM Site (telephone, Chuck Hern, Golden Planning Department, 279-3331).

Response acknowledged.

7.0 Minimization Of Unavoidable Impacts

Minimization actions are proposed for the following unavoidable residual impacts on the environment as a result of the proposed action.

7.1 Traffic Congestion

The proposed action would place increased demand on transportation networks. NREL proposes to provide administrative and technical support to completion of design and construction of CDOT's I-70/Denver West Marriott Boulevard improvement. In addition, NREL intends to work with agencies at all levels of Government to resolve overall cumulative impacts of regional development on the interchange (alternate access, major interchange upgrade, etc.) and other specific interest sections of area road networks. NREL would continue promotion of regional car pooling and use of public transportation, and would consider staggered work hours, remote parking, van and car pools, bicycling, etc., as means of reducing traffic impacts to the interchange and street networks.

7.2 Environmental Compliance and Monitoring

To assure minimization of impacts on the environment, NREL has a dedicated staff to implement environmental compliance, monitoring, and remediation activities. These activities can be divided into five major components: air, surface water, groundwater quality, waste management and National Environmental Policy Act.

7.2.1 Air Quality

Air quality is measured on both a local and regional basis. The STM is located within a non-attainment area, wherein air pollutant concentrations exceed a National Ambient Air Quality Standard (NAAQS) for carbon monoxide, ozone, and particulate matter less than or equal to 10 microns in diameter. Motor vehicles and residential wood burning are commonly considered to be the primary sources of pollution by EPA. Monitoring activities to date of particulate matter appear to be regional in nature. Due to the nature of the research activities conducted, NREL activities are classified by the Colorado Department of Health as being exempt from air permitting.

Continued monitoring and use of Best Available Technology (BAT) would be used to implement the proposed action, to minimize impacts on local air quality. NREL is committed to taking whatever action may be necessary in the future to assure compliance with all applicable regulations.

7.2.2 Surface Water

Surface water, like most water sources in the western United States, is a valuable public resource. While no permanent flowing water exists on the STM Site, several intermittent streams carry water for short periods of time during storm events. Drainage structures have been established on the STM Site to restrict flows off the site to meet Jefferson County requirements. Earth and concrete retention structures and drainage troughs have been constructed in the drainage basins to control runoff, allowing it to flow in prescribed channels through off-site residential areas. Near the southeast corner of the site, a storm sewer drain collects and carries storm water to an easterly flowing tributary stream. Although no surface water quality monitoring is required of NREL by other agencies, a surface water quality program has been established to assure no impacts to water quality from NREL activities would occur. As has been NREL's practice in the past, storm water discharge permits would be obtained for proposed construction activities and construction runoff would be detained and separated from natural stream flows to avoid siltation.

Weekly inspections of active construction sites would be conducted to assure compliance with storm water permits and erosion control plans.

7.2.3 Groundwater

NREL is committed to preserving and restoring, if necessary, the quality of the groundwater underlying the STM Site. As public custodian of this valuable natural resource, NREL would take steps to remove any threats of groundwater contamination and incorporate groundwater quality preserving features into all present and future site and construction designs. While no groundwater monitoring is required by other agencies, NREL has completed baseline groundwater studies and has established a baseline groundwater quality monitoring program. A year of quarterly monitoring has confirmed that the groundwater on the site is not contaminated. As site development progresses as described by the proposed action, NREL would expand its groundwater monitoring network and would continue monitoring activities.

7.2.4 Waste Management

Waste management is considered a very important function at NREL. All activities performed by NREL conform to the requirements of OSHA, RCRA, DOE, CDH, DOT, and NREL regulations for the handling, use, and disposal of hazardous substances.

Operational waste generation is minimal, and disposal is handled through a contract with a commercial waste disposal facility. Development of the site as described in the proposed action would result in slight increases in waste generation, as discussed in Section 4. However, NREL would continue to employ the same high standards for handling, storage, and disposal of waste as site development progresses, and through implementation of a formal waste minimization program would strive to reduce the waste streams generated.

7.2.5 National Environmental Policy Act

NEPA establishes a national policy to ensure that consideration is given to environmental values and factors in federal planning and decision-making. It is the policy of NREL and DOE to comply with the letter and spirit of NEPA. To ensure that environmental factors are considered in the decision-making process and to promote environmentally responsible decisions, NREL incorporates NEPA requirements early in the planning process for proposed actions. Additionally, NREL coordinated its NEPA activities with the host State of Colorado. NREL is committed to complete assessment and full disclosure of the environmental consequences of its proposed actions. As site development as described in the proposed action proceeds, NEPA compliance would continue to be a priority to NREL. Development would include the mitigative measures described in this NEPA document, according to NREL and DOE procedures for implementation of NEPA.

7.3 Agency Concerns

Agency concerns and methods for mitigation were analyzed and presented in Section 4.1.12. A detailed discussion was presented in Section 6 and the various concerns were considered throughout the EA under specific subject headings. A more detailed discussion relating to the sewer capacities of Pleasant View Water and Sanitation District and the water availability issues related to Consolidated Mutual are presented in the following two sections.

7.3.1 Water Availability

Metro Denver, which supplies two-thirds of the total system volume of water to Consolidated Mutual's integrated system, analyzed water use at NREL and concluded that NREL was not an industrial water user. There are no current or planned research processes which would require significant water usage, and recirculating systems are utilized in all facilities on the STM site.

Consolidated Mutual is generally divided into two systems: one-third of the total water volume is supplied from the Maple Grove System, and the remaining two-thirds comes from Metro Denver during times of low water volume. NREL's water is supplied from the Maple Grove System, and the current amount of water used by NREL is only 1.3% of the total volume of water consumed from Maple Grove. Based on NREL's projections for full site build out, NREL's use will increase to 2.2% of the total Maple Grove water consumption. During the past ten years, customers of this water supplier have never been asked to curtail water usage, despite the fact that several low water years occurred during this time.

Based on the fact that NREL's total water consumption is projected to be less than 3% of the total volume of water used from the Maple Grove System, the availability of additional water from Metro Denver, and the fact that no water curtailments have ever been required in the past, NREL does not anticipate any difficulty in obtaining the water supplies necessary to conduct operations. However, in the unlikely event of a water shortage, NREL would curtail water usage by scheduling water-intensive activities on off-peak hours and scaling back on research operations in order to meet any curtailment requirements which may be imposed by Consolidated Mutual.

7.3.2 Sewer Capacities

Pleasant View Water and Sanitation District has a current discharge volume of 1 million gallons of liquid per day. NREL's current discharge into the sanitary sewer is 2.5% of the total volume. At site build out, the discharge from NREL's operations would increase to 6% of the current system capability. Recent discussions with District representatives indicate that their sewer capacity is 25% greater than they originally thought, and this therefore provides increased capabilities.

NREL would continue to minimize its water usage, and therefore, minimize discharges to the sanitary sewer. As NREL has always had an excellent relationship with the management of Pleasant View Water and Sanitation District, we would continue to work closely with their representatives to ensure that the system continues to be capable of handling the discharges from NREL's operations. Based on the low percentage of total volume provided by NREL's operational discharges, however, it is doubtful that there would be a problem in accommodating our discharge requirements, even at site build out.

8.0 Selected References

- (1) SERI, February 5, 1980, Environmental Assessment of the Proposed Solar Energy Research Institute Facility at South Table Mountain, Jefferson County, Colorado.
- (2) SERI, September 1988, 1988 Addendum Updating Environmental Assessment of April 1980.
- (3) The FORUM Associates, Inc., September 1987, Wildlife Report.
- (4) SERI and the FORUM Associates, May 1988, Historical Review, Solar Energy Research Institute, Golden, Colorado Reservation.
- (5) NREL, October 1991, Preliminary Safety Analysis Review for the use of Hazardous Production Materials in Photovoltaic Applications at the National Renewable Energy Laboratory.
- (6) Howard Needles Tammen & Bergendoff (HNTB), January 1992, Traffic Impact Analysis.
- (7) Anderson DeBartolo Pan, Inc., January 1992, Technical Site Information
- (8) NREL, February 1992, Environmental Assessment for the Construction and Operation of the Solar Energy Research Facility at the National Renewable Energy Laboratory, Golden, Colorado.
- (9) NREL, internal impact assessment for the construction and operation of the Alternate Fuels User Facility and Process Demonstration Unit at the National Renewable Energy Laboratory.
- (10) Applied Environmental, January 1992, A Ground Water Monitoring Fourth Quarter, 1991.
- (11) Applied Environmental, March 1992, Baseline Surface Water Monitoring Program.
- (12) Roger Steen and James Kuenning, 1982, Airborne Particulate Concentration Study, September 1980 to September 1981, South Table Mountain, Jefferson County, Colorado.
- (13) Applied Environmental, March 1992, PM₁₀ Air Monitoring Plan.
- (14) U.S. Fish and Wildlife Service, June 1975. National Wetland Inventory Mapping, Golden, Colorado. Scale 1:24,000. Office of Biological Services, Washington, D.C.
- (15) U.S. Fish and Wildlife Service, June 1975. National Wetland Inventory Mapping, Morrison, Colorado. Scale 1:24,000. Office of Biological Services, Washington, D.C.
- (16) Cowardin, et. al., 1979.
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- (18) Nelson, S.M., 1980. Historic and Prehistoric Resources, South Table Mountain, Golden, Colorado, conducted for Heritage Conservation and Recreation Service, U.S. Department of the Interior. HCRS Contract #A53001 (80).
- (19) Hartman, J.E., May 7, 1992. Colorado Historical Society letter.

- (20) Welton, W.S., April 6, 1992. The Consolidated Mutual Water Company letter.
- (21) Felsburg, Holt and Ullevig, October 2, 1985, Operational Analysis: Interchange of Denver West Boulevard and I-70 (Lena Gulch), Englewood, Colorado
- (22) Howard Needles Tammen and Bergenduff, January 3, 1992. Traffic Impact Analysis for the Expansion of National Renewable Energy Laboratory, Jefferson County, Colorado.
- (23) Mathews, D., April 9, 1992. Jefferson County Sheriff's Department letter.
- (24) Carey, T.T., April 20, 1992. Department of the Army, Corps of Engineers letter.
- (25) Finstead, G., April 16, 1992. United States Department of Agriculture, Soil Conservation Service Letter.
- (26) Klein, M., April 13, 1992. The Nature Conservancy Letter.
- (27) Gambrill, K.M., May 4, 1992. Colorado Department of Transportation letter.
- (28) Crain, J.T., May 13, 1992. Jefferson County Colorado Letter.
- (29) Foelske, K., April 23, 1992. Jefferson County Colorado Open Space Letter.
- (30) Sheldon, P., April 3, 1992. City of Lakewood Letter.
- (31) Isom, J., May 29, 1992. Pleasant View Letter.
- (32) St. John, Robert H., December 13, 1988, Phase II Environmental Site Assessment for Denver West Office Building 16, Golden, Colorado.
- (33) Ventilation Engineering, August 1991. Atmospheric Air Flow Characteristics Study and Exhaust Stack/Air Intake Analysis.

Appendix A

Acronyms

Appendix A

Acronyms

AFUF	Alternative Fuels User Facility
BL	Biosafety Level
BTRF	Biotechnology Research Facility
Btu	British thermal units
Btu/h	British thermal units per hour
CBRF	Chemical and Biological Research Facility
CDOT	Colorado Department of Transportation
CEQ	Council of Environmental Quality
CERCLA	Comprehensive Environmental Responses, Compensation, and Liability Act
CHS	Colorado Historical Society
CMS	cubic meters per second
CMWC	Consolidated Mutual Water Company
CO	carbon monoxide
COE	Corps of Engineers
CUM	cubic meters
°C	Degrees centigrade
DA	Department of the Army
DOE	Department of Energy
DWOP	Denver West Office Park
EA	Environmental Assessment
E ² ASE	Energy Efficient Architecture Sensitive to the Environment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FETA	Field Experimental Test Area
FONSI	Finding of No Significant Impact
FR	Federal Regulation
FTLB	Field Test Laboratory Building
GLSP	Good Large-Scale Practice
GPP	General Plant Project
gsm	gross square meters
IDLH	Immediately Dangerous to Life and Health
ina	information not available
ITUTF	Industrial Thermochemical User Test Facility
I-70	Interstate Highway 70
JCCOS	Jefferson County Colorado Open Space
JCSD	Jefferson County Sheriff's Department
kg	kilogram
KVA	kilo-volt-ampere
Kwh	Kilowatt hour

LBFA	Lakewood - Bancroft Fire Authority
lit	liter
LSTTF	Large Scale Thermal Test Facility
LOS	Level of Service
MDSDD	Metropolitan Denver Sewage Disposal District
MUTCD	Manual of Uniform Traffic Control Devices
NAAQS	National Ambient Air Quality Standard
NEPA	National Environmental Policy Act
NIH	National Institute of Health
NMHC	non-methane hydrocarbons
NO _x	nitrous oxides
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
NWI	National Wetland Inventory
OSHA	Occupational Safety and Health Administration
OTEC	open-cycle thermal energy conversion
OTF	Outdoor Test Facility
PDU	Process Demonstration Unit
PEL	Permissible Exposure Limit
P.L.	Public Law
PM ₁₀	particulate matter, diameter less than 10 microns
POV	privately owned vehicles
PSCC	Public Service Company of Colorado
PV	photovoltaic
PVC	polyvinyl chloride
PVWSD	Pleasant View Water and Sanitation District
R(x)W	Range (number) West
RCRA	Resource Conservation and Recovery Act
R&D	Research and Development
SAR	Safety Analysis Review
SCS	Soil Conservation Service
SEN	Department of Energy (Secretary) Energy Notice
SERF	Solar Energy Research Facility
SERI	Solar Energy Research Institute
SERSB	Solar Energy Research Support Building
SDP	Site Development Plan
SHPO	State Historical Preservation Officer
SIATF	Solar Industrial Applications Test Facility
SOP	Safe Operating Procedures
SO _x	sulfur oxides
SRRL	Solar Radiation Research Laboratory
SRWF	Shipping/Receiving and Warehouse Facility

sss	septic tank system
STF	Structure Test Facility
STIP	Solar Technical Information Program
STM	South Table Mountain
T(x)N	Township (number) North
U.S.	United States
USFWS	United States Fish & Wildlife Service
VHF	very high frequency
WERC	Wind Energy Research Center

Appendix B

Definitions of Biosafety Levels

Appendix B

Definitions of Biosafety Levels

Biosafety levels describe guidelines for levels of containment appropriate to Good Industrial Large Scale Practices (GILSP) as they refer to the physical containment of organisms containing recombinant DNA molecules. They are promulgated by the National Institute of Health's (NIH) Guidelines for Research Involving Recombinant DNA Molecules (51 FR 16958). Within the levels of classifications, BL is biosafety level, large scale (LS) applies to research or production activities where greater than 10 liters of culture involving viable organisms containing recombinant DNA molecules are in use.

A number of increasingly restrictive or demanding criteria (applied to practices and techniques, safety equipment, and facilities) are required as levels of activity increase from Good Large-Scale Practice (GLSP) to BL3LS, and apply to such items as closed systems for propagation and growth of cultures, biological safety cabinets for centrifuges, inactivation, sample collection, control of aerosols and contamination of exposed surfaces, filtering of exhaust gases, sterilization, and emergency plans, among others. As an example of the difference between Level 1 and Level 2, Level 1 requirements for taking sampling minimize the release of aerosols, while Level 2 requirements prevent release of aerosols.

Table B.1 is a summary of Biosafety Level 1 and 2 requirements.

Table B.1
Summary of Biosafety Level 1 and 2 Requirements

Biosafety Level	Practices and Techniques	Safety Equipment	Facilities
1	Standard microbiology practices	None: primary containment provided by adherence to standard laboratory practices during open bench operations	Basic
2	Level 1 practices plus: laboratory coats, decontamination of all wastes, limited access, protective gloves, and biohazard warning signs as indicated.	Partial containment equipment (i.e., Class I and Class II Biological Safety Cabinets) used to conduct mechanical and manipulative procedures that may have high aerosolization potential which may increase the risk of release.	Basic

Refer to the NIH Guidelines for Research Involving Recombinant DNA Molecules for a complete description of requirements.

Appendix C

**Vegetation Species at the
NREL STM Site**

Appendix C

Vegetation Species at the NREL STM Site

This list was generated from the September 1987 Addendum Updating Environmental Assessment, April 1980 and edited from NREL sittings and a site reconnaissance by Janice McKee, Biologist, 1992.

Common Name	Scientific Name	General Location
<u>Grasses and Grass-Like</u>		
Goat-grass	<i>Aegilops cylindrica</i>	Species found in disturbed areas (D). Introduced by man (I).
Crested Wheat-grass	<i>Gropyron A. cristatum</i>	D(I)
Western Wheat-grass	<i>A. smith</i>	Species found in grasslands (G). Species found in wetlands (W).
Quackgrass	<i>A. repens</i>	G
Red three-awn	<i>Aristida longiseta</i>	G
Blue grama	<i>Bouteloua gracilis</i>	G
Smooth brome	<i>Bromus inermis</i>	D(I)
Japanese brome	<i>B. japonicus</i>	D(I)
Cheat-grass	<i>B. tectorum</i>	D(I)
Buffalo-grass	<i>Buchloe dactyloides</i>	G
Sedge	<i>Carex nebraskensis</i>	W
Spike-rush	<i>Eleocharis macrostachya</i>	W
Canada wild-rye	<i>Elymus canadensis</i>	G
Foxtail barley	<i>Hordeum jubatum</i>	D(I)
Baltic rush	<i>Juncus arcticus ssp. ater</i>	W
June-grass	<i>Koeleria cristata</i>	G
Timothy	<i>Phleum pratense</i>	W
Canada Blue-grass	<i>Poa compressa</i>	G,W

Common Name	Scientific Name	General Location
Kentucky blue-grass	<i>P. pratensis</i>	W,G
Tumble-grass	<i>Schedonnardus paniculatus</i>	G
Rye	<i>Secale cereale</i>	D(I)
Squirrel-tail	<i>Sitanion logifolium</i>	G
Needle-and-thread	<i>Stipa comata</i>	G
Green Needle-grass	<i>Stipa viridula</i>	G,W
<u>Forbs</u>		
Yarrow	<i>Achillea lanulosa</i>	Species found in relatively narrow and deep gulches (C),W
Wild flax	<i>Adenolinum lewisii</i>	
False dandelion	<i>Algoseris glauca</i>	G
Alyssum	<i>Alyssum alvssoides</i>	D,G
Rough pigweed	<i>Amaranthus retroflexus</i>	D(I)
Ragweed	<i>Ambrosia sp.</i>	D(I)
Indian hemp	<i>Apocynum cannabinum</i>	C
Prickly poppy	<i>Argemone polyanthemas</i>	G
	<i>Artemisia dracuncloides</i>	G
Pasture sagebrush	<i>A. frigida</i>	G
Prairie sage	<i>A. ludoviciana</i>	C
Low milkweed	<i>Asclepias pumila</i>	
Showy milkweed	<i>Asclepias speciosa</i>	D
	<i>Asparagus officionalis</i>	W
Blue aster	<i>Aster hesperius</i>	
White aster	<i>Aster hesperius</i>	
Milkvethc	<i>Astragalus drummondii</i>	G

Appendix C

Common Name	Scientific Name	General Location
Mariposa lily	<i>Calachortus gunnisonii</i>	G
Orange paintbrush	<i>Castilleja integra</i>	G
Blue mustard	<i>Chorispora tennella</i>	D
Water-hemlock	<i>Cicuta douglasii</i>	C,W
Canada thistle	<i>Cirsium arvense</i>	C,W
Bull thistle	<i>Cirsium undulatum</i>	C,G
White thistle	<i>Cirsium canescens</i>	
Bastard toad-flax	<i>Comandra undulatum</i>	G
Poison-hemlock	<i>Conium maculatum</i>	C,W
Small bindweed	<i>Convolvulus arvensis</i>	D
Morning glory	<i>Convolvulus arvensis</i>	
Plains larkspur	<i>Delphinium virescens</i>	G
Flixweed	<i>Descuranea sophia</i>	D
Spreading fleabane	<i>Erigeron divergens</i>	
Low daisy	<i>Erigeron pumilus</i>	
Sulphur-flower	<i>Eriogonum umbellatum</i>	M
Filaree	<i>Erodium cicutarium</i>	
Evolvulus	<i>Evolvulus multianus</i>	G
Green gentian	<i>Frasera speciosa</i>	
Cleavers (Bedstraw)	<i>Galium aparine</i>	C
Scarlet gaura	<i>Gaura coccinea</i>	G
Wild geranium	<i>Geranium caespitosum</i>	
White geranium	<i>Geranium richardsonii</i>	C
Wild liquorice	<i>Glycyrrhiza lepidota</i>	C
Gumweed	<i>Grindelia squarrosa</i>	D,G
Mountain gumweed	<i>Grindelia subalpina</i>	
Snakeweed	<i>Gutierrezia sarothrae</i>	G

Appendix C

Common Name	Scientific Name	General Location
Common sunflower	<i>Helianthus annuus</i>	
Little Sunflower	<i>Helianthus pumilas</i>	G
Golden aster	<i>Heterotheca villosa</i>	G
Hawkweed	<i>Hieracuim albiflorum</i>	C
Trumpet gilia	<i>Ipomopsis aggregata</i>	
Marsh-elder	<i>Iva Xanthifolia</i>	C
Burning-bush	<i>Kochia iranica</i>	D(I)
Prickly lettuce	<i>Lactuca scariola</i>	D,C
Reavine	<i>Lathyrus euccsmus</i>	C
Blazing star	<i>Liatris punctata</i>	
Toadflas	<i>Linaria dalmatical</i>	G(I)
Butter-n-Eggs	<i>Linaria genistifolia</i>	
Common lupine	<i>Lupinus argenteus</i>	
White sweet-clover	<i>Melilotus alba</i>	D(I)
Yellow sweet-clover	<i>Melilotus officinalis</i>	D(I)
Horse mint	<i>Monarda pectinata</i>	
Spearmint	<i>Mentha spicata</i>	C(I)
Pink bergamot	<i>Monarda fistulosa</i>	C
Yellow stemless evening primrose	<i>Oenothera howardii</i>	
Common evening-primrose	<i>Oenothera strigosa</i>	C
Yellow prickly pear	<i>Opuntia macrorhiza</i>	
Pink prickly pear	<i>Opuntia polyacantha</i>	
Colorado loco-weed	<i>Oxytropis lambertii</i>	
Butterweed/ragwort	<i>Packera fendleri</i>	
Mountain ball cactus	<i>Pediocactus simpsonii</i>	
Blue (Foothill) Renstemon	<i>Penstemon virens</i>	G

Common Name	Scientific Name	General Location
Scorpion-weed	<i>Phacelia heterophylla</i>	C
Prairie-clover	<i>Psoralea tenuiflora</i>	G
Prairie cone-flower	<i>Ratibida columnifera</i>	G
Wild rose	<i>Rosa arkansana</i>	
Dock	<i>Rumex sp.</i>	W
Russian-thistle	<i>Salsola Kali</i>	D(I)
Bouncing bet	<i>Saponaria officinalis</i>	
Figwort	<i>Scrophularia lanceolata</i>	C,W
Butterweed	<i>Senecio spartioides</i>	
Jim Hill Mustard	<i>Sisymbrium altissimum</i>	D,C
Buffalo-bur	<i>Solanum rostratum</i>	
Smooth goldenrod	<i>Solidago missouriensis</i>	
Sow-thistle	<i>Sonchus arvensis</i>	D,C
Copper mallow	<i>Sphaeralcea coccinea</i>	G
Hedge-nettle	<i>Stachys palustris</i>	C
Common dandelion	<i>Taraxacum officinale</i>	D,W
False lupine	<i>Thermopsis montana</i>	
Penny-cress	<i>Thlaspi arvense</i>	D,C
Easter daisy	<i>Townsendia hookeri</i>	
Salisfy	<i>Tragopogon dubius</i>	
Goat beard	<i>Tragopogon dufius</i>	D,G
Puncture-vine	<i>Tribulus terrestris</i>	
Broad-leaved cat-tail	<i>Typha latifolia</i>	
Great mullein	<i>Verbascum thapsus</i>	C
Vetch	<i>Vicia americana</i>	
Yucca	<i>Yucca glauca</i>	

Common Name	Scientific Name	General Location
<u>Shrubs & Vines</u>		
Four-wing saltbush	<i>Atriplex canescens</i>	G
Mountain-mahogay	<i>Cercocarpus montanus</i>	Species found in rock outcrops (M).
Rabbitbrush	<i>Chrysothamnus nauseosus</i>	G
Western virgins-bower	<i>Clematis ligusticefloia</i>	G
Hawthorn	<i>Crataegus erythropoda</i>	C
Starvation cactus	<i>Opuntia polyacantha</i>	G
Virginia creeper	<i>Parthenoassus inserta</i>	C,D
Wild Plum	<i>P americana</i>	C
Choke Cherry	<i>P. virginiana</i>	C
Skunkbush	<i>P. trilobata</i>	G,M
Smooth sumac	<i>Rhus glabra</i>	C
Common gooseberry	<i>Ribes inerme</i>	C
Rose	<i>Rosa arkansana</i>	C
Goldenrod	<i>Solidago sp.</i>	G
Snowberry	<i>Symphoricarpos sp.</i>	C
Poison ivy	<i>Toxicodendran radicans</i>	C,G
Yucca	<i>Yucca glauca</i>	G
<u>Trees</u>		
Hackberry	<i>Celtis reticulata</i>	C
Russian olive	<i>Eleagnus angustifolia</i>	D(I)
Hydrid cottonwood	<i>Populus xacuminata</i>	C,W
Plains cottonwood	<i>P. deltoides var. occident- alis</i>	C,D
Siberian elm	<i>Ulmus pumila</i>	D(I)

Appendix C

Common Name	<i>Scientific Name</i>	General Location
American brooklime	<i>Veronica americana</i>	W
American vetch	<i>Vicia americana</i>	C

Appendix D

Wildlife Species at the NREL STM Site

Appendix D

Wildlife Species at the NREL DWOP and STM Sites

This list was generated from the September 1987, Addendum Updating Environmental Assessment, April 1980 and edited from NREL sitings and reviews.

Common Name	Scientific Name
Cottontails	<i>Silvilagus</i> spp.
Jackrabbit	<i>Lepus</i> spp.
Deer mouse	<i>Peromyscus maniculatus</i>
Prairie vole	<i>Microtus ochrogaster</i>
Preble's meadow jumping mouse	<i>Zapus hudsonius preblei</i>
Coyote	<i>Canis latrans</i>
Red fox	<i>Vulpes vulpes</i>
Raccoon	<i>Procyon lotor</i>
Mule deer	<i>Odocoileus hemionus</i>
Bald eagle	<i>Haliaeetus leucocephalus</i>
Red-tailed hawk	<i>Buteo jamaicensis</i>
Golden eagle	<i>Aquila chrysaetos</i>
American kestrel	<i>Falco sparverius</i>
Peregrine falcon	<i>Falco peregrinus</i>
Killdeer	<i>Charadrius vociferous</i>
Mountain plover	<i>Charadrius montanus</i>
Band-tailed pigeon	<i>Columba fasciata</i>
Mourning dove	<i>Zenaida macroura</i>
Great horned owl	<i>Bubo virginianus</i>
Horned lark	<i>Eremophila alpestris</i>
Black-billed magpie	<i>Pica pica</i>
American robin	<i>Turdus migratorius</i>
European starling	<i>Sturnus vulgaris</i>
Western meadowlark	<i>Sturnella neglecta</i>
Canadian geese	<i>Branta canadensis</i>
Mallards ducks	<i>Anas platyrhynchos</i>
Red-wing blackbirds	<i>Agelaius phoeniceus</i>
Common garter snake	<i>Thamnophis sirtalis</i>
Western rattlesnake	<i>Crotalus viridis</i>
Regal fritillary butterfly	<i>Speyeria idalia</i>

Summary of Wildlife Resource Characteristics at NREL's STM Site

Wildlife Group	Common Representatives	Common Vegetation Associations	Comments
Large mammals	Mule deer	Grasslands Shrublands	High use of shrublands for winter forage by deer
Small mammals	Cottontails Jackrabbits Deer mouse Prairie vole	Grasslands Shrublands Wetlands Riparian areas	Species composition diverse and all vegetation types occupied
Furbearers	Coyote Red fox Raccoon	Grasslands Shrublands Wetlands	Members of this group tend to possess large home ranges
Waterbirds	Killdeer	Wetlands	Most representatives of this group are migrants
Upland gamebirds	Mourning dove Band-tailed pigeon	Shrublands Wetlands Riparian areas	
Raptors	Golden eagle American kestrel Red-tailed hawk Great horned owl	Grasslands Shrublands Riparian areas	Members of this group tend to hunt large territories
Songbirds/passerines	American robin European starling Mountain bluebird Black-billed magpie	Grasslands Shrublands Wetlands Riparian areas	Species composition divers, all vegetation types occupied, and species mixture changes seasonally
Reptiles and amphibians	Common garter snake Western rattlesnake	Grasslands Shrublands	

Sources: Hammerson and Langlois 1981, Hammerson 1982, Bissell and Dillon 1982, Chase et al. 1982, Hoover and Wills 1984, SERI 1988.

Appendix E

**Agencies Contacted and
Their Responses**

Appendix E

Agencies Contacted and Their Responses

This appendix consists of a letter similar to those sent to agencies, a list of agencies (addresses) to whom a letter was sent, and copies of responses received.

SAMPLE LETTER TO POTENTIALLY INTERESTED AGENCIES

Date

Name

Address

Dear ():

Greystone has been retained to assist in the development of an Environmental Assessment (EA) for the Department of Energy's (DOE) National Renewable Energy Laboratory (NREL). This EA is to address NREL's intention to develop their Government-owned South Table Mountain (STM) site for consolidation of NREL facilities and operations.

The Solar Energy Research, Development and Demonstration Act of 1974 (P.L. 94-473) authorized a federal program to develop solar energy as a viable source of the nation's future energy needs. As a means of implementing the act, The Solar Energy Research Institute (SERI) was created to be the nation's primary research laboratory responsible for the development of the renewable energy technologies. In September 1991, the President, in recognition of SERI's significant accomplishments in fulfillment of this mission, designated SERI the National Renewable Energy Laboratory (NREL). Research activities have been conducted in both leased and government-owned facilities near Golden, Colorado, on a continuous basis since the late 1970's. These activities include indoor bench-scale experimentation, theoretical studies, outdoor pilot plant testing, and all administrative and support activities necessary to operate the Laboratory. The majority of research and support operations have been conducted in leased facilities located in the Denver West Office Park. In 1982, the State of Colorado donated 300 acres, near South Table Mountain (STM), to the federal government (U.S. Department of Energy [DOE]) for development of the Laboratory's research complex. Shortly thereafter, development of the site was initiated.

DOE proposes to continue operation of NREL to promote the nation's goals of improving the environment, maintaining economic competitiveness, and achieving energy security. Research would be conducted in photovoltaics, wind, biomass, solar thermal, and solar buildings energy technologies, as well as other areas of national environmental/energy technology interest. Modern, efficient, and safe laboratory facilities are essential to maintaining the integrity, viability, and excellence of this mission.

The policy of NREL and the DOE is to conduct all activities in full compliance with the letter and spirit of applicable environmental statutes and regulations, including the National Environmental Policy Act (NEPA). In 1980, an Environmental Assessment, DOE/EA-0101, Environmental Assessment, Solar Energy Research Institute, South Table Mountain, Jefferson County, Colorado, was prepared to address site-wide impacts. In September of 1987 Addendum Updating Environmental Assessment of April 1980 was prepared to re-evaluate the impacts of continued development of the South Table Mountain (STM) site. A Finding of the Significant Impact (FONSI) was found to be justified for both of these previous EAs.

Accordingly, this Environmental Assessment (EA) is to provide information on cumulative effects on the human environment of continuing operations and development of the STM site. Sufficient information is to be presented to determine whether a Finding of No Significant Impact is justified, or whether preparation of an Environmental Impact Statement is warranted.

Enclosure (Figure 1) is a location map of the NREL STM site. The site generally consists of the southeast half of Section 36, T3S, R70W. Enclosure 2 (Figure 2) is a site map showing existing development on the STM site. NREL proposes a medium density campus-like development of the STM site. Enclosure 3 (Figure 3). Enclosure 4 is a Table that outlines phased development of the shown 72,277 square meters of site facilities.

A number of infrastructure improvements are prepared on the STM site is developed, with the exception of natural gas, upgrade all utilities to the site would be required. Denver West Parkway would be widened to divided 4-lane, from the eastern boundary to a point mid-way across the southern edge of the site. This parkway extended (2 lane) to Quaker Street (for emergency and controlled traffic only). A schedule of proposed site development infrastructure projects is at Enclosure 5. A description of proposed research operations is provided in Enclosure 6. The ultimate population of the STM site is projected to be 1,650 people (1,500 which would be full time employees). The purpose of this letter is to advise you of this proposed activity, and to invite you to express your thoughts and concerns regarding the collective construction and research operations as described. Specifically, please address any concerns related to _____.

(use specific wording of Greystone inquiries, i.e., T&E species for Fish and Wildlife, SHPO wording, etc.)

Please send written responses to the following address:

Greystone
Attn: (counterpart and title)
5990 Greenwood Plaza Blvd., Suite 104
Englewood, CO 80111

Please reply by May 3, 1992, to this request with any information or concerns you may have. Contact me at (303) 850-0930 should you need additional information concerning any aspect of this work. Thank you in advance for your responsiveness to this request.

Sincerely,
(counterpart)
(title)

6 Enclosures: as stated

Distribution List For Environmental Assessment Agency Letters

Mr. Len Magno, Director
Jefferson County Planning Department
700 Jefferson County Parkway, #220
Golden, CO 80401

Jefferson County Department of Highways and Transportation
700 Jefferson County Parkway
Suite 280
Golden, CO 80401

Mr. Kim Gambrill, Manager
Environmental Branch
Colorado State Highway Department
4201 E. Arkansas Avenue
Denver, CO 80222

Ms. Pamela Sheldon
Lakewood Planning Department
445 S. Allison Parkway
Lakewood, CO 80226

Mr. Gary Finstad
District Conservationist
Soil Conservation Service
730 Simms Street, No. 416
Golden, CO 80401

Mr. LeRoy W. Carlson
U.S. Fish and Wildlife Service
Colorado Field Office
730 Simms Street
Room 292
Golden, CO 80401

Ms. Mary Klein
The Nature Conservancy
2060 Broadway, Suite 230
Boulder, CO 80302

Mr. Perry Olson
Colorado Division of Wildlife
6060 Broadway
Denver, CO 80216

Mr. Ray Printz, Director
Jefferson County Open Space Department
700 Jefferson County Parkway, Suite 100
Golden, CO 80401

Mr. Robert DeSpaine, Chief - Env. Assessment Branch
Environmental Protection Agency
999 18th Street, 8 PM-EA
Denver, CO 80202

Mr. Terry McKee, Environmental Resource Specialist
U.S. Army Corps of Engineers, Omaha District
9307 State Highway 121
Littleton, CO 80123

Mr. Lew Ladwig
Colorado Geological Survey
1313 Sherman Street, Room 715
Denver, CO 80203

Ms. Barbara Sudler
State Historic Preservation Officer
1300 Broadway
Denver, CO 80203-2137

Mr. Ronald Beckham
Jefferson County Sheriff
17900 W. 10th Avenue
Golden, CO 80401-2679

Mr. Duane Tinsley, Director
Golden Planning Department
911 10th Street
Golden, CO 80401

Mr. Bruce Colter, Area Forester
Colorado State Forest Service
1504 Quaker Street
Golden, CO 80401

Mr. Joel Kohn, Executive Director
Colorado Department of Health
4210 E. 11th Avenue
Denver, CO 80220

Mr. Hal Simpson
Division of Water Resources
1313 Sherman Street, Rm. 818
Denver, CO 80203

Mr. Richard Brill, President
Pleasant View Water & Sanitation District
955 Moss Street
Golden, CO 80401

Mr. Raymond Fink, President
Lakewood Fire Protection District
1545 Robb Street
Lakewood, CO 80215

Mr. Virgil Hill, President
Consolidated Mutual Water Co.
12700 W. 27th Avenue
Lakewood, CO 80215

Mr. Bud Smead, Director
Jefferson County Public Works Division
1700 Arapahoe Street
Golden, CO 80419

Mr. Charles Stevinson
Denver West Ltd.
1546 Cole Blvd.
Golden, CO 80401

BOARD OF COUNTY COMMISSIONERS

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JOHN P. STONE
District No. 3

May 13, 1992

Ms. Lisa Welch, Project Scientist
Greystone
5990 Greenwood Plaza Blvd., Suite 104
Englewood, CO 80111

Response to Letters
dated 3-31-92 and 4-3-92
Re: NREL Expansion

Dear Ms. Welch:

The Jefferson County Planning Department appreciates the opportunity to make pertinent comments regarding the NREL expansion near South Table Mountain. In order to achieve a comprehensive county overview of the proposed activities at the site and the expansion of the physical plant, the expansion proposals were circulated to the Jefferson County Department of Health and the Environment, the Jefferson County Public Works Division and the Jefferson County Highways and Transportation Department for a review and comment. In addition, the planning department has examined the proposal and would offer these comments from a County perspective.

1. Traffic - Traffic impacts could be quite significant for Denver West Parkway, the I-70 interchange at Denver West, Quaker Street, and other area roadways. The Department of Highways and Transportation recommends a traffic study so that needed improvements can be determined. Access to Quaker Street should be emergency only as it is a local roadway.
2. Emergency Services - Provision of emergency services and access should be coordinated with the local fire district which appears to be the Pleasant View Fire District.
3. Compatibility/Visual Impacts - Due to the project's location on the flanks of South Table Mountain, the site is highly visible to I-70 and 6th Avenue. If possible, the following site planning techniques should be utilized:
 - Buildings, access, and parking should work with the topography as much as possible.
 - Buildings should be designed to blend in with the South Table Mountain backdrop by careful selection of materials and colors. Building mass should be softened by staggering of building facades and heights. Outdoor storage and rooftop mechanical equipment should be screened from public view. Lighting should be low intensity, downcast, and designed to prevent glare to

adjacent properties. Parking lot mass should be softened by interspersing of landscaping and breaking up huge expanses of parking where possible. It should be noted this development abuts residential development on its southern edge. There should be a good buffer between NREL and the adjoining neighborhood. Currently, this edge has chain link fencing, parking, and outdoor storage.

4. Trail Access - Due to South Table Mountain's designation in the Open Space Master Plan, it is quite possible it will someday be purchased as public open space. Consideration should be given to trail access through the NREL site for adjoining residential neighborhoods to the south.
5. Historical Resources - The site appears to have an old amphitheater of historical significance. The amphitheater and other historical resources should be thoroughly inventoried. Historical resources should be preserved and consideration given to providing public access to them.
6. Provision of Needed Ancillary Services - Given the fact that this site will have some 1650 employees, consideration should be given to incorporating needed ancillary services such as eating and athletic facilities to minimize driving.
7. Geological Hazards - The flanks of South Table Mountain are unstable. Site development should include sound geotechnical studies and work with the existing grade where possible.
8. Stormwater detention - The plan sent to us did not identify how stormwater detention would be handled. The neighborhood to the south has experienced drainage problems in the past. The Department of Highways and Transportation is also concerned about this issue.

We would request that as planning and development proceeds, that you give the necessary attention to the above mentioned items in the solution to potential problem areas noted above.

We would be happy to assist you in addressing these areas of concern by assembling representation of the various County departments who have given referral comments to further elaborate in order that adequate safeguards and solutions to the various concerns can be identified.

We believe the expansion of the NREL is of significant benefit to Colorado and to Jefferson County in particular. We are concerned that as expansion proceeds, sensitive treatment be expressed through design and development of the facilities to make the final product enhance the Denver West business area and respect the surrounding residential neighborhoods.

Ms. Lisa Welch
May 13, 1992
Page Three

It would appear that NREL's proposed development activity does not comply with the County zoning regulations and accordingly rezoning and/or site approval actions may be required. In order to make a definite determination of what zoning procedures, if any, will be required, NREL representatives should contact the Jefferson County Attorney's Office to provide additional information related to the project.

Please note that comments expressed here have been generated by County staff and are not policy expressions by the Jefferson County Board of Commissioners.

Thank you again for the invitation to comment.

Sincerely,

A handwritten signature in dark ink, appearing to read "Joseph T. Crain". The signature is fluid and cursive, with a long horizontal stroke extending from the end.

Joseph T. Crain
Community Planning Administrator

JC/jeb

Enclosures: Public Works/Highways and Transportation memos

cc: Pat Mahan, County Attorney
Terry Green, Director Administrative Services Division
Len Mogno, Planning Director
Jean Ayars, Assistant County Attorney
Kevin Nichols, Development Review Coordinator
Jean Jacobus, Policy Development Unit

COLORADO
HISTORICAL
SOCIETY

The Colorado History Museum 1300 Broadway Denver, Colorado 80203-2137

May 7, 1992

Lisa Welch
Project Scientist
Greystone
5990 Greenwood Plaza Boulevard, Suite 104
Englewood, CO 80111

Re: Prototype Pilot Plant and South Table Mountain Site Development

Dear Ms. Welch:

Thank you for your correspondence of March 31, and April 3, 1992, concerning the development of Environmental Assessments for the above two undertakings.

Biotechnology Research Facility and Alternative Fuels User Facility (Prototype Pilot Plant) - Since we understand that the two proposed buildings will be attached to existing buildings of recent construction, we find that there is no potential to impact historic properties.

Site Development - The South Table Mountain Site contains two features, an amphitheater and a nearby bridge, that are contributing elements of Camp George West, which has been determined eligible for inclusion in the National Register of Historic Places. It is our opinion that these features are not within the area of potential effects of the proposed new construction shown on the Site Development Plan/Long Range Plan/Scheme - A, received with this correspondence. Consequently this undertaking will have no effect on historic properties.

However, in the event that subsurface archaeological resources are encountered during ground disturbing activities, it will be necessary to halt the work until such resources can be evaluated in consultation with our office.

Sincerely,

James E. Hartmann
State Historic Preservation Officer

JEH/KKP

STATE OF COLORADO

DEPARTMENT OF TRANSPORTATION

4201 East Arkansas Avenue
Denver, Colorado 80222
(303) 757-9011

May 4, 1992

Byron G. Walker
Greystone
5990 Greenwood Plaza Blvd., Suite 104
Englewood, Colorado 80111

Dear Mr. Walker:

The Colorado Department of Transportation has reviewed the information which you provided as well as the Environmental Assessment for the Construction and Operation of the Solar Energy Research Facility at the National Renewable Energy Laboratory and has the following comments.

The Environmental Assessment needs to describe the impacts to the I 70/Denver West Marriot Boulevard interchange caused by the completion of the Solar Energy Research Facility. The traffic generated by SERF will be a significant contributing factor in causing two of the I 70 ramps to operate at level of service F even after completion of improvements to the interchange which CDOT has proposed. These improvements include widening the I 70 structure and signaling the ramps. The impacts to all local street networks should also be studied.

The need to consider alternatives to relieve the traffic pressure must also be addressed in the EA. Alternatives could include revised interchange design (single point interchange, additional ramp lanes, etc.), staggered work hours and remote parking. The Department of Energy should consider establishing a program for SERF employees to use alternative modes of transportation (carpooling, riding the bus, bicycling, etc.) if such a program does not exist already.

In Section 3.4, Air Quality/Visibility/Odor, it should be mentioned that the proposed SERF is located in a nonattainment area for carbon monoxide and PM-10. To help reduce pollutant emissions from the operation of the SERF, the use of alternate fuels (e.g. natural gas) in Department of Energy vehicles should be promoted.

Thank you for the opportunity to provide comments on this information. We apologize for our comments being late. We had requested a copy of the Traffic Impact Analysis to review with the EA but did not receive it until April 30.

Very truly yours,

Kenneth M. Gambrill
Manager
Office of Environmental Review and Analysis

cc: Deborah Anne Amidaneau, NREL

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District No. 3

OPEN
SPACE

April 23, 1992

Lisa Welch
Project Scientist
Greystone
5990 Greenwood Plaza Blvd. #104
Englewood, Colorado 80111

Dear Ms. Welch:

We have received your letters dated March 31 and April 3, 1992 concerning the Environmental Assessments for the proposed expansion of the National Renewable Energy Laboratory (South Table Mountain near Pleasant View and Golden).

We have commented previously that the Jefferson County Open Space Program's Master Plan notes the slopes and top of South Table Mountain being proposed as "Open Space acquisition candidate areas". With this classification, Open Space has a long term goal of preserving landmark features of Jefferson County.

The area of development noted for the National Renewable Energy Laboratory is down slope from the area proposed for open space preservation. The contours of 5900' and 5850' note the area of slope change and really define a generalized area upslope that could be defined as the slopes of South Table Mountain. As such, the proposed developments of the National Renewable Energy Laboratory do not impact areas noted on the Jefferson County Open Space Program's Master Plan.

Any developments upslope from these proposals should be considered in light of any visual and preservation impacts.

Should you wish additional information, please contact our office.

Sincerely,

Ken Foelske

Manager of Planning & Development

KF/joy

Copy: Ray Printz, Open Space Director
M.L. Tucker, Asst. County Attorney
Lynn Wodell, Manager of Acquisitions

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
TRI-LAKES PROJECT OFFICE, 9307 STATE HWY 121
LITTLETON, COLORADO 80123-6901

REPLY TO
ATTENTION OF

April 8, 1992

Greystone
Janice P. McKee, Project Scientist
5990 Greenwood Plaza Blvd. Suite 104
Englewood, CO 80111

Dear Ms. McKee:

The proposed activity by the Department of Energy's National Renewable Energy Laboratory to develop a building at their South Table Mountain site near Golden and Pleasant View, located in Section 36, Township 3 South, Range 70 West, Jefferson County, Colorado assigned number 199280149, will not require a Department of the Army (DA) Permit.

Although a DA Permit will not be required for the project, this does not eliminate the requirement that other applicable federal, state, and local permits be obtained as required.

If there are any questions concerning this matter, please feel free to contact Mr. Terry McKee of this office at 303-979-4120 or 4121.

Sincerely,

A handwritten signature in black ink, appearing to read "Timothy T. Carey", is written over a circular stamp or seal.

Timothy T. Carey
Project Manager

ited States
partment of
griculture

Soil
Conservation
Service

Lakewood Field Office
730 Simms, Room 416
Golden, CO 80401
Phone: (303) 236-2702

April 16, 1992

Bill Mahoney
Pebblestone
990 Greenwood Plaza Blvd.
Suite 104
Englewood, CO 80111

Re: Environmental Assessment for National Renewable Energy Laboratory

Dear Mr. Mahoney,

We have received two different letters from you, dated March 31 and April 3, 1992, requesting information about any concerns we may have about soils on this South Table Mountain site.

We have no concerns about soils related to the project discussed in the March 31 letter.

The April 3 letter, however, describes the long range development plan for the site and we do have some general comments.

Our principal soil-related concerns may be lumped into two categories: 1) On and offsite erosion from stormwater runoff, resulting from increased impervious surface area on the site; and 2) Appropriate landscaping and revegetation of disturbed areas.

These concerns overlap, and the prompt establishment, or reestablishment, of native and adapted plant materials after land disturbing activities will aid in the management of precipitation. "Appropriate" vegetation, especially grasses, is often key to the successful performance and maintenance of engineered structures--especially stormwater detention basins and drainage channels. Site soils will (or should) dictate what species can be used effectively.

Apparently, there is no planned activity which would impact the steep sides or top of South Table Mountain. These are, obviously, extremely fragile environments. If more information is desired about these locations, please advise.

I appreciate the opportunity to comment on this project, even though I'm limited to making only generalized comments at this time.

Sincerely,

Gary Finstad
District Conservationist

United States Department of the Interior

FISH AND WILDLIFE SERVICE FISH AND WILDLIFE ENHANCEMENT

Colorado State Office
730 Simms Street, Suite 290
Golden, CO 80401

FWE/CO: Endangered Species
Mail Stop 65412

Phone (303) 231-5280
FAX (303) 231-5285

APR 14 1992

David M. Cameron, Senior Scientist
Greystone Development Consultants, Inc.
5990 Greenwood Plaza Blvd., Suite 104
Englewood, Colorado 80111

Dear Mr. Cameron:

This is the list that responds to your April 1 and April 3, 1992, requests for information on federally listed threatened and endangered species in the vicinity of the proposed Department of Energy National Renewable Energy Laboratory projects in Jefferson County.

The list of federally listed endangered and threatened species for the area of your highway project include:

Birds: Bald eagle (Haliaeetus leucocephalus)
Peregrine falcon (Falco peregrinus)

Plants: Ute ladies' tresses orchid (Spiranthes diluvialis)

Bald eagles are found in the area during the winter months. They especially use riparian woodlands, wetlands, and prairie dog communities. The bald eagles and peregrine falcons are the species most likely to occur within the project area. Peregrine falcons may use the area of the project for hunting their prey.

The Ute ladies' tresses orchid is a rare plant species which dwells in wetlands and riparian habitats along the Front Range of Colorado. Known sites include wetlands in Boulder and Jefferson Counties. This orchid has been located in Boulder County along South Boulder Creek in what is the largest known population in Colorado. This orchid also has been sighted in small numbers at other locations in Boulder County, Golden, and Wheat Ridge Open Space. This plant is present in the Clear Creek Basin in Jefferson County and may occur in other streams and wetlands in the Golden-Wheat Ridge-Arvada area. We recommend that any adverse impacts to wetlands within the project influence be avoided (Section 404 of the Clean Water Act regulates the fill of wetlands on public and private land). If unavoidable impacts to wetlands or riparian habitats are identified during the preparation of the Environmental Assessment (EA) of the proposed project, this office must be contacted prior to any earthmoving operations that would affect these type of habitats, and a survey may be necessary. The survey must be performed in late summer (late July through mid-September) when this plant is in bloom. The Service must stress the importance of determining the presence of wetland and riparian habitats and the possibility of this orchid occurring at or near the project site.

he Service also is interested in the protection of species which are candidates for official listing as threatened or endangered species (Federal Register, Vol. 54, No. 4, January 6, 1989; Vol 55, No. 35, February 21, 1990). While these species presently have no legal protection under the Endangered Species Act (Act), it is within the spirit of the Act to consider project impacts to potentially sensitive candidate species. It is the intention of the Service to protect these species before human-related activities adversely impact their habitat to a degree that they would need to be listed and, therefore, protected under the Endangered Species Act. Additionally, we wish to make you aware of the presence of Federal candidates should any be proposed or listed prior to the time that all actions related to the project are completed. If any candidate species will be unavoidably impacted, appropriate mitigation should be proposed and discussed with this office.

Birds: Mountain plover (Charadrius montanus)

Insects: Regal fritillary butterfly (Speyeria idalia)

Mammals: Preble's meadow jumping mouse (Zapus hudsonius preblei)

Plants: Bell's twinpod (Physaria bellii)

Recent surveys within the boundaries of the Rocky Flats Plant revealed the presence of the Preble's meadow jumping mouse, a Category 2 candidate species. Thus the Service believes that this mouse species could potentially exist in the area of the project if suitable habitat exists there.

According to Rare Plants of Colorado, Bell's twinpod prime habitat is the "limestones and calcareous shales of the Niobrara Formation in Larimer, Boulder and Jefferson Counties."

Another issue of environmental concern for the Service that should be addressed in the EA of this project deal with proper disposal of hazardous materials and the securing of the proper state and Federal permits associated with a facility of this type.

We recommend you contact the Colorado Division of Wildlife (CDOW) prior to commencement of any of the activities associated with this project regarding possible impacts to native fauna and flora, especially State-listed endangered or threatened species. The CDOW contact person for this area of the state is Dave Weber from the Denver Regional Office at (303) 291-7231.

This office has the two National Wetlands Inventory (NWI) maps that cover the area of the proposed project. If your company would like to see the NWI maps for the proposed project area or if the Service can be of further assistance, please contact Bernardo Garza of this office at (303) 231-5280.

Sincerely,

Laurence R. New

LeRoy W. Carlson
Colorado State Supervisor

cc: FWS/FWE; SLC
CDOW, Denver, CO (Attn. Dave Weber)
Reading file
Project file

Reference: JBG*SPPLST60.WPF

Janice P. McKee
Greystone
5990 Greenwood Plaza Blvd., Suite 104
Englewood, CO 80111

April 6, 1992

Dear Ms. McKee:

I have search the Colorado Heritage Program's database for rare and endangered species within the area you specified in your letter (Town 3S Range 70W, Section 36). The database has no records for this area or adjacent sections. This may well reflect the fact that the area has not been surveyed recently (to our knowledge), not an absence of rare species.

Information from the Colorado Heritage Program's database may not be construed as complete. It should not substitute for field surveys by qualified biologists during the growing season.

Thank you for consulting with the Natural Heritage Program Data Network.

Sincerely,

Mary Klein
Regional Information Manager

JEFFERSON COUNTY SHERIFF'S DEPARTMENT

200 Jefferson County Parkway
Golden, Colorado 80401-2697

(303) 271-5305
FAX (303) 271-5552

Ronald L. Beckham
SHERIFF

Doug Matthews
UNDERSHERIFF

April 9, 1992

Greystone

Attn: Lisa Welch, Project Scientist
5990 Greenwood Plaza Blvd., Suite 104
Englewood, CO 80111

Dear Ms. Welch:

This Department is in receipt of your letter and plans, dated March 31, 1992, regarding the NREL site expansion.

As far as potential emergency situations, this Department is capable of responding to any situation regarding law enforcement needs. We will also respond to assist other emergency response agencies, i.e., fire.

With regards to hazardous substance incidents which may occur within this facility, according to statute law, C.R.S. 29-22-101 through 108, the Sheriff's Department is the "designated emergency response authority". This Department has highly trained personnel to handle such responses, plus participate and coordinate with the County Hazardous Substance Response Team.

I wish to thank you for keeping us informed of expansions which may impact our resources. Prior notification and planning can alleviate surprises during an emergency response.

Should you have any questions or concerns, please feel free to contact our Hazardous Material Specialist Mark Gutke, at 271-5696.

Sincerely,

RONALD L. BECKHAM, SHERIFF

A handwritten signature in cursive script that reads "Doug Matthews".

Doug Matthews
Undersheriff

DM/gp

cc: Mark Gutke
Hazardous Material Specialist

THE CONSOLIDATED MUTUAL WATER COMPANY

12700 West 27th Avenue • P.O. Box 15068

LAKEWOOD, COLORADO 80215

Telephone 238-0451

April 6, 1992

Lisa Welch, Project Scientist
Greystone
5990 Greenwood Plaza Blvd., Suite 104
Englewood, Colorado 80111

Re: NREL Site Development

Dear Ms. Welch:

This will acknowledge receipt of your correspondence dated March 31 and April 3, 1992.

Please be advised that The Consolidated Mutual Water Company currently provides domestic water service to the National Renewable Energy Laboratory (NREL) facilities (formerly SERI) as described in your above referenced correspondence. In addition, we provide water service to Denver West Office Park, where a number of the NREL activities are carried on in leased office space.

Your March 31st letter references' the Alternative Fuels User Facility (AFUF) that is proposed to be constructed on the westerly end of the property. The Company currently serves the present site and we do not anticipate any major problems regarding service to the proposed redevelopment of this property. Three key concerns that should be addressed are outlined as follows:

- 1) The fire protection requirements for this proposed redevelopment should be established by the appropriate fire protection district, in coordination with the owner and the Company. Once an accurate site plan is available, we can determine if the existing facilities will be adequate to serve this redevelopment or if relocation, modification and/or enlargement may be necessary. Any relocation, modification and/or enlargement of the existing water service facilities would be at the sole expense of the owner (DOE/NREL).
- 2) The Company needs to review the domestic water requirements for this proposed project to determine if the existing service is adequate.
- 3) A facility of this nature will require that very careful consideration be given to the backflow requirements necessary to protect the Company's water system from any potential contamination. A

thorough review of the existing and proposed water requirements may necessitate significant upgrading on the backflow prevention equipment.

I am not able to completely concur with your closing statement that "the current supply system is more than sufficient to supply the proposed future expansion of the NREL facilities." Based on our present knowledge of the future development of the NREL property, we anticipate that water service may be provided at a satisfactory level. However, an independent review of each proposal will be needed to determine the extent of on-site water main extensions required to meet the domestic water and fire protection needs. Obviously, future water supplies are subject to a number of factors. The Company's Maple Grove water system which supplies water to NREL, relies on Clear Creek for its raw water supply. Clear Creek Basin, in turn, depends on the annual snow-pack for its supply which is a variable from year to year. While we do not anticipate any major problems in meeting proposed and future expansion of the NREL facilities, there are factors beyond the Company's control that would prohibit us from providing an ironclad guarantee.

I would also apply the above comments to your April 3, 1992 letter. Your April 3rd letter indicated that there is a possibility that Denver West Parkway may be extended westerly from its current terminus to Quaker Street. Should that extension occur, the Company would want to reserve the right to obtain a right-of-way and install a water main westerly along that proposed extension.

We appreciate the efforts of the NREL/DOE personnel to keep us apprised of their present and future plans. If the current level cooperation and communication continues into the future, we would not anticipate any major problems providing service to this site that is consistent with that offered to the rest of the Company's Stockholders. If you have any questions or comments, please do not hesitate to contact me.

Sincerely,

Walter S. Welton, PLS/PE
President

WSW:rm

cc: Robert J. Rivera, Vice President
Engineering and Operations CMWCo

May 29, 1992

Lisa Welch
Greystone Environmental
5990 Greenwood Plaza Blvd.
Suite 104
Englewood, CO. 80111

RE: NREL Sanitary Sewer Use.

Dear Ms. Welch:

In my letter of November 27, 1991 to Tom Mulkey, I advised him that before construction of the NREL Phase C, a study of the impact on the sanitary sewer facilities would have to be done.

This study was to be done by the District engineer and funded by NREL. It shouldn't be too involved, as a study was done by the District in 1990, so it would involve putting in the numbers of Phase C to see what impact there is.

If you have questions, please call.

Sincerely,

Jeff Isom
Manager

Jl/pl
cc. Thomas W. Mulkey - NREL
Thomas J. Napolilli - Meurer & Assoc.

City of Lakewood

PLANNING, PERMITS AND
PUBLIC WORKS

445 South Allison Parkway
Lakewood, CO 80226-3015
303/987-7500
FAX - 303/987-7678

April 3, 1992

Lisa Welch, Project Scientist
Greystone Development Consultants
5990 Greenwood Plaza Blvd
Suite 104
Englewood, CO 80111

Dear Lisa,

Thank you very much for notifying us of the proposal to construct the National Renewable Energy Laboratory (NREL) at the Department of Energy's South Table Mountain site. The information provided in your letter and the attached diagrams were very helpful in explaining the proposal. The City of Lakewood Planning Division has no concerns with this project at this time. We appreciate this opportunity to offer comments.

Sincerely,

Pamela Sheldon
City Planner