2. PROPOSED ACTION AND ALTERNATIVES

This Chapter of the Site-Wide EA describes the Proposed Action and No Action Alternatives. Other alternatives were considered prior to and during the scoping period. Those alternatives and the rationales for eliminating them from further consideration in this EA are described in Chapter 1.

2.1 PROPOSED ACTION

The Proposed Action is to operate the STM complex for alternative energy research and development with new and improved capability to support DOE's mission to research, develop and transfer to industry renewable energy and energy efficiency technologies. The Proposed Action consists of new activities and new and modified facilities. Construction would include permanent physical improvements to the site that involve buildings and equipment, utilities, and other infrastructure. Implementation of the Proposed Action is expected to occur between 2003 and 2008.

The actual components and implementation schedule for the site improvements are dependent on federal budgeting decisions and fluctuating priorities. Therefore, the Proposed Action is described in general rather than specific terms, and only some portion of the Proposed Action components would be expected to be in place prior to or by 2008. At this time, there is no certainty over which of the many Proposed Action components would be funded and then implemented, with one exception. This exception is the proposed S&TF. The preliminary design and location of the S&TF are known and described in Section 2.1.2. The designs and locations of other proposed facilities are uncertain, so various options are possible. Consequently, specific details are subject to modification and the analyses in this EA allow for future flexibility.

This EA fully addresses the potential impacts of the proposed S&TF and employs a "bounding analysis" approach for the other proposed improvements based on a conceptually defined site "buildout" scenario. A bounding analysis uses simplifying assumptions and analytical methods that are certain to overestimate actual environmental impacts. In this case, the "menu" of components that defines the Proposed Action represents projects that may or may not be in place by 2008. The defined buildout scenario for the STM Complex in 2008 is described later in this Chapter.

The defined buildout scenario may never occur or it could change to involve less development. All of the possible improvements described in the following sections will not be in place by 2008; only some components out of the entire list of possibilities will actually be implemented. Federal funding decisions and changing program priorities primarily control the level of site development as well as which facilities and programs go forward by 2008. The purpose of defining various possible components of the 2008 buildout scenario in this EA is to allow for comprehensive assessment of potential impacts from the realm of possible future site activities. This will provide an analysis within the expected limits of future site use and development.

2.1.1 Site Development Zones

As shown in Figure 2.1, NREL has established seven zones on the STM site. The future development to be allowed in these zones is summarized as follows.

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INSERT FIGURE 2-1 (Zones)

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Zone 1: Top of Mesa, Buildable Area (13 acres) – This zone includes land for specialized research such as solar collection and solar radiation. Additional facilities, if any, are to be of minimal size, low occupancy, and designed for minimal disruption to views of the mesa.

Zone 2: Conservation Area (177 acres) – This zone includes approximately 87.5% of the mesa top area within the STM site boundary and all of the mesa slopes on the site. Land within Zone 2 provides broad vistas of the surrounding community and is highly visible from numerous vantage points. Zone 2 would be preserved in its natural form; no development is allowed in this area with the exception of hiking trails and associated signage and maintenance activities.

Zone 3: West Campus (20 acres) – Includes the OTF, TTF, AFUF, S&R, Maintenance, Bulk Storage, and West Entrance. Buildings in this zone are smaller than those in Zone 4, largely due to space limitations. This zone is primarily for general research and development and process pilot facilities. It may also include functions such as wet chemistry, transportation research, and biological sciences. This portion of the site is considered suitable for using hazardous materials. Hazardous materials are discussed in Sections 3.10 and 4.10. The pattern of development for this zone is to continue development with density increased by in filling between existing facilities.

Zone 4: Central Campus (55 acres) – This zone includes major buildings such as SERF, FTLB, and the future S&TF. It also includes wet laboratories and space for heavy research such as experiments with hydrogen, toxic gases, PV, biofuels, and industrial technology. This portion of the site is considered suitable for the use of potentially hazardous materials and process demonstration activities. This zone is considered the center of the campus.

Zone 5: East Campus (26 acres) – This zone includes the Visitor Center and East Entrance, and is presently otherwise undeveloped. The zone is designated to be for general research and development with dry laboratories and minimal use of hazardous materials. It is also a zone where research support facilities could be located.

Zone 6: Camp George West Parcel (25 acres) – This is an undeveloped area of the site, bordered on the east and west by residential properties and on the south by a future regional park. This zone is designated to be for general research and development with minimal use of hazardous materials. It is also a zone where research support facilities could be located.

Zone 7: Historic Resources (11 acres) – Zone 7 has two parts. Both parts include areas previously developed as part of Camp George West and include protected cultural resources. The amphitheater and associated footbridge are in the larger part of Zone 7. The ammunition igloo is located in the smaller part of Zone 7. NREL plans no new improvements in this zone.

2.1.2 Science and Technology Facility

The S&TF is at the completion of the preliminary design stage. This means considerable detail is available for this component of the Proposed Action, but the details of the design remain subject to change as the process proceeds. The site planning and design proposals presented for this component of the Proposed Action are based on the S&TF Title I Preliminary Design Report (100% submittal).

The proposed S&TF facility would be located in Zone 4 (see Figure 2-1). Figure 2-2 clarifies the site location and a future expansion site for another facility in the future. The future expansion of the S&TF, or other specific improvements in this location, is not being analyzed in this EA. No design work has been done for such an improvement and no funding is available or set aside for such an improvement. For these reasons, future S&TF expansion(s) in this location is not considered reasonably foreseeable at this time. The proposed hardscape/ landscape plan for the S&TF is presented in Figure 2-3. The Preliminary Site Grading and Drainage Plan is presented in Figure 2-4.

The following discussion is based on the preliminary design report and summarizes the key features of the proposed S&TF.

- **Location, Purpose and Overall Description:** The proposed S&TF would be located at the STM site in Zone 4. The location is in compliance with the current campus development plan, and the design respects the siting concepts developed for the adjacent SERF.

  The S&TF would provide for PV research and office space, and expand activities currently conducted in the SERF. The S&TF would accommodate expected growth in both fundamental and process PV research. More specifically, research activities planned for the S&TF would include thin-film deposition/process, electro-optical diagnostic development, user thin film characterization, machine shop activities, surface analysis and analytical microscopy, degreasing and cleaning, interconnect process development, wet chemistry and electrodeposition, contact process development, and process development and integration.

  The proposed three-level building would provide approximately 70,000 to 75,000 sf of space and would be tucked into the existing slope so that the first and second level of the S&TF would align with the SERF. A total of 55 offices spaces are included. A pedestrian connection at each of the two laboratory levels and a service connection aligned with the second level service corridor at the SERF would promote interaction between the two facilities. Exterior building design features and materials would be similar to and compatible with those of the adjacent SERF and the surrounding site.

  The western edge of the general site location is defined by an existing 78-foot-wide utility easement east of the SERF. The existing service road would be extended in an east/northeast direction providing service access to the new facility. In addition, an emergency access drive is planned on the south side of the S&TF to provide the required fire equipment accessibility. The emergency access drive would most likely have an unpaved, all-weather surface. The service drive at the north edge of the research buildings is being implemented incrementally with each building project, and

FIGURE 2-2 PROPOSED SITE FOR THE PROPOSED SCIENCE AND TECHNOLOGY FACILITY

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INSERT FIGURE 2-3 HARDSCAPE/LANDSCAPE PLAN FOR THE SCIENCE AND TECHNOLOGY FACILITY

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INSERT FIGURE 2-4 SITE GRADING & DRAINAGE PLAN FOR THE SCIENCE AND TECHNOLOGY FACILITY

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would eventually form a complete loop. The south edge of the site would approximately align with the office pods of the SERF.

The proposed site for the S&TF is a disturbed site that exhibits past dumping of construction debris and the deposit of excavated soil. The building would occupy the disturbed site, and the site would be returned to the natural grades to the extent possible by removal of excess soil and construction debris. At the conclusion of construction, the disturbed area of the site would be reseeded with native grasses and other native and drought-tolerant vegetation.

The construction period is expected to be approximately 21 months. Exterior construction would be complete in approximately 10 to 11 months. Construction activities are expected to occur during daylight hours only.

- **Building Layout:** The conceptual building organization reflects the desire to provide daylight and views for the laboratory, circulation corridors and office space of the S&TF. Safety for building occupants is of primary importance. The S&TF is horizontally zoned similar to the SERF in that people access to the laboratories is separated from the movement of chemicals and equipment. A dedicated service corridor at each laboratory level, which is linked to the S&R dock, provides space for transportation of hazardous materials and laboratory support equipment. The vertical zoning of the three-level building places office and laboratory program components at the first level, laboratory and service functions at the second level, and a mechanical equipment penthouse at the third level. Laboratory components that have vibration sensitivity, such as the Process Development Integration Laboratory (PDIL), are placed on grade to minimize site and building-generated vibration. The vertical zoning of the three-level building allows for daylight and views into all occupied components of the building. The laboratory modules on the first level opposite the office component are light sensitive, and daylight would be incorporated only into the circulation corridor.

  The first level of the S&TF contains the public lobby, laboratory space and adjacent single level office and support space. The office component has exposure on three sides of the office to views and daylight. The second level contains the laboratory components that have a direct relationship to the PDIL. The second level service corridor would be extended west to the SERF as an elevated conditioned bridge spanning the utility easement. Both the first and second levels have been organized to provide an opportunity for future growth to the northeast. The third level is the mechanical equipment penthouse, which contains both air handling and exhaust.

- **Parking:** The existing on-site parking that was constructed as part of the SERF project would be utilized for parking for the S&TF. A vehicular turnaround would be constructed at the northeast corner of the existing parking access drive and a new pedestrian sidewalk would provide access to the S&TF.

- **Grading, Erosion Control and Drainage:** Some cuts and slope grading will be required. Grading for this project would be blended into existing grades as much as possible. It is important that the grades be feathered in to make it look more natural. All disturbed areas would require seeding and erosion control mats. Soil roughening and contouring would also help reduce runoff. Sediment control devices would be specified

at discharge points to accumulate sediment and prevent migration downstream. The project shall conform to the EPA NPDES discharge permit requirements.

The storm drainage would consist of roof drains from the building, as well as surface drainage at the dock area and around the building. The roof drains and overflow roof drains would connect within the building and tie into the surface drainage outside of the building. Storm water would then be routed to either an existing storm drain below grade that discharges into an on-site storm water detention basin, or routed through landscaped areas to the existing storm water detention basin.

Additional measures to slow runoff flow and reduce the likelihood of downstream flooding would be developed and implemented as feasible. An example would be routing runoff flows through landscaped beds before discharge.

- **Central Plant / Heating and Cooling:** The SERF currently has a central heating and chilled water plant that was designated for expansion. An annex to the existing central plant would expand the central plant. The existing boiler room would be expanded to accommodate a new boiler sized for the heating load of the S&TF. The existing chilled water system would be expanded by adding a new chiller room with equipment sized to meet the chilled water load of the S&TF with connections made into the existing primary and secondary chilled water supply and return headers.

  The heating water system for the SERF is also a primary/secondary piping system. The new boiler, sized to handle the S&TF heating load, would be installed and piped in parallel with the existing boilers. A new secondary heating loop with primary and standby pumps would extend from the SERF central plant to the heating coils in the S&TF. The heating water piping would be extended to the S&TF via a pipe bridge and would be routed through the S&TF in the service corridor up to the penthouse mechanical room and the office pod mechanical room. The central plant expansion is discussed further in Section 2.1.3. under the SERF Energy Center Expansion.

- **Water / Wastewater / Fire Protection:** The S&TF would have two separate waste systems, a sanitary waste and a laboratory waste. The toilet rooms, janitor closet, mechanical equipment rooms, and break room would connect to the cast iron sanitary waste. The laboratory waste line would connect to all sinks, floor drains, and service trenches in the laboratory, process areas and service corridors. With the "Zero Discharge" policy in place at NREL, acid resistant piping would not be required for the laboratory waste lines. A sampling station for all laboratory waste would be installed on the laboratory waste line before it exits the building and ties into the sanitary line. Floor drains in all laboratories would be equipped with a normally closed plug or cap. The sanitary line would connect to the existing main in Denver West Boulevard.

  The existing 12 inch (300 mm) water main is a combination domestic water and fire main, and is located to the east of the SERF. This line would be modified to extend east along the south side of the S&TF, around the new S&TF, and re-connect to the SERF main water line north of the existing building. Since the water main is considered the property of the water purveyor, Consolidated Mutual Water Company, they would perform all of the design and construction associated with the water main. A new water meter would be located outside of the S&TF mechanical equipment room to serve the building. Copper pipes would deliver the domestic water to toilet rooms, janitor closets,

laboratory sinks, and safety showers. Domestic hot water would be delivered to end users through a re-circulating piping system.

The fire protection system would consist of an automatic sprinkler system installed throughout the S&TF. The dock area would be provided with a dry pipe system. All other areas would have a wet pipe system installed. Electrically supervised shut-off valves would be located in strategic areas to permit the isolation of problem areas without disabling the entire fire protection system of the building. The system would be designed per the requirements of National Fire Protection Association (NFPA) 13 for an Ordinary Hazard, Group 2 area. The estimated system demand is 300 gallons per minute (gpm) at 60 pounds per square inch gauge (psig) residual water pressure. Based on the estimated residual pressure, a fire pump would not be required. NREL would perform water pressure tests and verify the static and residual pressures.

- **Compressed Air System:** The existing compressed air system located in the central plant of the SERF would be expanded to accommodate the needs of the new S&TF. Currently a 50-horsepower compressor and dryer/filter system provide laboratory quality air to the SERF. Two smaller compressors act as back-up units to this system. Based on the age and capacity of the back-up compressors, these units would be replaced and a larger compressed air system would be connected in parallel to the existing laboratory compressed air loop.

  The type of work being done in the S&TF does not require the use of house vacuum. Based on this information, a central vacuum system would not be installed for the building. Vacuum requirements would be satisfied with individual vacuum pumps located in the service corridor. The individual vacuum pumps would be provided on an as-needed basis by NREL.

- **Laboratory Gases / Fuels:** The S&TF would have a dedicated nitrogen system. A large liquid nitrogen storage tank would be located outside of the building, and 120 psig nitrogen gas would be supplied to all laboratory process areas through a piping system located in the service corridors.

  A dedicated hydrogen gas system would serve the new building. Hydrogen storage tanks would be located outside of the building, and 150 psig hydrogen gas would be piped into the laboratory/process areas through the service corridor. Excess flow valves and detection systems would be designed to shut off the supply of hydrogen gas in an emergency. The detection system would be connected to the existing building management system.

  Many of the processes that would be performed in the new facility require the use of Silane. A dedicated Silane storage area would be located on the north side of the building and Silane would be supplied to three Laboratories through a piping system located in the service corridors. Piping inside the building would be routed through a continuously ventilated piping raceway to the point-of-use.

  The processes that would be performed in the new facility also require several types of specialty gases. To accommodate the variety of different gases, a dedicated gas storage room (Toxic Gas Room) would have cabinets to house gas cylinders. This would include toxic, highly toxic and corrosive gases. Stainless steel tubing through the

service corridors would deliver the gas to the end user via a continuously ventilated piping raceway system.

A toxic gas monitoring system would be installed in the S&TF, and would be based on the type and criteria used for the SERF system. Toxic gas monitoring shall consist of a minimum of two points in Laboratories 101, 109, and 110, the Toxic Gas Room, and the Silane storage area.

A new de-ionized water system would be installed with new supply lines to serve the S&TF. The de-ionized water system would be continuously recirculated.

The S&TF would have a dedicated argon system. A liquid argon storage cylinder would be located outside of the building, and argon gas would be distributed to process areas through a piping system located in the service corridors.

- **Electrical / Power Systems:** The grounding system is designed to provide a condition of zero potential throughout the facility. It would incorporate all the elements required by code (bonds to steel, water, etc.), as well as those required for the high-frequency support of electronic systems. The latter would include dedicated busses regularly located in all laboratory spaces. Lightning protection would be an adjunct to the grounding system, and would consist of a single Early Streamer Emission (ESE) mast equal to that used on SERF. The ESE would be tied into the overall ground grid via electrodes placed at two roughly opposite points.

  Branch circuit, telephone and data distribution within the laboratories would be handled in several ways, including but not limited to, surface wiremold, conduit to individual receptacles, cable trays, cord reels, and direct connection via junction boxes.

  Internal lighting for most of the S&TF would be accomplished by blending natural and artificial sources. Control systems to make this blending as efficient as possible would include ambient and external light sensing. These would be coupled with occupancy sensors, timers, and override switches to ensure that no room goes dark while occupied. Emergency lighting fixtures would be turned off under normal conditions, and through relays, would come on when utility power is lost in any area. A limited amount of accent lighting would be incorporated in public spaces and conference rooms. Explosion-proof fixtures would be used where hazardous chemicals are stored. External lighting would be provided primarily by ground-mounted PV bollards matching those at SERF.

  A single diesel-fueled engine generator would provide standby power for egress and night lighting in the entire S&TF and ventilation in the laboratories. Enough fuel would be stored in the skid tank to run the generator at least 24 hours at full load.

- **Communications:** Communications in the S&TF would be comprised of telephone, data and paging systems. Design of the telephone and data equipment and cabling would be completed during final building design.

2.1.3 Additional Proposed Action Components

The additional Proposed Action components are organized into the following categories:

- Construction of New and Modification of Existing Facilities and Research Areas
- Infrastructure Modifications and Improvements
- Operation and Maintenance of New and Modified Facilities

The following Proposed Action components are under consideration in each category.

Construction of New and Modification of Existing Facilities and Research Areas:

- New laboratories for plant biotechnology and research greenhouses
- Biorefinery pilot-scale facility
- Microbial water/gas shift pilot plant
- Facilities for whole building testing, integrated building/transportation energy systems, and consolidating staff and laboratory space
- Facility for large vehicle test research
- Laboratory facilities for expanded fundamental hydrogen research
- New facility for larger scale hydrogen process development and integration
- Additional space for computing facility and increased connectivity
- Visitor Center expansion
- Research support facilities
- Modification of other existing facilities
- Expansion of Solar Radiation Research Laboratory (SRRL)
- Expansion of the FTLB
- Zero Energy Building
- Small scale wind turbine research and development

Infrastructure Modifications and Improvements:

- SERF Energy Center Expansion
- Additional alternative fueling stations
- Upgrade the existing electrical infrastructure
- Upgrade and extend telecommunications infrastructure
- Upgrade existing domestic water system
- Upgrade fire protection system
- Upgrade sewage system
- Upgrade and modify on-site roads, parking areas, and site entrances
- Visitor Center parking expansion
- Security structures and equipment
- Gray water system

Operation and Maintenance of New and Modified Facilities:

- Office work
- Onsite environmental monitoring
- Site amenities
- Fuel storage and use
- Routine tasks

Future facility construction and improvements to existing facilities would incorporate various sustainable design features.

The following discussions elaborate on the Proposed Action components.

Construction of New and Modification of Existing Facilities and Research Areas:

- **New laboratories for plant biotechnology and research greenhouses –** These laboratories would provide for expanded fundamental bioscience research. Research would be in areas such as plant biotechnology, kinetics for processes, process modeling, integrated process development, sensor and control systems, and gas clean-up capabilities for biopower plants.
- **Biorefinery pilot-scale facility –** This facility would provide for integrated process development and testing. Research at the facility would support the development of a biorefinery capability that produces fuels and chemicals using biological and/or thermal conversion processes.
- **Microbial water/gas shift pilot plant –** This (20,000 sf) facility would provide for pilot-scale process development and testing of biologically mediated processes to treat synthesis gas streams (principally containing carbon monoxide and hydrogen) to produce additional hydrogen and other biodegradable and environmentally friendly chemicals. The facility would include standard pilot-scale chemical process control and analysis capabilities, a small-scale gasifier for the on-site generation of synthesis gas, and pilot-scale biological reactors for production of microbial cultures including conventional and photosynthetic bacterial cultures.
- **Facilities for whole building testing, integrated building/transportation energy systems, and consolidating staff and laboratory space –** These improvements would allow for continuing research on heating, ventilation, and air conditioning (HVAC) technologies, lighting, windows, the building envelope, and appliances. There would be more research and development emphasis on cooling loads; natural gas; fuel cells and micro co-generation for combined heating, cooling, and power. Materials research would also be conducted for polymers, reflective materials, electrochromic coatings, as well as other areas. Testing and validation for emerging building technologies would also be important.
- **Facility for large vehicle test research –** This improvement would provide space for advanced vehicle prototyping and computer modeling and vehicle total environmental testing.
- **Laboratory facilities for expanded fundamental hydrogen research; new facility for larger scale hydrogen process development and integration –** These improvements would provide space for expanded hydrogen research and development. The types of work that may be done could include photo biological conversion, which uses molecular biology to modify algae and bacteria to produce hydrogen from water; photo electrochemical conversion, which uses PV cells to directly split water; and thermo chemical conversion, which uses pyrolysis and gasification to produce hydrogen and other gases from biomass. Process development and testing would be done at all stages of research processes. Systems engineering to integrate hydrogen with fuel cells and other technologies may be conducted, as well as developing storage technologies for transportation applications and developing refueling systems. The process development facility could be planned with blast walls for higher-pressure hydrogen experiments. Additional environmental review would be conducted prior to construction of a pilot-scale hydrogen facility.
- **Additional space for computing facility and increased connectivity –** NREL would increase its connectivity to access supercomputing capabilities at other laboratories. NREL would also improve its high-performance computing capability with space for high-

end workstations, a modest supercomputer, and disk and tape libraries. This capability would ideally be centrally located in either a new computing facility or modified to space in an existing facility on the STM site.

- **Visitor's Center expansion –** The existing facility would remain and be expanded to the north and/or west up to double its present size. The expanded Visitor's Center would contain exhibits and demonstrations for visitors related to renewable energy and energy efficiency; sustainability in building design, landscaping, or resource use; and other similar topics.
- **Research support facilities –** One or more facilities for research support activities would be constructed for activities such as computing and modeling, analysis, planning, graphics, reproduction, management, administration, library services, and information technology.
- **Modification of existing facilities –** Various internal and external modifications of existing facilities would be part of future improvements.
- **Expansion of the SRRL –** The existing mesa top building would be expanded to provide office space for all six team members, a small conference area, and additional laboratory space. Old office space would then be converted to new laboratory space. The new addition is anticipated to provide approximately one-half the square footage of the current building. The expanded SRRL is expected to provide just over 4,000 sf of total net area. The final area and dimensions would be determined during building design.
- **Expansion of the FTLB –** Additional office and laboratory space would be added to the FTLB. Areas to support offices and laboratories would also be constructed, such as fan lofts. The expansion could involve construction of office areas on the front (south side) of the building, laboratories at the southeast corner, laboratories and offices on the north side on a mezzanine over the existing Central Plant (utility) area and the recently constructed office area, or laboratories and support space on the west side.
- **Zero Energy Building –** A sustainable demonstration building that incorporates a variety of renewable energy features would be constructed on the STM site. A demonstration building that showcases sustainable renewable energy technology may be built as an educational facility, visitor residence, or other type of facility.
- **Small Scale Wind Turbine Research and Development –** Although NREL's primary site for wind turbine testing is the National Wind Technology Center, it is sometimes desirable to install a small wind turbine at the STM site. Turbine testing would be done at the STM site if it is needed to further NREL's mission objectives related to the site or its programs, more efficient in terms of location of staff, or more cost-effective because of existing instrumentation. Such a turbine may be a stand-alone turbine or part of a hybrid system (two or more technologies combined, for example a renewable technology and fossil fuel). One turbine, a Whisper H40 model, has been subject to previous NEPA review and installation is expected within a few months. Installation of a second turbine is possible in the future. Wind turbine testing at the STM site would meet the following criteria:
    - Turbine tower height would not exceed 40 feet (13 meters) above the ground;
    - No more than two turbines would be installed or tested at a time;
    - The power rating of each turbine would not exceed 1000 watts.

Infrastructure Modifications and Improvements:

- **SERF Energy Center Expansion –** An expansion of the SERF Energy Center would be constructed on the east side of the existing SERF building. The Energy Center

Expansion would provide space for a new chiller for the SERF, expected to be about 400 tons capacity. The expansion would also be sized to accommodate the new chiller and boiler needed for the proposed S&TF. Although design of the proposed Energy Center Expansion has not yet been completed, the dimensions of the expansion are expected to be approximately 30 feet by 30 feet.

- **Additional alternative fueling stations –** NREL's sustainable management philosophy affects decisions about all aspects of the NREL operations, including vehicle fleet choices that move the NREL toward 100% alternative-fueled vehicles. As more alternative fueled vehicles become available, NREL may install additional alternative fueling stations for various types of viable alternative fuels. These may include (but are not limited to) electric, natural gas, methanol, ethanol, or new diesel blends, including biodiesels.
- **Upgrade the existing electrical and natural gas infrastructure –** Xcel Energy provides electrical and natural gas service to the STM site. Both services are expected to be adequate for NREL's future needs; however, if circumstances change, replacement or upgrade to existing facilities may be necessary.
- **On-site power generation using renewable energy sources –** NREL would consider using renewable energy sources on the STM site to demonstrate its technologies and to provide some energy for on-site power needs in order to further NREL's goals to become a more sustainable facility. On-site generation would be on a small scale, with the primary purpose of demonstrating NREL-developed technologies and providing for on-site power needs.
- **Upgrade and extend telecommunications infrastructure –** Qwest Communications provides telephone and electronic communications to the STM site. Two five-inch conduits are routed along Denver West Parkway to the west end of the site for future upgrades to these systems (see Figure 1-3). While the infrastructure is considered adequate for current needs, it is anticipated that as development progresses at the site, the connectivity capacity would need to be increased to support NREL access to high-performance computing capabilities at other laboratories. The capacity of these systems would also have to be increased, as required, to meet growing needs. Improvements are planned in the DWOP area and Qwest may extend the duct bank into the STM site in the future.
- **Upgrade domestic water system –** As new facilities are added to the STM site, new connections to the water system would be added. Although the current water system is anticipated to be adequate for the foreseeable future, if circumstances change, modifications and/or upgrades may be necessary.
- **Upgrade sewage system –** The existing on-site sewer system capacity is considered adequate for current buildings, the S&TF and a bioenergy research facility, or other facilities with similar wastewater requirements. New development associated with the Proposed Action would not require modifications to the overall sewer system infrastructure. Minor changes would be expected to allow for new connections.
- **Upgrade fire protection system –** As new facilities are added, they would be equipped with adequate fire protection systems according to appropriate industry and DOE standards.
- **Upgrade and modify on-site roads, parking areas, and site entrance –** On-site roads and parking areas would be resurfaced, upgraded, or modified in size or location, as necessary, to most effectively and safely support on-site activities. Access roads to new facilities and test sites would be installed.

- **Visitor Center parking lot –** The Visitor Center parking lot would be expanded to the north. The drainage north of the current parking area would either be routed beneath the new parking area or re-routed around the new parking lot.
- **Security structures and equipment –** Modifications and upgrades to security measures would be implemented in accordance with federal security mandates and site needs. These could include changes or additions to the site entrance building, gates, fences, alarms and surveillance systems, access control systems, or other security equipment and facilities. It might also include fencing of the entire NREL site, with the exception of the conservation easement land.
- **Gray water system –** As development of the STM site progresses, NREL would consider various options to enhance the efficient use of water; for example, collection and storage of rainwater, or treatment and reuse of process wastewater for such uses as irrigation of building landscaping.

Operation and Maintenance of New and Modified Facilities:

- **Office work –** Work in NREL's offices would involve computer workstations, printers, copiers, FAX machines, and other typical office equipment and supplies.
- **On-site environmental monitoring –** Environmental monitoring on the STM site would be performed on an as-needed basis and could include monitoring of off-site control areas. Although there is no routine environmental monitoring performed on the STM site, an occasion may arise for which monitoring of one or more environmental media is warranted, either in a localized area on site or on a site-wide scale. This could include one or more of a variety of environmental media, for example, surface water, groundwater, air, soil, wildlife, or vegetation.
- **Site amenities –** Site amenities would consist of improvements such as foot and bicycle trails, sidewalks, and outdoor gathering places. These outdoor areas may include benches, tables, gazebos, or small recreation areas.
- **Fuel storage and use –** On-site fuel storage and use could involve a variety of traditional and/or alternative fuels, such as propane, hydrogen, liquefied natural gas, ethanol, gasoline, diesel, biodiesel, and other diesel blends for research, site operations, and vehicle fueling.
- **Routine tasks –** This category of activities is comprised of tasks such as:
  - Cleaning both research and site operations facilities and equipment;
  - Inspections and audits of systems, processes, and equipment;
  - Equipment storage and maintenance;
  - Landscape maintenance (e.g., mowing, trimming, weeding, replacement of plants, upgrades, etc.);
  - System testing, preventive maintenance, repairs of systems and components;
  - Snowplowing;
  - Road maintenance;
  - Re-alignment of on-site roads, parking lots, and the site entrance, as needed, to maintain safe and adequate traffic flow;
  - Pest control including control of such pests as rodents and insects;
  - Preventative maintenance including such items as changing air filters and testing diesel generators;
  - Corrective maintenance including such items as changing light bulbs, replacing leaking pump seals, resetting circuit breakers, and performing minor repairs;
  - Troubleshooting malfunctioning items and systems related to facilities;

- Coordinating outside subcontractors with such items as pest control and equipment inspections;
- Maintenance, testing, upgrades, modifications, and additions to the fire protection system including, but not limited to, distribution piping and equipment, fire hydrants, and monitoring capability;
- Maintenance, testing, upgrades, modifications, and additions to the domestic water system including, but not limited to, additional distribution points (buildings), distribution piping and equipment;
- Maintenance, testing, upgrades, modifications, and additions to wastewater handling capability at the site.

2.1.4 Site Planning Assumptions

The overall balance of program activities and personnel assigned to the STM and DWOP sites, respectively, would be expected to change and fluctuate over time based on site management efficiencies and associated federal budget priorities and funding. Site planning assumptions are specified for the proposed S&TF, but remain flexible for other improvements. This flexibility reflects the current need for long-term site planning studies that would guide and refine future development proposals in terms of sites for specific uses and constraints on future building designs.

Current site planning assumptions do not include on-going site planning efforts or previously developed conceptual plans for the STM site. However, the old plans help define the parameters for the bounding analysis in this EA. In 2002, NREL began a new site planning effort to develop a 25-Year General Development Plan for both of NREL's sites (both STM and NWTC). The outcome of the effort will be a single unified vision for the STM site. The resulting plan will be flexible enough to allow for adaptation so it continues to align with laboratory and program priorities as they change over time.

In some instances, previous plans included drawings showing locations for specific facilities and buildings, building perimeters, site access configurations and overall site development philosophies. Although these drawings show considerable detail, they present different alternatives and are not current proposals. These plans may or may not reflect future outcomes and do not relate directly to conditions anticipated in 2008.

As described in Sections 2.1.1 and 2.1.2, the STM site has been divided into zones and the Proposed Action has been divided into components. Table 2-1 provides a summary that clarifies potential locations for each primary component of the Proposed Action by zone.

Table 2-1. Summary of Potential Locations for Each Primary Proposed Action Component by Zone.

Proposed Action Component	Zone 1 Mesa Top	Zone 2 Conser-vation Area	Zone 3 West Campus	Zone 4 Central Campus	Zone 5 East Campus	Zone 6 Camp George West Parcel	Zone 7 Historic Resources
Science and Technology Facility				X			
New laboratories for plant biotechnology and research			X	X	X	X	

greenhouses							
Biorefinery pilot-scale facility			X	X	X	X	
Microbial water-gas shift pilot plant			X	X	X	X	
Facilities for whole building testing, integrated building/transportation energy systems, and consolidating staff and laboratory space			X	X	X	X	
Facility for large vehicle test research			X	X	X	X	
Laboratory facilities for expanded fundamental hydrogen research			X	X	X	X	
New facility for larger scale hydrogen process development and integration			X	X	X	X	
Additional space for computing facility and increased connectivity			X	X	X	X	
Visitor's Center Expansion					X		
Visitor's Center Parking Expansion					X		
Research Support Facilities			X	X	X	X	
Modification of Existing Facilities	X		X	X	X	X	
Expansion of SRRL	X						
Expansion of FTLB				X			
Zero Energy Building			X	X	X	X	
Small scale wind turbine research and development			X				
Infrastructure Modifications and Improvements	X		X	X	X	X	
Operations and Maintenance	X		X	X	X	X	

The following additional site development assumptions would also apply.

- Only facilities and facility modifications presenting environmental consequences and risks approximately equivalent to existing facilities would be added.
- Security gates at the west and east ends of the site would remain in place to control site security and limit public access to the site.
- No major, off-site road or utility services would be implemented.
- New buildings and building modifications would have heights that do not exceed five stories above ground level.
- New buildings would be set back from the STM site's parcel boundaries. These setbacks would vary and would be determined during the site planning process and/or during the final design processes for individual buildings.

The following discussion provides a description of anticipated future improvements at the STM Complex by 2008 in terms of growth over time in employment and facility square footage.

2.1.5 Site Development, Occupancy and Phasing

The number of workers and square footage of space at the STM Complex would be expected to increase as components of the Proposed Action are implemented. Workers are defined as full

and part time employees, contract employees, consultants and others who work on the site. The total figures for workers presented in the following discussion represent estimates of the annual average number of workers at the STM and DWOP sites. The anticipated increase in workers from 2002 to 2008 is anticipated to occur as follows:

- Worker totals would increase by up to five percent compounded annually; and
- The relative proportions of personnel between STM and DWOP would change such that 75 percent of anticipated worker increases would be housed at the STM site with the remainder at the DWOP site.

Table 2.2 provides estimated present and future workers on both sites based on these assumptions. Table 2.3 presents estimated future total net building square footage figures to generally characterize corresponding construction phasing. No other construction phasing assumptions for the components of the Proposed Action are proposed.

Table 2-2. Estimated Present and Future Workers at the STM and DWOP Sites.

Site	2002 Workers	2008 Workers
STM	400	669
DWOP	655 *	745
TOTAL	1055	1414

***** Includes 55 DOE GO workers

Note: The figure of 1055 workers was increased five percent compounded annually for 2003, 2004, 2005, 2006, 2007, and 2008. The total was distributed between the STM and DWOP with 75 percent at STM and 25 percent at DWOP

Table 2-3. Current and Estimated Future Building Square Footage at the STM and DWOP Sites.

Site	2002 and 2003	2008
STM	324,231	450,000
DWOP	214,514*	250,000
TOTAL	538,745	700,000

* Includes DOE GO

This EA assumes that additional square footage needs in DWOP by 2008 would be met by leasing additional space in buildings within the DWOP that are currently occupied by DOE or others.

2.2 NO ACTION

The No Action Alternative would leave the STM in its current configuration, add no new facilities, and maintain current levels of research, operation and management activities. No significant changes to current levels of research, operation and management activities would occur at the DWOP.

As described in Chapter 1, the types of research and development that these sites support would not change nor would the existing facilities. Work would continue to improve technical designs, improve power generation efficiencies, increase economic competitiveness, transfer technologies to industry, and fully characterize and minimize environmental impacts from various technologies. The EERE research and development program focus areas would continue to include, but not be limited to:

- Solar;
- Wind and Hydropower;
- Geothermal;
- Distributed Energy, Electrical Infrastructure and Reliability;
- Biomass;
- Industrial Technology;
- Freedom Car and Vehicle Technology;
- Hydrogen and Infrastructure;
- Buildings;
- Weatherizations and Intergovernmental Grants; and
- Federal Energy Management Program.

In addition, the sites would continue to support:

- Other DOE Sponsored Programs, and
- Work for Others Supporting the DOE Mission.

Routine operations and maintenance would occur in the future as it does at this time.

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