DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers

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Technical Letter
No. 1110-3-491 | 30 June 1998

Engineering and Design
SUSTAINABLE DESIGN FOR MILITARY FACILITIES

Distribution Restriction Statement

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SUSTAINABLE DESIGN FOR MILITARY FACILITIES

1. Purpose. This letter provides basic criteria and information pertaining to the incorporation of sustainable design concepts in the design and construction of Military facilities.

2. Applicability. This letter applies to all HQUSACE elements and USACE commands having Army military construction and design responsibility.

3. References. See Appendix A.

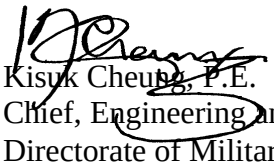
4. Distribution. Approval for public release; distribution is unlimited.

5. Objective. Sustainable Design is the design, construction, operation, and reuse/removal of the built environment (infrastructure and buildings) in an environmentally and energy efficient manner. The major tenet of sustainable design is to meet the needs of the present without compromising the ability of future generations to meet their own needs. Synonymous with Sustainable Design is "Green Building." Sustainable design includes efficient use of natural resources, better performing, more desirable, and more affordable infrastructure and buildings. Sustainable design incorporates the energy efficiency concerns of the 1970's with the concerns in the 1990's related to damage to the natural environment; emissions of greenhouse gases and ozone depleting chemicals; use of limited material resources; management of water as a limited resource; reductions in construction, demolition and operational waste; indoor environmental quality; and occupant/worker health, productivity and satisfaction. This ETL provides designers with guidance on sustainable design for the design and construction of all new Army facilities, and the rehabilitation/renovation of existing facilities.

6. Action. The guidance in Appendix B to this technical letter will be used for planning, design and construction of Army facilities to incorporate Sustainable Design or Green Building concepts.

7. Implementation. This technical letter will have immediate application, as defined in paragraph 6c, ER 1110-345-100.

FOR THE COMMANDER:



Kisuk Cheung, P.E.
Chief, Engineering and Construction Division
Directorate of Military Programs

3 Appendices
APP A - References and Bibliography
APP B - Sustainable Design for Military Facilities
APP C - Green Building Criteria Update Program (GBCUP)

APPENDIX A

REFERENCES AND BIBLIOGRAPHY

1. Referenced Laws, Regulations And Publications

a. Alternative Motor Fuels Act (AMFA) of 1988, P.L. 100-494 (42 USC 6374).

b. Energy Policy Act (EPACT), P.L. 102-486, December 1992.

c. National Environmental Policy Act (NEPA) of 1969; as amended by P.L. 91-190, 42 U.S.C. 4321-4347, January 1, 1970; P.L. 94-52, July 3, 1975; P.L. 94-83, August 9, 1975, and P.L. 97-258, 4(b), Sept. 13, 1982.

d. National Pollution Discharge Elimination System (NPDES), established by Clean Water Act, 33 U.S.C. Chapter 26, established 1972 and as amended.

e. Executive Order 12873, Federal Acquisition, Recycling, and Waste Prevention, signed on August 6, 1993.

f. Executive Order 12902, Energy Efficiency and Water Conservation at Federal Facilities, signed on March 8, 1994.

g. Executive Memorandum, Environmentally and Economically Beneficial Practices on Federal Landscape Grounds, signed on April 26, 1994.

h. Technical Manual 5-803-13, Landscape Design and Planting

i. Technical Manual 5-803-14, Site Planning and Design

j. MIL-HDBK 1165, Military Handbook, Water Conservation.

k. Engineering Regulation (ER) 1110-345-100, Design Policy for Military Construction.

l. Comprehensive Procurement Guidelines I (CPG I) for Products Containing Recovered Materials; Final Rule [60 FR 21370, May 1, 1995].

m. Comprehensive Procurement Guidelines II (CPG II) for Products Containing Recovered Materials; Final Rule [62 FR 6096, November 13, 1997].

n. Recovered Materials Advisory Notice I (RMAN I); Final Notice of Availability, [60 FR 21386, May 1, 1995].

o. Recovered Materials Advisory Notice II (RMAN II); Final Notice of Availability, [62 FR 60995, Nov 13, 1997].

p. American Society of Heating, Refrigerating and Air-Conditioning Engineers ASHRAE) Standard 62-1989, Ventilation for Acceptable Indoor Air Quality.

q. Federal Recycling Guide for Waste Prevention, Recycling and Buying Recycled, EPA-904B95007, USEPA Region 4 Library, 345 Courtland Street, N.E., Atlanta, GA.

r. Illumination Engineering Society of North America (IESNA), 120 Wall Street, New York, NY.

s. Leadership in Energy and Environmental Design (LEED) Building Rating System, U.S. Green Building Council, 90 Montgomery St., Suite 1001, San Francisco, CA.

2. Bibliography

a. Recommendations for Incorporating Green Building Concepts in USACE Guidance Documents, Prepared by the Civil Engineering Research Foundation (CERF) for Headquarters, U.S. Army Corps of Engineers, Washington, DC, 1995.

b. Sustainable Building Technical Manual--Green Building Design, Construction, and Operations. Prepared by Public Technology, Inc., for the U.S. Green Building Council. Sponsored by U.S. Department of Energy and U.S. Environmental Protection Agency, 1996.

c. U.S. Air Force Environmentally Responsible Facilities Guide (Draft), Prepared by Hellmuth, Obata & Kassabaum (HOK), Inc., for the U.S. Air Force Center for Environmental Excellence, Brooks AFB, San Antonio, TX, 1996.

d. Sustainable America: A New Consensus for Prosperity, Opportunity, and a Healthy Environment for the Future, 1996, The President s Council on Sustainable Development (PCSD). US Government Printing Office, Superintendent of Documents, Washington, DC 20402-9328.

e. Sustainable Communities: A New Design Synthesis for Cities, Suburbs and Towns, 1986, Sierra Club Books, PO Box 7959, San Francisco, CA, 94120-7959.

f. A Sustainable World: Defining and Measuring Sustainable Development, 1994, International Center for the Environment and Public Policy, P.O. Box 189040, Sacramento, CA 95818.

g. Community Energy Workbook: A Guide to Building a Sustainable Economy, 1995, Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass, CO, 81654.

APPENDIX B

SUSTAINABLE DESIGN FOR MILITARY FACILITIES

APPENDIX B
SUSTAINABLE DESIGN FOR MILITARY FACILITIES

1. Background.

a. On August 6, 1993 Executive Order (EO) 12873, "Federal Acquisition, Recycling, and Waste Prevention," was signed. Section 401 of this E.O. states that "In developing plans, drawings, work statements, specifications, or other product descriptions, agencies shall consider the following factors: elimination of virgin material requirements; use of recovered materials; reuse of product; life cycle cost; recyclability; use of environmentally preferable products; waste prevention (including toxicity reduction or elimination); and ultimate disposal, as appropriate." The EO also directed the Environmental Protection Agency (EPA) develop guidance to help federal agencies incorporate environmental preferability into their purchasing procedures.

b. In response to EO 12873, EPA developed Comprehensive Procurement Guidelines (CPG I and II). These are the first formal regulations implementing sustainability requirements. The companion Recovered Materials Advisory Notices (RMAN I and II) contain EPA's recommendations for purchasing all items designated in the final CPGs. Currently, EPA has designated 36 items that are, or can be, manufactured using recycled and recovered materials. Construction, landscape, park and recreation products are among the designated items. Federal Agencies are required to purchase EPA-designated items meeting minimum recycled-content standards unless they are not available within a reasonable period of time; fail to meet reasonable specification standards; are not available from two or more sources (to maintain competition); or are unreasonably priced (5% higher than comparable non-recycled products). Recycled-content purchase requirements are discussed in EPA's "Federal Recycling Guide for Waste Prevention, Recycling and Buying Recycled."

c. On March 8, 1994, EO 12902, "Energy Efficiency and Water Conservation at Federal Facilities," was signed. This E.O. mandates that agencies improve energy efficiency and water conservation in federal buildings and increase investments in solar and other types of renewable energy. Section 306 states that "Each agency involved in the construction of a new facility that is to be either owned by or leased to the Federal Government shall design and construct such facility to minimize the life cycle cost of the facility by utilizing energy efficiency, water conservation, or solar or other renewable energy technologies." The EO is designed to meet and exceed provisions for federal energy and water efficiency that were contained in the Energy Policy Act of 1992 (EPACT). EPACT contains several major energy efficiency regulatory provisions. EO 12902 exceeds EPACT requirements by requiring federal agencies to establish a conservation program that will reduce gross square foot energy consumption in existing facilities by 30 percent by the year 2005. EO 12902 requires federal agencies to prioritize facility audits, improve efficiency at facilities previously exempted by EPACT, incorporate efficiency provisions into new and existing leases, minimize the use of petroleum-based fuels, specify showcase buildings, purchase energy-efficient products, and report water consumption annually.

2. Definition.

a. Sustainable Design (Green Building) is the design, construction, operation, and reuse/removal of the built environment (infrastructure as well as buildings) in an environmentally and energy efficient manner. Sustainable Design is meeting the needs of today without compromising the ability of future generations to meet their needs. Sustainable Design includes not only efficient use of natural resources, but it can also translate into better performance, desirability, and affordability.

b. Sustainable Design incorporates the energy concerns of the 1970's with new concerns in the 1990's, including damage to the natural environment; emissions of greenhouse gases and ozone depleting chemicals; use of limited material resources; management of water as a limited resource; reductions in waste; indoor environmental quality; and occupant/worker health, productivity and satisfaction. Ideally, we would only use resources in the built environment at the speed at which they naturally regenerate, and discard them at or below the rate at which they could be absorbed by natural ecological systems.

c. While the ideal may not be achievable at present, those involved in designing, constructing, operating, maintaining, and retiring the components of the built environment, such as the U.S. Army Corps of Engineers (USACE), can take steps now to maximize energy efficiency and minimize environmental impact. Green Building goes beyond simple green products and recycled materials. Green Building is an environmental consciousness or resource awareness about using or not using our valuable natural resources in an energy-conscious or conservative way. This is an important concept. It is an attitude about applying sound design principles and practices to create a built environment, which optimizes the functionality and operability of the total system while incorporating sustainable design principals.

3. Goals and Objectives of Sustainable Design.

a. The overall USACE goal of Sustainable Design is to be environmentally responsible in the delivery of facilities. The key traditional elements for decision making in the facility delivery process are cost, quality and time. These elements need to be expanded to include the ecological and human health impacts of all decisions.

b. Each project generates its own set of goals. However, sustainable design goals should apply to all projects. The goals for improving the environmental performance of facilities include: (a) use resources efficiently and minimize raw material resource consumption, including energy, water, land and materials, both during the construction process and throughout the life of the facility, (b) maximize resource reuse, while maintaining financial stewardship, (c) move away from fossil fuels towards renewable
energy sources, (d) create a healthy and productive work environment for all who use the facility, (e) build facilities of long-term value, and (f) protect and, where appropriate, restore the natural environment.

c. Identify environmental goals and requirements from paragraph 3A and 3B above to be implemented during the design process, and include them in the project development document.

Consider using the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Building Rating System as an outline of environmental performance targets for the project. Integrate into the project planning and goal setting process applicable requirements from the installation Pollution Prevention (P2) Program. Make decisions during the planning and design process to support installation-wide reduction in the release of ozone depleting chemicals (ODC) and greenhouse gases; reduction in the use of hazardous materials and pesticides, and the generation of solid wastes; and support the EPA 33/50 Program (a voluntary program targeting 17 chemicals for reduction).

d. Where possible, budget for environmental and energy-efficient equipment, systems, and design solutions based on life cycle cost assessment (LCCA). Consider potential for cost-effective use of photovoltaics, on-site wastewater treatment, and graywater systems. Generally the potential for these is greatest in remote areas. Where those technologies show promise, include as special requirements in the project description, and budget accordingly.

e. Consider establishing a solar amount (SA) in the budget to fund passive and/or active solar strategies. SA will apply only to those features that prove to have a good savings based on LCCA. While developing the DD1391, identify funding sources for environmental items that cannot be addressed within the Programmed Amount (PA). If the project is a renovation, consider the use of MCP Energy Conservation Investment Program (ECIP) funds. Pollution Prevention (P2) funds may be available for some environmental initiatives which contribute to P2 goals. Budget for full Systems Commissioning and for the preparation of O&M Manuals, and identify by line item in approved DD Form 1391.

4. Project Design Team.

a. Only through an interdisciplinary approach can true sustainability be achieved. Technical Manual 5-803-14, Site Planning and Design, describes the design team. Guidelines set forth in the AEI on Installation Support should be followed in establishing the design team. The makeup of the team will be determined by the particular type of project, but members must achieve a common understanding of environmental and energy conservation concerns. All members of the design team should participate in initial goal setting and should also attend the design charette.

b. Set clear and specific environmental and energy conservation goals for the project. Quantify goals wherever possible; for example, energy use, water use, allowable levels of volatile organic compounds (VOC) emissions, etc. The Environmental members of the design team shall educate the entire team about opportunities for incorporating sustainable design.

5. Planning and Site Selection.

a. Use the procedures described in Technical Manual 5-803-14, Site Planning and Design, to analyze the site. In addition, when planning and selecting a site, the following should be considered to minimize environmental impacts: (a) renovate and reuse existing buildings, where possible, (b) leave pristine areas untouched and minimize disturbance to wildlife habitats, (c) give priority to and build on previously disturbed or damaged sites, and, where possible, restore

damaged areas, (d) minimize transportation requirements for the transport of goods and services and for employee, occupant, or customer commuting, (e) maximize existing transportation links, especially public transit, and minimize the need to build new links, and (f) maximize cluster development strategies to reduce disturbance of open areas and reduce utility and transportation costs.

b. Review the established Installation Master Plan, Installation Design Guide, general planning guidelines, or sub-installation area development plans to ensure an optimal coordinated site selection, as described in Technical Manual 5-803-14. Rank alternate sites for the proposed project based upon a comparative analysis of the issues. Consider the potential environmental impacts the proposed improvements will have on the surrounding environment, neighboring communities and cultural resources. Review the Environmental Impact Statement (EIS), and pay particular attention to impacts of decreased water quality, increased storm water runoff, increased erosion potential and ambient air quality. Ensure compliance with the National Environmental Policy Act (NEPA). Consider the reuse or rehabilitation of an existing previously developed site rather than altering undisturbed raw land, if an existing base is not to be utilized for the proposed improvements. Consider the location of the proposed site in relation to existing facilities to minimize transportation requirements and to provide opportunities for shared use of common areas wherever possible. Understand the micro-climate of each site and identify which sites have the best potential for sustainable design based on temperature, humidity, wind and solar orientation. Consider each site's potential for producing alternative forms of electricity. For example, remote guard shacks may be good candidates for the use of photovoltaics. Consider the vegetation and topography of each site and identify which site would require the least amount of disruption in order to accommodate the proposed improvements. Consider the geology and hydrology of each site and identify which sites are most suitable for the proposed improvements. Avoid development of sites that would adversely affect watersheds. Consider any potential for cleanup (Installation Restoration Program) requirements for the site. Understand the ecology of the site in order to identify natural habitats that may be endangered through its development, and select a site on which the proposed improvements can be developed in a manner that maintains the existing ecological balance.

6. Site Development.

a. The project site should be developed as described in Technical Manual 5-803-14 and within the following guidelines to ensure minimum environmental disturbance: (a) protect site natural resources, such as water, soil, vegetation, natural amenities, etc., (b) place infrastructure and buildings on the site (cluster buildings, where possible) to minimize disturbance, preserve open space and environmentally sensitive areas, and to make beneficial use of renewable resources (sun, wind, rain, snow, etc.)., and (c) maximize the use of existing site conditions such as: natural drainage patterns, natural vegetation and soils, clean air, etc.

b. A complete site survey and soils report should be produced as described in Technical Manual 5-803-14. Include watersheds, drainage areas, stream corridors, wetlands, aquifer recharge zones, hundred year flood plains, special vegetative areas, and a tree survey (include location, genus and species) of all trees sized 15 cm DBH (diameter breast height) or greater. Identify locations of any special cultural or archaeological sites. Document all information on

site analysis drawings. Test site radon levels if the region has potential for radon contamination. Develop a plant list to be used during the design process that identifies acceptable native plants and other plants that are suitable for use on the site based upon existing climate, soils and ecology and pest and disease considerations, as described in Technical Manual 5-803-13, Landscape Design and Planting.

7. Sustainable Design and Construction of the Built Environment.

Design and construction of sustainable buildings should be in accordance with the following concepts:

a. Strategic Facility Planning and Programming--Analysis to determine whether to renovate or build new, sell existing facilities or lease, consolidate or decentralize, is critical to ensuring long-term viability, resource conservation and life-cycle cost benefits;

b. Site Work and Planning--Environmentally sensitive planning looks beyond the boundary of the project site to evaluate linkages to transportation and infrastructure, ecosystems and wildlife habitat and community identification. Site planning evaluates solar and wind orientation, local microclimate, drainage patterns, utilities and existing site features to develop optimal siting and appropriate low maintenance landscape plant material;

c. Building Layout and Design--Optimize building size, and maintain an appropriate building scale for the environment and context of the building or a building component. Layout the rooms of a building for energy performance and comfort, and design for standard sizes to minimize material waste. Pay careful attention to the location of exterior windows. Avoid structural over-design and the resultant waste. Design components of the built environment for durability and ease of adaptation to other uses, and for waste recycling.

d. Energy--Building orientation and massing, natural ventilation, day-lighting, shading and other passive strategies, can all lower a building's energy demand and increase the quality of the interior environment and the comfort and productivity of occupants. The efficiency of required systems is maximized through use of advanced computer modeling and life cycle cost analysis;

e. Building Materials--Environmentally preferable building materials are durable and low maintenance. Within the parameters of performance, cost, aesthetics and availability, careful selection and specification can limit impacts on the environment and occupant health;

f. Indoor Air Quality--Indoor air quality is most effectively controlled through close coordination of architecture, interiors and MEP design strategies that limit sources of contamination before they enter the building. Construction procedures for IAQ and post-occupancy user guides also contribute to good long-term IAQ;

g. Water--Site design strategies that maximize natural filtration of rainwater and consideration of on-site biological treatment systems for building gray water and waste water can enhance water quality. Water conservation is enhanced by low flow plumbing fixtures, water appropriate landscaping and HVAC and plumbing system design;

h. Recycling and Waste Management--Waste and inefficiency can be limited during construction by sorting and recycling demolition and construction waste, reuse of on-site materials and monitoring of material use and packaging. Accommodating recycling into building design reduces waste while generating revenues;

i. Building Commissioning, Operations and Management--Effective building commissioning is essential to ensure proper and efficient functioning of systems. Facilities operations benefit from the monitoring of indoor air quality and energy and water saving practices, waste reduction and environmentally sensitive maintenance and procurement policies; and

j. Strategic Environmental Management--By integrating long-range environmental considerations into their proactive planning process, manufacturing-based organizations (such as AMC) can eliminate emitted or discharged pollutants. Strategic environmental management helps to understand and assess environmental risks and opportunities so users can make informed decisions about their facilities and processes.

8. Maximizing User Health and Productivity.

a. In order to maximize the health and productivity of inhabitants and users of sustainable projects, the following guidelines should be followed to the maximum extent practicable:

(1.) Pay particular attention to indoor air quality, i.e., minimize radon entry, exposure to electromagnetic fields, pesticides, products that release formaldehyde and volatile organic compounds, and other "sick building" factors, and

(2.) Provide adequate, efficient lighting, and where possible, incorporate into design of a building: day lighting, natural ventilation, views, greenery and other indoor environmental amenities.

(3.) Provide effective air distribution patterns and ensure that temperature and humidity comply with existing Corps criteria.

b. Use existing Corps criteria as well as ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality, as a design guideline. Document IAQ related site characteristics. In urban, industrial or other areas with possible air quality problems, test ambient air quality on-site. Typical facility-related air pollutant emissions sources to be addressed include aircraft operations, motor vehicles, energy generators and boilers, incinerators, industrial processes (such as plating, spray-painting and abrasive blasting), volatile fuels and solvents, jet and rocket engine test facilities, asphalt/concrete plants, wastewater treatment facilities and bakeries and laundries. Determine air filtration requirements and ensure that the requirements of CEGS 15895, Air Supply and Distribution System, are met. Consider air filter alarms to notify building maintenance personnel so that excessive static pressure does not develop and compromise efficiency. Determine fresh air rates based on ASHRAE Standard 62-1989 and other Corps criteria. Do not underestimate occupant densities. Consider programmed number of occupants

plus visitors and plan for possible future requirements.

9. Designing for Energy Efficient Operation.

a. Sustainable design requires the use of energy efficient equipment and systems, such as the following:

(1.) Use high levels of insulation, tight construction, high-performance windows (superior insulating value), and glazing with low solar heat gain (in appropriate climates).

(2.) Make use of renewable energy sources, i.e., passive solar heating, natural cooling or ventilation, day-lighting, photovoltaic electricity production, etc, where life cycle cost effective.

(3.) Use energy conserving mechanical and electrical equipment and their accessories, as well as lighting, that meets or exceeds existing Corps criteria. Investigate the use of cleaner fuels such as natural gas and cogeneration where remote government owned power plants are available.

b. Ensure that the design methodology and other energy conservation criteria of Chapter 11, Architectural and Engineering Instructions--Design Criteria, are followed or exceeded, including the selection of equipment and systems based on life cycle cost and compliance with energy use budgets. Consider the use of low energy consuming systems such as geothermal heat pumps, desiccant cooling and thermal storage, as well as equipment that exceeds the minimum energy efficiencies contained in the CEGS and other Corps criteria.

c. Gather information on the climate including temperature, humidity, insulation, wind, precipitation and other weather anomalies. Identify aspects of the micro-climate that create opportunities for energy conservation such as solar orientation for passive and/or active solar strategies, and topography or vegetation for shade and windbreaks. Explore energy sources available at the site. Identify opportunities for the cost-effective use of alternative energy resources such as photovoltaic panels, wind, biofuels and geothermal. Review utility rate structures and identify demand charges. Evaluate potential for utility rebates. Investigate building usage patterns and occupant loading rates for optimum conditions.

d. Determine lighting levels for all programmed areas based on Illumination Engineering Society (IES) recommendations. Consider lighting strategy when determining foot-candle levels (e.g., uplighting, downlighting, etc.). When task lighting is anticipated, reduce ambient lighting levels accordingly. Determine plug loads for energy modeling purposes based on the probable usage. Consider difference between energy surge during equipment start up and actual energy usage of equipment, and factor in diversity to reflect actual number of equipment users at any given time. Plug loads are commonly overestimated. Require office equipment and appliances to meet the requirements of the EPA Energy Star program.

10. Management of Water as A Limited Resource.

a. Water is one of our most important life sustaining resources; with potable water being critical in much of the U.S. Sustainable Design requires careful consideration of the following: (a) utilize xeriscape design principles, and water-efficient, low-maintenance, native landscape materials, (b) utilize water-efficient plumbing fixtures, (c) design for the reuse of rainwater and "graywater" (water from showers, sinks, and washing machines) where permitted, and (d) recycle sewage treatment plant sludge or minimize the environmental impact of its disposal.

b. The designer must evaluate the possibility of eliminating permanent irrigation systems through the use of plant materials that are appropriate for the site's climate and soils as described in TM 5-803-13. If plant materials with supplemental water requirements are desired, limit their use to a defined area and utilize efficient drip irrigation systems. The designer should evaluate potential for rainwater retention or graywater recycling as described in TM 5-803-14. Analysis using LCCA is required if systems were identified during the planning phase. Ideal applications are regions with limited water availability and where some landscape irrigation is desirable.

c. Since graywater reclamation and wastewater treatment facilities require regulatory authority approval, initiate the permitting process as soon as the requirement is known. Identify the personnel who will operate and maintain the treatment system and obtain their input before selecting a system. Evaluate potential for cost-effective mechanical or biological on-site wastewater treatment of wastewater or runoff from paved areas. Analysis using LCCA is required if these systems were identified during the Planning Phase. Ideal applications for wastewater include facilities with high water use requirements and localities where water treatment is limited and/or costly. Ensure that facility siting is in accordance with the wellhead protection plan of the installation. Develop water-conserving criteria for plumbing fixtures.

d. At a minimum, the designer must use low-flow fixtures as described in CEGS 15400, Plumbing, General Purpose, and CEGS 15405, Plumbing, Hospital. Evaluate requirements for National Pollution Discharge Elimination System (NPDES) permitting, resulting from facility operations or construction. Facilities and surrounding area should minimize potential for storm water runoff and resulting erosion.

11. Resource-Efficient Materials In Design and Construction.

a. The designer must incorporate Sustainable Design by investigating the following:

(1.) Consider the total life-cycle costs and environmental impact of products and materials rather than just their initial price. Use durable products and materials. Select materials with low embodied energy.

(2.) Avoid environmentally harmful materials, i.e., those containing ozone-depleting chemicals or releasing gaseous pollutants, toxins, etc. Also avoid utilizing excessive packaging, where possible.

(3.) Buy locally produced materials to minimize the impact of transporting them.

(4.) Reuse salvaged materials, or use products made from recycled materials. Select materials that can be recycled at the end of their use.

(5.) Use integrated pest management practices to reduce the use of pesticides that may present a hazard to humans and the environment. In selecting pest management, preference should be given to practices that minimize or eliminate the need for chemical applications.

b. Designers will specify a preference for recycled-content building materials in accordance with EPA Guidelines. Designers should identify locally manufactured building materials and products, and create list of manufacturers/suppliers for the design team. This process will streamline materials research during design, and will enhance early consideration of locally manufactured types of products. This process will not be used to limit competition during bidding. As an exception, the designer of historic building renovations will identify building materials for renovation, etc. These materials are subject to the Secretary of Interior Standards.

12. Corps Of Engineers Green Building Criteria Update Program

a. In 1994, funding was provided for a 5-year program for the Corps to develop and update technical guidance and criteria for sustainable design and construction of Army facilities. The Corps has taken a comprehensive, ground-up approach to sustainable design technology in military construction. The Corps philosophy is to effect a fundamental and permanent change in the way all military projects are designed and constructed as opposed to a project-by-project basis. In order to institutionalize sustainable design into Corps design procedures, we are revising current construction guide specifications (CEGS) which are used to design and construct military projects. We have called this our Green Building Criteria Update Program (GBCUP).

b. We currently have completed, or are finalizing, nearly 60 construction guide specifications, and approximately 30 technical/engineering manuals, engineering technical letters and instructions, covering sustainable design principals. Together, these provide a solid basis for incorporating a wide range of Green construction products and services into Corps projects, including:

- Floors, carpets, walls, doors, ceilings and roofing systems, including insulation and painting--Assessment of reusability, solid waste generation, and indoor air quality.
- Masonry, stucco, lathing and plastering--Environmental characteristics of recycled and composite materials.
- Metal studs in load-bearing walls as a substitute for wood.
- Scrap tire chips and cement and asphaltic concrete in pavements--Elimination and use of waste materials.
- Bottom ash used as fill, and waste materials in pavements--reusing construction waste materials.
- Recycled plastic composite railroad ties.
- Recycled site furnishings and playground equipment.
- Energy efficient HVAC controls, radiant heating systems and desiccant cooling systems.
- Water and energy conserving plumbing fixtures.

For a list of criteria projects in the GBCUP, see the Table in Appendix C.

13. List of Sustainable Design and Green Building Organizations

a. Institute for Sustainable Design, University of Virginia, Charlottesville, Virginia, 22903.

b. Center for Sustainable Technology, Construction Research Center, Georgia Institute of Technology, 490 10th St NW, Atlanta, GA 30332-0519.

c. Centre for Sustainable Design, Faculty of Design, Surrey Institute of Art & Design, Falkner Road, Farnham, Surrey, GU9 7DS, United Kingdom.

d. Natural Resources Defense Council, 40 West 20th Street, New York, NY 10011.

e. U.S. Green Building Council, 90 Montgomery Street, Suite 1001, San Francisco, CA 94105.

f. Context Institute, PO Box 946, Langley, WA 98260.

g. Center of Excellence for Sustainable Development, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Denver Regional Support Office, 1617 Cole Boulevard, Golden, CO 80401.

h. Center for Environmental Design Research, 390 Wurster Hall, Berkeley, CA, 94720.

i. Green Building Information Council, Dr. Ray Cole, University of British Columbia, BC, Canada.

j. Design Center for Appropriate Technology, PO Box 41144 Tucson, Arizona 85717.

k. Energy Efficient Builders Association, 2950 Metro Drive, Suite 108, Minneapolis, MN, 55425.

l. Passive Solar Industries Council, 1511 K Street, NW, Suite 600, Washington DC, 20005.

m. Center for Building Science, Lawrence Berkeley National Laboratory, 1 Cyclotron Rd, Berkeley, CA 94720.

n. Sustainable Building Coalition, 3102 Breeze Terrace, Austin, TX, 78722.

o. Habitat for Humanity International, 121 Habitat Street, Americus, GA, 31709.

p. Alliance to Save Energy, 1200 18th Street, NW, Suite 900, Washington, DC, 20036.

q. American Council for an Energy-Efficient Economy, 1001 Connecticut Avenue, NW, Suite 801, Washington, D.C. 20036.

r. Geothermal Resources Council, PO Box 1350, 2001 Second Street, Suite 5, Davis, CA 95617-1350.

s. Ecology Action, 5798 Ridgewood Road, Willits, CA, 95490.

t. Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass, Colorado 81654-9199.

APPENDIX C

GREEN BUILDING CRITERIA UPDATE PROGRAM

Item No.	Pub Type	Pub Number	Title	HQUSACE Proponent	Description of Work
1	TM	5-814-4	Solid Waste Incineration	Fred Eubank 202-761-1128	Add criteria for developing solid waste recycling alternatives used in Army incinerator projects.
2	CEGS	15250	Thermal Insulation	Bob DiAngelo 202-761-8619	Include recycled insulation materials in Corps construction projects.
3	CEGS	02273 02272 02271	Geonet Separation/Filtration Geotextile Waste Contaminant Geomembrane	Tomiann McDaniel 202-761-4363	Allow the use of recyled geotextile materials in geonets, aeparation/filtration treatment units and waste contaminant membranes.
4	CEGS	02221 02222 02225 02241	Excavation, Filling & Backfilling Excavation, Trenching & Backfilling for Utility Systems Earthwork for Roads, Railroads & Airfields Aggregate Base Course	Greg Hughes 202-761-4140	Include crushed concrete as fill material or a subbase. Review literature, state regulations, FHWA and Bureau of Reclamation guidance and projects at Corps Districts. Update Corps guidance on excavation, trenching and backfilling abd earthwork for roads, railroads and airfields.
5	CEGS	Various	Minimum Equipment Efficiencies	Tim Gordon 202-761-1773	Revise minimum equipment efficiencies to reduce energy consumption.
6	CEGS	11301	Air Stripping Systems	T. McDaniel	Allow recycled materials in mass transfer packing units, and environmentally friendly cleaning agents.
7	CEGS	07220 07240 07510	Roof Insulation Exterior Insulation and Finish System Built-Up Roofing	Rick Dahnke 202-761-1203 D.S. Gim 202-761-0440	Environmental characteristics of materials related to roof and roof insulation will be determined, to include recycled material content, reusability, solid waste generation, indoor air quality and life-cycle assessment.
8	CEGS	09650 09680 09655	Resilient Flooring Carpet Resilient Athletic Flooring	Amitava Ghosh 202-761-8603 Frank Norcross 202-761-0881	Environmental characteristics of materials related to ceramic tile, carpet and resilient flooring will be determined, to include recycled material content, reusability, solid waste generation, indoor air quality and life-cycle assessment.
9	CEGS	09510 09520 09950	Acoustical Ceilings Acoustical Wall Treatment Wall Coverings	A. Ghosh F. Norcross	Environmental characteristics of materials related to acoustic ceilings and walls will be determined, to include recycled material content, reusability, solid waste generation, indoor air quality and life-cycle assessment.
10	CEGS	06100 06200	Rough Carpentry Finish Carpentry	R. Dahnke	Environmental characteristics of recycled and composite carpentry materials will be determined to include stress grading for load bearing members, lumber harvesting, and solid wastes
11	ETL CEGS	New New	Use of Scrap Tire Chips in Pavement Construction	G. Hughes	Develop a design procedure for the use of scrap tire chips in pavement construction.
12	ETL CEGS	New 2851	Recycled Plastic Composite Rail Road Ties	G. Hughes	Allow use of recycled plastic composite railroad ties as a replacement for wood ties.
13	CEGS	New	Desiccant Cooling Systems	T. Gordon	Include new wheel type thermal storage systems, such as Englehart to reduce energy consumption.
14	CEGS	New	Site Furnishings Made from Recycled Waste Material	Ed Racht 202-761-8816	Incorporate recycled vehical tires, cement/concrete for patio blocks, and plastic for geotextiles.
15	CEGS	02285	Soil Treatment for Subterranean Termite Control	E. Racht	Incorporate EPA recommendations for chemicals and recycled materials.
16	CEGS	02564	Cold Mix Recycling	G. Hughes	Update CEGS to include recycling of asphalt concrete pavement using in-plant and mobile plant cold-mixes.

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17	CEGS	11255 11301	Downflow Liquid Activated Carbon Adsorption Units Air Stripping Systems	T. McDaniel	Allow the use of recycled/regenerated carbon materials in adsorption and stripping units.
18	CEGS	09900	Painting, General	R. Dahnke	Investigate the use of alternative coatings in paint specifications to comply with new limitations on VOC content in paints.
19	CEGS	New	Supervisory Control and Data Acquisition (SCADA) System	Bob Fite 202-761-8626	Develop SCADA CEGS for the control of electrical systems to maximize energy efficiency.
20	CEGS	New	Metal Studs in Load Bearing Walls	Ray Navidi 202-761-0223	Study to investigate the use of metal studs in load bearing walls in building construction.
21	CEGS	02935 02950 02955	Turf Trees, Shrubs, Ground Cover & Vines Crown Vetch	E. Racht	Incorporate EPA recommendations for fertilizer chemicals into landscaping products including hydraulic mulch and yard trimmings.
22	CEGS	New	Construct Waste Management	Sue Abu-Eid 202-761-4539	Guidance on evaluation of recycling and waste minimization efforts for specific construction projects.
23	CEGS	02596	Heater Planning of Bituminous Pavements (In Place Hot Mix Recycling)	G. Hughes	Update existing CEGS to include hot-mix recycling and rename to “In-Place Hot-Mix Recycling”.
24	ETL	New	Bottom Ash as Flowable Fill	G. Hughes	Allow use of bottom ash as flowable fill or as a soil stabilizer.
25	ETL	New	Efficiency Bidding for Chillers	T. Gordon	Develop contracting procedure for procuring more energy efficient chillers.
26	CEGS	05500	Miscellaneous Metal	R. Dahnke	Include recycled aluminum in handrails.
27	CEGS	02860 02535	Playground Equipment Playground Safety Surfacing	E. Racht	Incorporate EPA recommendations for recycled materials including vehicule tires, cement/concrete for patio blocks, and plastic for geotextiles.
28	CEGS	07920	Joint Sealing	R. Dahnke	Investigate environ characteristics of recycled joint sealers.
29	CEGS EM	02071 1110-3-178	Removal of Underground Storage Tanks Removal of Underground Storage Tanks	T. McDaniel	Allow recycling of used hydrocarbons and salvaged storage tanks.
30	ETL	New	Portland Cement and Asphaltic Concrete Recycled in Place as Base Course Material	G. Hughes	Allow recycling in-place of asphalt concrete (AC) and asphalt base (AB) and compare with virgin AC and AB materials.
31	CEGS	11242	Chemical Feed Systems	T. McDaniel	Allow solvent substitution in feed systems.
32	CEGS	08201 09200 09225 09250	Wood Doors Lathing & Plastering Stucco Gypsum Wallboard	R. Dahnke	Environmental characteristics of recycled and composite interior construction materials will be determined to include wood doors, stucco, lathing and plastering, and gypsum wallboard.
33	CEGS	03300	Concrete for Buildings (Flyash)	G. Hughes	Incorporate flyash requirements in accordance with EPA guidelines.
34	CEGS	04200	Masonry	Charlie Gutberlet 202-761-4802	Incorporate lightweight concrete masonry units with high flyash content.

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35	CEGS	03450 03550	Precast Architectural Concrete Precast/Prestressed Concrete Floor & Roof Units	Dan Chen 202-761-4912	Investigate concepts to maximize the use of flyash in precast concrete used for architectural products and floor and roof units.
36	CEGS	03200 05120	Concrete Reinforcement Structural Steel	D. Chen	Incorporate recycled steel requirements in accordance with EPA guidelines.
37	ETL	New	Life Cycle Environmental Evaluation of Buildings	G. Hughes	Develop method of systematic life-cycle environmental evaluation of buildings.
38	CEGS	New	Leachate Collection Systems	T. McDaniel	Develop CEGS to minimize hazardous waste leachate discharge from landfills to ground and surface waters.
39	ETL	1110-1-162 1110-1-172	Checklist for Hazardous Waste Landfill Cover Design Geomembranes for Waste Containment	T. McDaniel	Develop guidance for evaluating the use of recycled materials in geosynthetic in the subject documents.
40	ETL	New	Landfill Off-Gas Treatment Systems	T. McDaniel	Develop method to evaluate feasibility of energy recovery from landfill off-gases.
41	ETL EM	New New	Green Building Technology in Hazardous Waste Cleanup Applications	T. McDaniel	Develop general guidance document for designing green building concepts into HTRW projects.
42	ETL	New	Waste Material in Pavement Construction	G. Hughes	Allow use of waste materials in pavement construction including agricultural, domestic, industrial mineral wastes.
43	ETL	New	Use of Contaminated Soil in Pavement Construction	G. Hughes/T. McDaniel	Allow use of petroleum and hyrocarbon contaminated soils as asphalt stabilized base course under pavements.
44	CEGS	Various	Floor Radiant Heating Systems	T. Gordon	Include energy efficient systems in child care centers, vehicle maintenance shops, aircraft hangars, etc.
46	CEGS ETL	15400 New	Plumbing--General Purpose Domestic Hot Water Requirements for Barracks	Dale Otterness 202-761-8621	Add water saving plumbing fixtures.
47	EI CEGS	New	Recycling & Reuse of Concrete Fine Fractions	C. Gutberlet 202-761-4802	Develop guidance for examining concrete fines for recycling attributes, and criteria for developing concrete admixtures using recycled concrete fines.
49	EI	New	Roofing System Selection	Ray Navidi	Incorporate Green Material into roofing systems.
50	ETL	New	HVAC Controls for Energy Efficiency	J. McCarty 202-761-8619	Incorporate energy efficient HVAC controls.
51	--	--	PM Support	Ray Navidi	Project Management Support
52	EI & CEGS	New	Photovoltaic Power Systems	John Tokar 202-761-8625	Establish criteria for design and construction of photovoltaic power systems for Corps of Engineer projects.
53	EP	New	Green Building Technology in Hazardous Waste Cleanup	T. McDaniel	Present recycling options and pollution prevention opportunities available for materials/wastes recovered from HTRW site remediations.
54	CEGS	11500	Air Pollution Control	D. Gentil 202-761-8622	Include new/innovative air pollution control systems effective in reducing toxic and NOx emissions, reducing reactive organic compounds, and other Greenhouse gases to promote clean air and protect the ozone.

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55	TM	5-815-1	Air Pollution Control Systems for Boilers and Incinerators	D. Gentil	Include new/innovative air pollution control systems effective in reducing toxic and NOx emissions, reducing reactive organic compounds, and other Greenhouse gases to promote clean air and protect the ozone.
56	CEGS	New	Geothermal Heat Pump Systems	D. Gentil	CEGS to include most feasible, technologically-advanced and life cycle cost effective geothermal heat pump systems for Corps projects. Will reduce Greenhouse gas emissions and save non-renewable resources.
57	CEGS	15895	Air Supply, Distribution, Ventilation, and Exhaust Systems	T. Gordon	Update CEGS with new efficiencies for fan coil unit electric motors and incorporate valence heating and cooling.
58	CEGS	15995	Commissioning of HVAC Systems	T. Gordon	Revise CEGS to require that HVAC systems are installed and operated in an energy efficient manner.
59	TM	5-810-1	Mechanical Design: HVAC	T. Gordon	Incorporate commercially available desiccant cooling systems which provide dehumidification and cooling with minimal energy usage, thermal storage systems which use less energy during peak energy demand periods, new energy efficiency minimums for central water chilling equipment, and updated procedures for safe/environmentally acceptable handling of refrigerants.
60	EI	New	Floor Radiant Heating Systems	T. Gordon	Develope EI on floor radiant heating systems for use in facilities having very high ceilings such as aviation hangers. For this type of heating FRH is the most energy efficient, reliable and life cycle effective.
61	CEGS	New	Water Treatment for Mechanical Systems	T. Gordon	Develop new CEGS to ensure consistency in water treatment for mechanical systems, such as boilers, chillers and cooling towers to enable efficient heat transfer.
62	--	--	Reserved for Future	R. Navidi	Future Activities
63	CEGS	15400	Plumbing, General Purpose	D. Otterness 202-761-8621	Evaluate and revise CEGS to incorporate plastic (PVC) piping that contains recycled waste plastic materials.
64	CEGS	02530	Playing Surfaces for Outdoor Sports Facilities	D. Moeller 202-761-8814	Revise CEGS to include environmentally preferable products applicable to playing surfaces for outdoor sports in compliance with Executive Order 12873.
65	CEGS	07240	Exterior Insulation and Finish Systems	F. Norcross	Revise CEGS to include environmentally preferable products applicable to exterior isulation and finish systems in compliance with Executive Order 12873.
66	CEGS	07311	Roofing, Strip Shingles	J. Hooghouse 202-761-1069	Revise CEGS to include environmentally preferable products applicable to strip shingle roofing in compliance with Executive Order 12873.
67	CEGS	08120	Aluminum Doors and Frames	S. Swofford 202-761-0441	Revise CEGS to include environmentally preferable products applicable to aluminum doors and frames in compliance with Executive Order 12873.
68	CEGS	08520	Aluminum Windows	S. Swofford	Revise CEGS to include environmentally preferable products applicable to aluminum windows in compliance with Executive Order 12873.

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69	CEGS	09310	Ceramic Tile	A. Ghosh	Revise CEGS to include environmentally preferable products applicable to ceramic tile in compliance with Executive Order 12873.
70	CEGS	10160	Toilet Partitions	S. Swofford	Revise CEGS to include environmentally preferable products applicable to toilet partitions in compliance with Executive Order 12873.
71	CEGS	12390	Cabinets and Countertops	S. Swofford	Revise CEGS to include environmentally preferable products applicable to cabinets and countertops in compliance with Executive Order 12873.
72	CEGS	02556 old 02740 new	Hot Mix Asphalt for Airfields	G. Hughes	Incorporate recycled asphalt into existing specification.
73	MIL-HDBK	New	Industrial Wastewater Pretreatment	F. Eubank	Provide technical guidance for controlling the discharge of nondomestic, industrial type wastewater to sanitary sewer systems for compliance with municipal and Federal pretreatment requirements.