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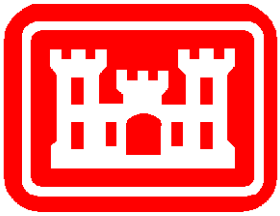
CONSIDERATIONS IN IDENTIFYING ARMY LANDS SUITABLE FOR FOREST PRODUCTS AND AGRICULTURAL OUTLEASING



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CONSIDERATIONS IN IDENTIFYING ARMY LANDS SUITABLE FOR FOREST PRODUCTS AND AGRICULTURAL OUTLEASING

1. Purpose.

a. This Public Works Technical Bulletin (PWTB) offers guidance to implementing Army regulations that encourage the expanded use of forestry and agricultural reimbursable programs to maximize mission, environmental, and economic benefits. It provides (1) a sense of the Army's potential for forest and agricultural products, and (2) preliminary factors to be considered when locating/identifying lands supportive of forest and agricultural products.

b. All PWTBs are available electronically at the National Institute of Building Sciences' Whole Building Design Guide webpage, which is accessible through this link:

http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215

2. Applicability. This PWTB applies to engineering activities at all Continental United States (CONUS) Army facilities, including the Army Forestry Community and the Natural Resource Community.

3. References.

a. Army Regulation (AR) 200-1, "Environmental Quality – Environmental Protection and Enhancement," revised 13 December 2007.

b. AR 405-80, “Management of Title and Granting Use of Real Property,” revised 10 October 1997.

c. Executive Order (EO) 13423, “Strengthening Federal Environmental, Energy, and Transportation Management,” 24 January 2007.

d. “Army Forest Conservation Policy” Memorandum from Principal Deputy Assistant Secretary of the Army Installations and Environment (I&E) for Assistant Chief of Staff for Installation Management (ACSIM), 16 January 2001.

e. “The Sikes Act” (16 USC 670 et seq.), as amended by Public Law 108-136, the National Defense Authorization Act of 2004.

f. “National Environmental Policy Act of 1969 (NEPA),” Public Law 91-190 42 U.S.C. § 4321, § 4331-4335, 1 January 1970, as amended.

g. “Endangered Species Act of 1973,” Public Law 93–205, Approved 28 December 1973, 87 Stat. 884, as amended through Public Law 107–136, 24 January 2002.

4. Discussion.

a. AR 200-1 addresses environmental responsibilities of all Army organizations and agencies, and contains policy and direction for the conduct of forestry and agricultural programs that are compatible with mission operations and that support conservation compliance, sustainability, and natural resources stewardship.

b. The AR 405 series outlines Army policy on the acquisition, management, and disposal of Army-controlled real property. AR-405-80 authorizes the use of real property held by Department of the Army to other governmental departments and agencies as well as private organizations and individuals.

c. EO 13423 requires the Army to conduct periodic utilization surveys to ensure all Army-controlled property is being used effectively.

d. Army Forest Conservation Policy Memorandum provides direction to implement Army forest management policy.

e. The Sikes Act provides overall authority for natural resources management and preparation of Integrated Natural Resources Management Plans (INRMPs).

f. Both NEPA and ESA are statutes that have added demanding requirements to Army land management for protection of the natural environment and threatened or endangered species' habitat.

g. The Army's conservation reimbursable and fee collection programs consist of three individual and distinct program areas, two of which — Forestry and Agriculture/Grazing — are the subjects of this PWTB.[1] These two programs exist to provide ecosystem-level management that supports and enhances the land's ability to support each installation's respective military missionscape, while simultaneously obtaining ecologically responsible results that satisfy all federal mandates for natural resources.

h. Program revenues are generated through the sale of forest products and the collection of lease payments for agriculture or grazing outleases. The programs are designed and managed to supplement other Army natural resources management funding and to implement conservation-based natural resource projects.

i. Appendix A contains an introduction and background to Army forest and agricultural land management. It also discusses land classifications, as used in this bulletin.

j. Appendix B contains the results of screening for landscapes suitable for forest and agricultural products production.

k. Appendix C contains a description of various landscapes and land uses.

l. Appendix D gives abbreviations and references cited in this PWTB.

5. Points of Contact.

m. Headquarters (HQ), US Army Corps of Engineers (USACE) is the proponent for this document. The point of contact (POC) at HQUSACE is Mr. Malcolm E. McLeod, CEMP-CEP, 202-761-5696, or e-mail: Malcolm.E.Mcleod@usace.army.mil.

[1] Hunting and Fishing Permits is the third program, but will not be discussed in this PWTB.

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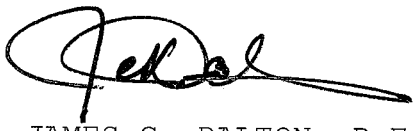

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APPENDIX A

BACKGROUND OF ARMY FOREST AND AGRICULTURAL PROGRAMS

History of the Army's Forest and Agricultural Programs

Prior to the last century, there was no particularly organized forest, agricultural, or land management program on Army lands. This history started to change in 1917–1918 when US forces in Europe required large quantities of wood products such as lumber, railroad ties, poles, piling, bridge timbers, cordwood, and stakes for barbed wire. During that period, two US Army regiments worked in France to provide US forces with the large amount of timber necessary for the war effort. Those making up these regiments came from forest ranger, logging, and sawmill jobs throughout the United States, and they largely assisted in local wood procurement operations (Forest History Society 2012).

The first US Army installation forestry program was implemented in 1918 at the US Military Academy at West Point. During this period and the following two decades, the Secretary of Agriculture and the Secretary of Defense formed the concept of Military National Forests, with the intent that these areas could be used jointly for Army training and timber production. In part because of jurisdictional disputes, agreements between the two departments did not produce any lasting results.

The advent of World War II meant that, as in World War I, forest products would be needed for war material. While Allied Forces were able to obtain the necessary timber in Europe, wartime planning showed that significant supplies of timber existed on US military lands. In 1947, the US Army Chief of Engineers requested that the US Forest Service (USFS) conduct a study of installation resources and make recommendations to place the forests under sound management plans. These first forest management plans provided for personnel, improvements, equipment, and harvesting schedules (USAEC 2011a).

Similarly, the Army agricultural leasing program began during World War II as agricultural producers leased the open space around airfields and ammunition storage sites. By 1956, the Army was leasing almost 1 million acres for agriculture and grazing purposes. The Army recognized that agriculture and grazing outleases provided benefits, such as weed and brush control and

construction of fire lanes, that went beyond the lease payments received (USAEC 2011b).

Establishment of the Reimbursable Forestry and Agricultural Programs

In 1956, legislation was passed that created a reimbursable fund for the Department of Defense (DoD) forestry program.[2] This legislation paved the way for what is known today as the Army's conservation reimbursable and fee collection programs. The original legislation provided authority for the military departments to retain the receipts from sales of forest products. In 1961, Congress authorized the use of timber sale proceeds to reimburse program expenses. Following the passage of this law, the forestry program expanded and management activities increased.

Over the next 7 years, the number of woodland acres increased from 1.1 million to 1.5 million, and the gross income derived from these lands increased from $10.5 million to $26.7 million. It was not until 1983 that the agriculture and grazing outlease program became a reimbursable program by granting military installations the authority to use revenues gained from leasing or the improvement of agricultural lands. The ability to retain and use lease proceeds provided a measure of funding stability to the agriculture and grazing outlease program (USAEC 2011b).

During the 1960s, increased public pressure for access to military and other federal lands for recreation and commercial purposes led to adopting the policy of "multiple use" on public lands.[3] Passage of the Sikes Act in 1960 provided the legal basis for wildlife conservation and public access for recreation on military land. The Sikes Act also authorized the collection of fees and the development of cooperative plans by the military, the US Fish and Wildlife Service (USFWS), and state fish and game agencies. The revenues generated from forestry and fish and wildlife programs became a major source of funding for installation natural resources management programs (Lillie and Ripley 1998).

[2] "Sale of Certain Interests in Land; Logs." 10 USC 2665

[3] The DoD defines multiple use as "The integrated, coordinated, and compatible use of natural resources so as to achieve a sustainable yield of a mix of desired goods, services, and direct and indirect benefits while protecting the primary purpose of supporting and enhancing the military mission and observing stewardship responsibilities." (DoDI 4715.03, Environmental Conservation Program 2011).

The 1970s and 1980s were decades of increasing pressure on the Army's natural resources management programs. The National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), and other environmental protection statutes have added demanding new requirements on top of evolving military training requirements. The development of new weapons systems — systems that featured heavier vehicles and longer-range weapons — has intensified damages to land and increased the military's need for additional and diversified training lands.

As a way of better addressing these new weapons problems, the Sikes Act and other authorities called for the development of Integrated Natural Resources Management Plans (INRMPs) on all installations having significant natural resources. These plans were intended to help balance competing interests and began to set the stage for a new approach to natural resources management (NatureServe 2008). Today, EO 13423 requires federal agencies to meet a series of deadlines critical to achieving INRMPs goals.[4]

The Forestry and Agricultural Programs Today

In the past, the role of Army foresters was to manage and develop forest resources for the commercial production of forest products. Both this role and the management of the Army's forestry program have changed in response to mission needs, land management philosophies, and environmental stewardship requirements. Unlike their initial focus on soil stabilization, erosion control, and coordinating the production of commercial forestry products, modern Army foresters manage Army forest lands as an integral part of Army training. This management also now provides biological diversity, wildlife habitat, air and water quality, soil conservation, watershed protection, and recreational opportunities (Forest History Society 2012).

The Army's current forestry and agriculture reimbursable and fee collection programs exist to provide ecosystem-level management that enhances the land's ability to support each installation's respective military missionscape, while simultaneously obtaining ecologically responsible results that satisfy all federally mandated requirements for natural resources. These programs act in accordance with AR 405-80, authorizing outleasing of Army-controlled real property.

[4] EO 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," 5 October 2009 expands on the energy reduction and environmental performance requirements for Federal agencies identified in EO 13423.

The Department of the Army's real property goals are to:

- Ensure proper management and use of real property authorized for mission purposes.
- Promote full use of Army lands.
- Minimize additional real property acquisition.
- Reduce maintenance and custody costs.
- Dispose of real property interests no longer required for Army needs or to discharge Army responsibilities, to include environmental.

Toward that end, AR 200-1 says that installation/command staff is required to "routinely examine Army land to determine what areas, if any, are available for agricultural outleasing and/or sale of forest products." This language encourages installations to expand the use of forestry and agricultural reimbursable programs to maximize environmental and economic benefits, without compromising the mission.

Land Classification

Outlease Land Activities

It is acknowledged that the landscape categorization and division presented in this PWTB is somewhat arbitrary. Nonetheless, this work attempted to generally follow broad ecoregional concepts and terminology, as used by Bailey (1995, 2009). It should be noted that some landscapes are artifacts of human activity (e.g., agricultural and forest crops), rather than ecological divisions. Based on practical experience, the authors have adjusted Bailey's ecoregional characterization to take into account important landscapes and land uses as they occur on US Army installations.

It is recognized that on any given Army installation, many different landscapes may occur. Grasslands for example, are ubiquitous as a land cover type, making them geographically widespread. However, the grasslands that may occur in eastern states can be considered somewhat artificial results of geologically and ecologically recent anthropogenic change as compared to the grasslands of the Midwest and western United States, which are the product of evolutionary-scale climactic, soil, and other forces. Additionally, landscapes types are not

equally distributed. Deserts and desert grasslands, for example, do not exist in the eastern United States.

Appendix B contains the full description of each landscape that is particular to supporting forest products and agricultural outleasing. A listing of the landscapes is given below.

- Desert and Desert Grassland
- Short / Tall Grassland
- Shrubland / Savannah
- Forest / Plantation
- Wetland
- Agricultural Crops

Army Land Management Areas

Within the 50 US states and various territories, the Army owns over 11,360,500 acres and controls over 14,134,900 total acres (US Army 2011b). This acreage includes approximately 2,045 properties or sites, ranging in size from over 2,293,000 acres to less than 10 acres. Land use and capability (military and ecological) at these sites and properties can vary considerably because of mission requirements and ecological settings. In general, larger military properties are used for land-based maneuver training and testing purposes, while smaller properties are utilized more for classroom training and administrative purposes. Examples of this diversity include White Sands Missile Range, NM, (2,293,400 acres), with over 1,050 owned buildings. By contrast, Fort Benning, GA, is much smaller with about 178,200 acres (approximately $1/8^{th}$ the land area of White Sands Missile Range), but has over 1,200 owned buildings (US DoD 2009). Overall, the building component on Army civil works properties is relatively small, and Land use can generally be categorized as recreation related.

Land cover and capability are a function of many factors, the most important of which are climate and soils. For example, vegetative cover in desert settings (e.g., Fort Huachuca, AZ) is different from what would be in a historically eastern broadleaf forest (e.g., Fort Drum, NY). Additionally, land use and land cover is not uniformly documented for Army properties.

Land use and land management on Army installations is guided and determined by multiple authorities. Although an exhaustive list, those listed below are perhaps the most relevant authorities.

- Sikes Act 16 USC 670 et seq. (see previous footnote)
- Department of Defense Instruction (DoDI) 4715.03, "Natural Resource Conservation Program"[5]
- AR 200-1, "Environmental Protection and Enhancement"[6]
- AR 210-20, "Real Property Master Planning for Army Installations"[7]
- AR 350-19, "The Army Sustainable Range Program"[8]
- Army Forest Conservation Policy Memorandum (US Army 2001)

The Army does not have a standardized land-use classification system. Land-use classifications at any given installation are determined in part by local environmental conditions, use, and convention. Land-use classifications shown in Table A-1 are representative of those used on Army properties.

Table A-1. Land uses common on US Army installations (US Army 2011).

Land Use	Land Use Description
Airfield	Landing and takeoff area, aircraft maintenance, airfield operational and training facilities, and navigational and traffic aids.
Maintenance	Depot maintenance, installation maintenance, Table of Organization and Equipment (TOE) unit maintenance.

[5] DoDI 4715.03. "Natural Resources Conservation Program," March 18, 2011. (Reissues and renames DODI 4715.3. Washington, DC: Under Secretary of Defense for Acquisition Technology, and Logistics (USDAT&L).

[6] US Army regulation, revised 13 December 2007.

[7] US Army regulation, 16 May 2005.

[8] US Army Regulation, 30 August 2005.

Land Use	Land Use Description
Industrial	Production; research, development, and test facilities; potable water supply, treatment, and storage; electric power source, transmission, distribution, substations, and switching stations; heat sources, transmission lines, and distribution lines; sewage and industrial waste collection, treatment, and disposal; and parking areas.
Supply/Storage	Installation ammunition storage, depot ammunition storage, cold storage, general-purpose warehouse, controlled-humidity warehouse, flammable materials storehouse, fuel storage, engineer material storage, medical warehouse, unit storage, and salvage and surplus property storage.
Administration	Installation command and control, directorates, tenants, organizational, and special.
Training/Ranges	Training facilities, buildings; training grounds and facilities other than buildings; firing ranges–training; and firing ranges–research, development, testing, and evaluation.
Unaccompanied Personnel	Officer unaccompanied personnel housing, enlisted unaccompanied personnel housing, and visiting officer and soldier quarters.
Housing	Family housing
Community Land	Commercial products and services.
Medical	Hospital, dental clinic, clinic without beds, electric power source, heat source, parking areas.
Outdoor Recreation	Recreation building, outdoor swimming pool, tennis courts, multiple court areas, baseball field, softball field, football field, and soccer field.
Open Space	Unoccupied land, buffer, easement, and greenbelt.

In the end, a new list of land management areas was created by the authors to be representative of Army lands. That list is given below and represents a selection of common land uses that are most likely to support forest and agricultural activities. Housing types of land uses, for example, are generally understood as unsuitable for forest products or agriculture and were not included. Following are the descriptions of the selected land management areas that support forest products and agricultural outleasing. While these land management areas may be found in virtually all the land-use categories shown in Table

B-1, they are most likely found in the Training/Ranges, and Open Space land classifications.[9]

- **Natural, Recreational, and Protection Areas** are land areas such as forest, grassland, wetland, and other coherent landscapes that possess important scientific, environment-protected, educational, recreation, and aesthetic status. They are created with the goal of conservation/restoration in the natural state and/or providing the conditions for organized recreation for the population.

- **Right-of-way and Easements** are land areas on which facilities are located (e.g., transmission line, roadway, fencing). These areas are generally small in acreage, but are available in multiple locations or corridors. Planting restrictions may be in place to ensure necessary clearance for safety, operation, and maintenance.

- **Buffer Zones** refers to land between two or more areas for reasons of segregating or conjoining them. Common types of buffer zones form boundaries for noise, dust, light, or fire; create green belts; and protect the cantonment from testing and training hazards.

- **Lands in Transition** are land areas between change-of-use or irregular-shaped parcels. These areas can be characterized by their short-term availability (less than 5 yr) before transitioning to a long-term use identified in the installation’s Master Plan.

- **Heavy Forces Maneuver Areas** are for ground and air combat forces to train movements and tactics. The "heavy" designation refers to areas where maneuvers are unrestricted and that can be accessed by all types of vehicles and equipment, including tracked vehicles. Heavy maneuver/training areas encompass large acreage and can also be used by light forces. Compatibility with additional land use is dictated by training schedules and maintenance requirements.

- **Light Maneuver Areas** are also training areas for ground and air combat forces but the "light" designation refers to

[9] It is recognized that live fire (e.g., artillery, rockets, missiles) impact areas may be ecologically or otherwise suited for the production of forest or agricultural products. However, since safety considerations and access are most likely the dominant limiting factors for these sites, further discussion is not warranted in this PWTB.

areas where maneuvers are restricted to only small units or units having only wheeled vehicles. These areas also encompass large acreage but cannot be used by heavy forces. Compatibility with additional land use is dictated by training schedules and maintenance requirements.

- **Dismounted Operation Areas** are land areas used to train individual soldiers, squads, and platoons on tasks necessary to operate within a built-up/urban area. These training areas encompass urban assault courses, live-fire exercise shoot-houses, and live-fire exercise breach facilities. Situations vary, but may include rural landscapes surrounding the simulated urban environment to give enhanced training realism.

- **Drop Zones** are land areas used for landing troops and supplies by parachute. These sites are characterized as open areas, often requiring a mosaic of vegetation suitable for the “soft” landing of troops as well as for the durability required for aircraft landing. Drop zones must provide adequate room for aircraft to maneuver, unobstructed views of the ground, and areas where equipment and troops may be dropped that are free from woody vegetation and other hazards.

- **Storage Areas** are open sites within which resources are stored. These sites may follow strict regulations for building and planting, depending upon what is stored. Storage areas can be above- or below-ground structures.

APPENDIX B

SUITABILITY SCREENING

The potential of land for forest products or agricultural outleasing is determined by an evaluation of the climate, the soil and topographical environmental components, the understanding of local economies, and most importantly, the land's compatibility with the Army's mission.

The Concept of Land Suitability

Land suitability is the ability of a given type of land to support a defined use. The main objective of a land suitability determination process is the prediction of a land unit's inherent capacity to support a specific land use for a long period of time without deterioration, in order to minimize the environmental and socio-economic costs (FAO 1976). Land suitability analysis is an interdisciplinary approach that includes information from different domains such as soil science, crop science, meteorology, social science, economics, and management. Being interdisciplinary, a land suitability analysis deals with information which is measured in different scales (e.g., ordinal, nominal, ratio). Based on the scope of suitability, there are two types of classifications.

- **Current suitability** refers to the suitability for a defined use of land in its present condition, without any major alterations in it.

- **Potential suitability** refers to a defined use of land units in their future condition, after necessary specified major alterations have been completed.

Land Suitability Methods

The analysis of land suitability for particular uses was successfully developed by Ian McHarg. McHarg's 1969 work, *Design with Nature*, characterized land suitability analysis as both rational and explicit. A land-suitability analysis is rational because evidence is mainly derived from exact sciences (from academic literature and existing knowledge bases). A land-suitability analysis is explicit because it allows stakeholders to apply their own value system to decide the final suitability of land uses.

In 1976, the Food and Agriculture Organization of the United Nations (FAO) published *A Framework for Land Evaluation* (FAO 1976). This bulletin synthesized international thinking on the best way to assess the potential uses of land. The framework attracted wide interest as the popularity of suitability analysis spread and more diverse disciplines became involved. Since its first publication, the methodology has been applied to a variety of applications (Steiner 1987). FAO subsequently published a series of documents describing procedures for land evaluation for rain-fed agriculture (1983), forestry (1984), irrigated agriculture (1985), and grazing (1991). In simplified form, the FAO's framework is designed to:

- describe promising land-use types;
- determine the requirements (e.g. for water, nutrients, avoidance of erosion, etc.) for each land-use type;
- conduct the surveys necessary to map land units and to describe their physical properties, (e.g. climate, slope, and soils); and
- compare the requirements of land-use types with the properties of the land units, to arrive at a land-suitability classification.

The principal problem associated with land-suitability analysis is measuring both the individual and cumulative effects of different factors. In other words, a suitability analysis generally determines an appropriate approach to combining these factors. Some scientific approaches to that combination include ranking and rating, weighted summation, and heuristic rules of combination. These combination methods, however, become limiting when numerous variables are involved.

Land Suitability for the Army

As previously stated, the potential of land for forest products or agricultural outleasing on Army lands requires consideration of the military mission along with environmental and economic variables. To incorporate these augmented variables, Army environmental managers and planners are using multi-criteria evaluation (MCE; Carver 1991). The objective of using MCE models is to find solutions to decision-making problems that are characterized by multiple alternatives, which can be evaluated by means of decision criteria. Evaluation is structured within a geographical information system (GIS) environment, where

concerns of different actors are explored and tradeoffs between conflicting goals are identified. This work naturally leads to evaluating options from different perspectives. MCE models are now commonly used to develop Army land-use plans, environmental impact reviews, and site-selection studies for many different land uses and facilities (Myers 2012). These MCE models can be individually built for specific decisions by each installation, property, or project.

A transferable MCE-structured hierarchy of criteria, subcriteria, and alternatives (with the number of levels of criteria being determined by the problem) does not exist for forest or agricultural products on Army lands. The US Army Environmental Command (USAEC) is pursuing this concept for determining grazing potential on Army lands.[10] A challenge is that the set of subcriteria and alternatives will change significantly when transferred to each installation or property. Thus, the uniqueness of each site makes this process challenging; it has been either too theoretical or too specific to be directly applicable to all sites. Moreover, datasets available at each installation or other Army property vary, further hindering framework construction. For example, the current grazing potential of Army lands is determined qualitatively with annual questions submitted through USAEC's Army Environmental Database-Environmental Quality (AEDB-EQ) process.

Suitability Framework

AR 210-20 – "Real Property Master Planning for Army Installations," provides a systematic method for assessing a wide range of site conditions and land uses. Below are the five steps defined in AR 210-20. The process is to be tailored to an individual analysis; thus, each step is broadly defined.

1. Describe land-use requirements.

Land-use requirements are described in terms of the land's activities, products, and management practices. For national-level analyses, highly generalized descriptions may be sufficient. At the installation level, however, it is necessary to specify the use in more detail. Such descriptions serve as the basis for determining the requirements of a use.

[10] Maddox, Mathew, personal communication, August 10, 2011. Rangeland Management Specialist, US Army Environmental Command

2. Select mission qualities and land characteristics to be used in comparisons of land-use requirements.

To understand land-use requirements, it is necessary to decide which characteristics are suitable to the missionscape. In any particular assessment, only a limited number of land-use qualities need to be selected for evaluation. Criteria for selection are: (1) the quality must have a substantial effect either on performance or on cost of mission operations, and (2) critical values of the quality must occur in the missionscape (i.e., if a quality is adequate everywhere, there is no need to include it).

3. Set limiting values.

Limiting values are the values of a mission quality or land characteristic that determine the class limits of land suitability for a certain use.

4. Define suitability.

Defining suitability involves comparing the requirements of each land-use type with the missionscape qualities. The simplest comparison will check the measured values of each land quality against the class limits. For those cases in which at least one limitation is enough to render the land unsuitable for the use, the method of taking the most severe limitation is valid. For less severe values of limitations, alternative methods of combining the rating for individual qualities can be used. This can become an even wider process if land-use types are examined to see if, through modification, the suitability of those land units can be raised. The end result is to bring requirements together in a land-suitability classification (Table B-1). Suitability is then indicated separately for each land-use type, showing whether the land is suitable or not suitable, including degrees of suitability.

Table B-1. Generalized categories of a land suitability system (FAO 1976)

Land Suitability Category	Category Meaning
Orders	Reflecting kinds of suitability.
Classes	Reflecting degrees of suitability within Orders.

Land Suitability Category	Category Meaning
Subclasses	Reflecting kinds of limitation or main kinds of improvement measures required, within Classes.
Units	Reflecting minor differences in required management within Subclases.

5. Plan for research needed.

The evaluation process will almost certainly have highlighted information deficiencies. The tolerances of crops, crop cultivars, or tree provenances[11] to particular land limitation or mission requirements are rarely known with any precision. Gaps in knowledge of land resources may also have been revealed, thus calling for additional data collection. It is impractical to delay the land-use analysis until all such research has been completed; at the same time, it is unwise to proceed if there is a serious lack of information.

Opportunity Matrix

Using the suitability framework outlined above in steps 1-5, Table B-2 provides an evaluation of applicable forest and agricultural product compatibility on Army land types. There were four suitability criteria used in this compatibility determination, as listed below.

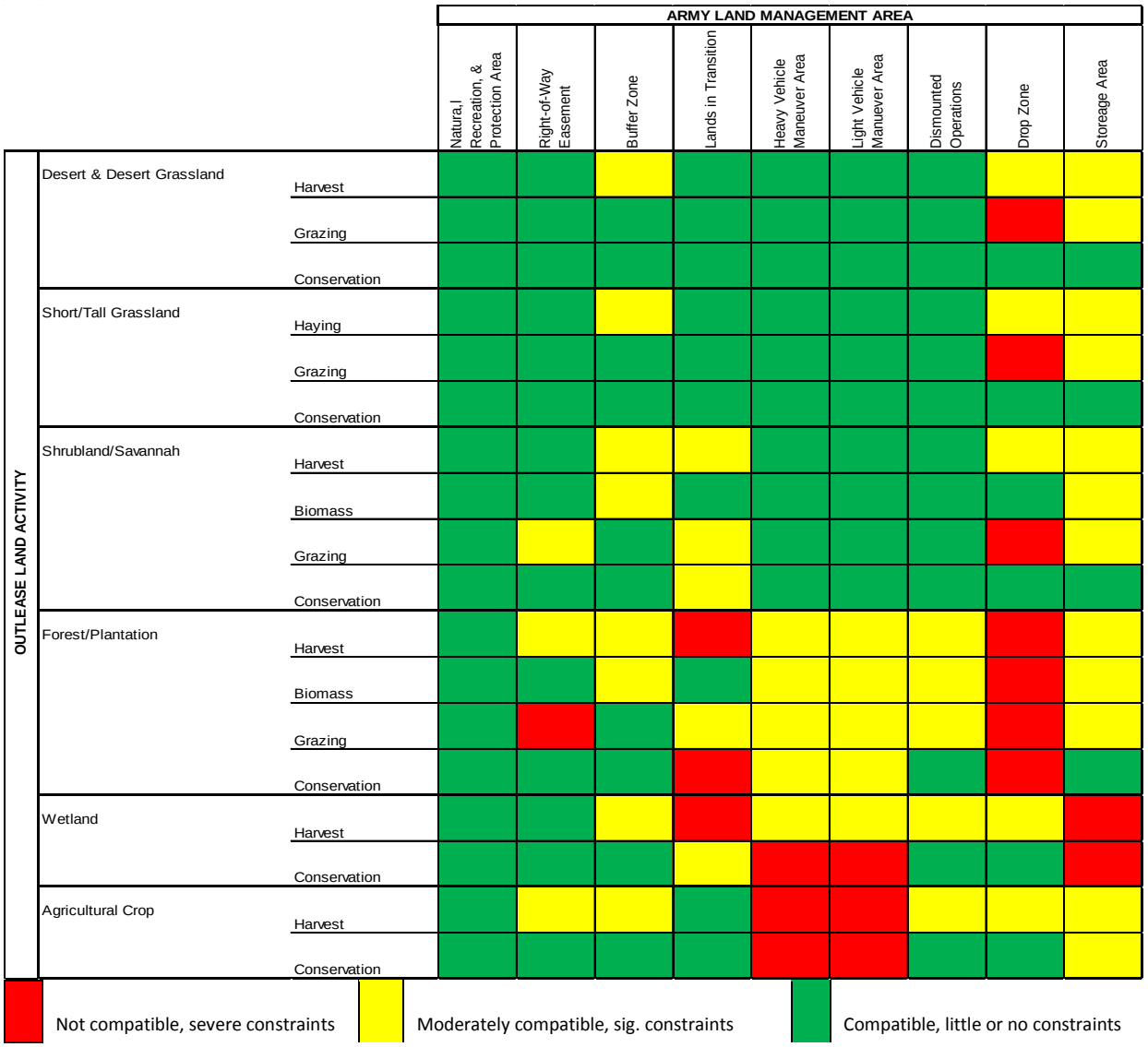
- *Management units* – parcel size, configuration, and land ownership.
- *Cultivation practices and inputs* – labor, power, land preparation, planning, fertilizer, irrigation, weeds/pests/disease, threatened and endangered species, and harvesting.
- *Temporal characteristics* – training schedules and crop growth.
- *Spatial characteristics* – maneuverability, concealment, line-of-sight, and safety.

[11] The term “provenance” is used in this instances to describe the location of the population from which a seed or individual specimen is collected.

The compatibility of each of the criteria characteristics was determined by the authors' and installation manager's expert opinions, broad literature review, existing Army land use, management plans (such as INRMPs), and Army environmental analysis documents. These suitability ratings are detailed for each Army land management area in Table B-3–Table B-11.

Compatibility was qualified on a red-yellow-green color scale. A red rating indicates the uses are not compatible and constraints are severe; these areas and landscapes are likely not compatible. Yellow ratings indicate potential compatibility; in those cases, constraints exist but may be easily overcome given local conditions. Finally, a green rating indicates likely compatibility with little or no constraints.

Table B-2. Opportunity matrix for land activities and areas (ERDC-CERL).



The above table (Table B-2) is intended for screening purposes only. It is a sense of Army lands' potential for forest and agricultural products. The decision to incorporate forest products or agricultural outleasing on Army lands is site-specific, meaning it is subject to local site conditions, installation adjustments, and larger regional ecological, economic, and other considerations. In short, the criterion that most significantly contributes to the benefit of forest or agricultural products (or lack thereof) will vary from site to site.

Table B-2 applies to a wide variety of conditions and circumstances, including those related to ecological setting and overall mission requirements. The results, admittedly, have a subjective element associated with them. Nonetheless, Table B-2 provides a qualitative sense of compatibility. Consideration was given to inherent suitability for sustainable forest and agricultural product production. The more "green" the table, the higher the potential for incorporating forest and agricultural products on Army lands. The converse is true for a "red" table.

Finding Focus among a Myriad of Opportunities

Looking across the opportunity matrix, opportunities for the forest and agricultural reimbursable program on non-traditional lands is great (59% green, 29% yellow, and 12% red). The problem is how best to sort through and prioritize multiple opportunities to make optimal use of people, money, and time. Determining the most important strategic growth levers more precisely involves understanding what combinations to pursue, how to win (optimize), and what is winning worth (optimization).

To understand what combinations to pursue, Table B-2 provides the first layer; it suggests the most potentially compatible lands and reimbursable activities. Additional studies are required to drill into each part of the matrix to quantify combinations potential.

Evaluating land suitability for forest and agricultural products goes beyond economics and site characteristics to system-wide considerations. If the Army is to adopt any of these potential combinations, then an understanding is needed on the suitability with missionscape requirements of the various ecological, energy, GHG reduction, air and water quality, and economical factors. The type and quantity of forested and agricultural lands plays into the different mission, ecosystem, and economic systems in which each installation is functioning. Beyond site

conditions, system-wide consequences need to be considered to fully understand the benefits and costs of expanding forest and agriculture reimbursable lands.

Table B-3. Matrix of suitability criteria and land types for natural, recreation, and protection areas (ERDC-CERL).

Natural, Recreation, & Protection Areas		OUTLEASE LAND ACTIVITY																	
		Desert & Desert Grassland			Short/Tall Grassland			Shrubland/Savannah				Forest/Plantation				Wetland		Agricultural Crops	
		Harvest	Grazing	Conservation	Haying	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Conservation	Harvest	Conservation
SUITABILITY CRITERIA	Management Units																		
	Cultivation Practices and Inputs																		
	Temporal Characteristics																		
	Spatial Characteristics																		

Table B-4. Matrix of suitability criteria and land types for right-of-way easement (ERDC-CERL).

Right-of-Way Easement		OUTLEASE LAND ACTIVITY																	
		Desert & Desert Grassland			Short/Tall Grassland			Shrubland/Savannah				Forest/Plantation				Wetland		Agricultural Crops	
		Harvest	Grazing	Conservation	Haying	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Conservation	Harvest	Conservation
SUITABILITY CRITERIA	Management Units																		
	Cultivation Practices and Inputs																		
	Temporal Characteristics																		
	Spatial Characteristics																		

Table B-5. Matrix of suitability criteria and land types for buffer zone (ERDC-CERL).

Buffer Zone		OUTLEASE LAND ACTIVITY																	
		Desert & Desert Grassland			Short/Tall Grassland			Shrubland/Savannah				Forest/Plantation				Wetland		Agricultural Crops	
		Harvest	Grazing	Conservation	Haying	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Conservation	Harvest	Conservation
SUITABILITY CRITERIA	Management Units																		
	Cultivation Practices and Inputs																		
	Temporal Characteristics																		
	Spatial Characteristics																		

Table B-6. Matrix of suitability criteria and land types for lands in transition (ERDC-CERL).

Lands in Transition		OUTLEASE LAND ACTIVITY																	
		Desert & Desert Grassland			Short/Tall Grassland			Shrubland/Savannah				Forest/Plantation				Wetland		Agricultural Crops	
		Harvest	Grazing	Conservation	Haying	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Conservation	Harvest	Conservation
SUITABILITY CRITERIA	Management Units																		
	Cultivation Practices and Inputs																		
	Temporal Characteristics																		
	Spatial Characteristics																		

Table B-7. Matrix of suitability criteria and land types for heavy vehicle maneuver area (ERDC-CERL).

Heavy Vehicle Manuever Area		OUTLEASE LAND ACTIVITY																	
		Desert & Desert Grassland			Short/Tall Grassland			Shrubland/Savannah				Forest/Plantation				Wetland		Agricultural Crops	
		Harvest	Grazing	Conservation	Haying	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Conservation	Harvest	Conservation
SUITABILITY CRITERIA	Management Units																		
	Cultivation Practices and Inputs																		
	Temporal Characteristics																		
	Spatial Characteristics																		

Table B-8. Matrix of suitability criteria and land types for light vehicle maneuver area (ERDC-CERL).

Light Vehicle Manuever Area		OUTLEASE LAND ACTIVITY																	
		Desert & Desert Grassland			Short/Tall Grassland			Shrubland/Savannah				Forest/Plantation				Wetland		Agricultural Crops	
		Harvest	Grazing	Conservation	Haying	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Conservation	Harvest	Conservation
SUITABILITY CRITERIA	Management Units																		
	Cultivation Practices and Inputs																		
	Temporal Characteristics																		
	Spatial Characteristics																		

Table B-9. Matrix of suitability criteria and land types for dismounted operations (ERDC-CERL).

Dismounted Operations		OUTLEASE LAND ACTIVITY																	
		Desert & Desert Grassland			Short/Tall Grassland			Shrubland/Savannah				Forest/Plantation				Wetland		Agricultural Crops	
		Harvest	Grazing	Conservation	Haying	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Conservation	Harvest	Conservation
SUITABILITY CRITERIA	Management Units																		
	Cultivation Practices and Inputs																		
	Temporal Characteristics																		
	Spatial Characteristics																		

Table B-10. Matrix of suitability criteria and land types for drop zone (ERDC-CERL).

Drop Zone		OUTLEASE LAND ACTIVITY																	
		Desert & Desert Grassland			Short/Tall Grassland			Shrubland/Savannah				Forest/Plantation				Wetland		Agricultural Crops	
		Harvest	Grazing	Conservation	Haying	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Conservation	Harvest	Conservation
SUITABILITY CRITERIA	Management Units																		
	Cultivation Practices and Inputs																		
	Temporal Characteristics																		
	Spatial Characteristics																		

Table B-11. Matrix of suitability criteria and land types for storage area (ERDC-CERL).

Storage Area		OUTLEASE LAND ACTIVITY																	
		Desert & Desert Grassland			Short/Tall Grassland			Shrubland/Savannah				Forest/Plantation				Wetland		Agricultural Crops	
		Harvest	Grazing	Conservation	Haying	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Biomass	Grazing	Conservation	Harvest	Conservation	Harvest	Conservation
SUITABILITY CRITERIA	Management Units																		
	Cultivation Practices and Inputs																		
	Temporal Characteristics																		
	Spatial Characteristics																		

APPENDIX C

FOREST PRODUCT AND AGRICULTURAL LAND USES

This PWTB does not intend, nor is it necessary, to provide a detailed description of the various landscapes. Given the geographic diversity and extent of Army installations, properties, and landscapes as a whole, that amount of detail would be impractical. Rather, in the descriptions of landscapes that follow, the authors have provided a broad descriptive context and in some instances, provided more specific examples or references to Army properties. It is assumed that the reader has a fundamental and broad understanding of landscapes and the products they provide for meeting sustainability goals and regulations as well as additional management or legal constraints. Discussion focuses, therefore, on the activity requirements of each landscape.

Desert and Desert Grasslands

Figure C-1. Desert grasslands in New Mexico.

Deserts are part of a wide classification of regions that, on an average annual basis, have a moisture deficit (Figure C-1). However, measurement of rainfall alone cannot provide an accurate definition of a desert because being arid also depends on evaporation, which depends in part on temperature.

Deserts are located where vegetation cover is sparse to almost nonexistent. Compared with prairie grasslands, the grasses in desert grassland are shorter, less dense, and more frequently interspersed with desert shrubs and succulents. Populations of trees, shrubs, and (to a lesser extent) succulents are kept at low levels by lack of moisture and periodic fires.

Grasslands in states west of the Rocky Mountains are mostly intermediate between deserts and the true prairies (e.g., tall grasslands) of the American Midwest. Thus these grasslands fall into the semi-desert or desert grasslands category. Unlike prairieland grasses, which usually grow more or less uniformly across the landscape, the desert grasses (often called “bunch” grasses) typically grow as closely spaced mounds. Some desert grasses grow as ephemerals, others as perennials.

Although cacti are often thought of as characteristic desert plants, other types of plants have adapted well to the arid environment. They include plants from the pea (legume) and sunflower (aster) families. The dry climate of the desert grassland dictates a dominance of short, warm-season bunchgrasses. On the other hand, cold deserts have grasses and shrubs as dominant vegetation.

In the United States, desert areas include the Sonoran, Chihuahuan, and Mojave Deserts of the Southwest and the Great Basin desert between the Rocky and Sierra mountain ranges.

Products

Desert and desert grassland products are comparatively limited because of low precipitation. To date, human development also is generally limited in deserts. Historic overuse by grazing has resulted in generally degraded conditions in many areas, but low-level and low-stocking-rate grazing is now the dominant land use. Because of geologic conditions, liquid (e.g., oil and gas) and solid (e.g., coal and mineral) extraction also occurs on these landscapes.

Ecological Considerations

Unlike the Great Plains of the Midwest — where solid stands of tall, mixed, and short grasses once covered the landscape from horizon to horizon — the desert grasslands occur in a scattered, quilt-like pattern. Classic desert grasslands occur in the basins and valleys that skirt the hills and mountain ranges in the Southwest and have a character more like an arid shrub savannah, with stands of grass punctuated by a diversity of plants such as creosote bush, mesquites, cacti, yuccas, and forbs.

Historically, grazing pressure was severe across the western United States during the last half of the nineteenth century. Most desert and desert grassland landscapes have been and continue to be grazed extensively, even though plant and

livestock production from them is low. As a result, desertification has been well documented since the 1850s and has resulted in conversion of desert grassland to desert shrubland. By 1900, dessert grasslands were greatly altered, and this trend is continuing; only a few relict areas continue to support intact and undisturbed desert grasslands.

Low moisture and nominal high and low temperatures, coupled with generally sparse vegetative cover, make desert and desert grasslands highly susceptible to wind and water erosion, if surfaces are disturbed. Precipitation events tend to be scattered and intense, and damage to landscapes by grazing, heavy foot traffic, motorized or mechanized vehicles, and military training activities in general can occur quickly and take decades to repair without human intervention.

Invasive species can be a significant problem in particularly in desert grasslands. Cheat grass and Lehmann lovegrass are perhaps the best examples of Eurasian exotics which have disrupted grassland systems. Along stream courses and washes with seasonal moisture, salt cedar or tamarisk also has significant negative effects.

The availability of water for military use is also a major consideration in these areas.

Mission Compatibility

Desert and desert grassland landscapes can be compatible with many Army and other military missions. For example, large areas of important installations contain these landscapes (e.g., Fort Irwin, CA, and Dugway Proving Ground, UT). This landscape type can provide not only appropriate testing conditions but also training realism for warfighter actions in arid environments.

Sustainability Goals and Regulations

Deserts and desert grassland landscapes require active management with an eye toward minimizing surface disturbance. Moisture and temperature conditions are such that disturbed sites do not recover quickly. Additionally, because of these same moisture and temperature conditions, the success of assisted ecological repair and site remediation can be difficult to predict. As with many landscapes long-term (80-100 yr), the use of periodic, prescribed burns may be advantageous to maintaining, preserving, and sustaining these landscapes. Management of these areas in accordance with scientifically

established practice and the installation INRMP will help ensure long-term sustainability.

Managerial and Legal Constraints

Deserts and desert grasslands contain surprisingly diverse flora and fauna. Perhaps the most important managerial and legal considerations associated with deserts and desert grasslands are those related to ESA-listed (e.g., desert tortoise) and state-listed (e.g., Mojave ground squirrel) species. The ESA and resulting biological opinions may require active, positive management of these landscapes in order to recover populations of listed species. Initiation and maintenance of protective measures to minimize surface disturbance may serve as a land management tool in conformance with goals and objectives identified in the installation INRMP.

Water availability and water rights, including compliance with Clean Water Act (CWA)[12] provisions and state authority regarding water appropriation and use, may also present managerial and legal constraints.

Short Grassland

Shortgrass prairie (also called steppe) has historically covered a large area of North America, stretching from southern portions of the western Canadian provinces of Saskatchewan and Alberta to south-central Texas. Shortgrass prairie is characterized by open herbaceous vegetation less than 1 m (39.4 in.) high, with the tufts of the vegetation discrete yet sufficiently close together to dominate the landscape. Shortgrass prairies are dominated by grasses such as buffalo grass and blue grama, but many forbs such as the various milkvetches also are prevalent. The western parts of this ecoregion have an increasing shrub component and grade to semi-desert, while in the eastern portion the grade is toward mid and tall grasses. The low precipitation in this ecoregion, in conjunction with grazing, causes most short-grass vegetation to rarely exceed .25 m (10 in.) in height.

Shortgrass prairie landscapes were formerly maintained by grazing pressure of bison and also to an important degree by fire. With the advent of European settlement, many parts became severely overgrazed and have been invaded by prickly pear cactus and other thorny plants. Additionally, large areas have been converted to various forms of dry land agriculture such as the

[12] 33 USC 26 et seq.

production of sugar beets, beans, and wheat. Also, in recent decades, this region has been subject to significant coal and natural gas development, perhaps most notably on federal lands. Consequently, very few sites remain in an undisturbed condition.

Products

The shortgrass ecoregion is associated with generally low annual precipitation and, as the name illustrates, is dominated by grass. The dominant land use geologically and historically has been that of grazing by large ungulates, originally bison, but now by cattle and to a lesser extent, sheep. Native vegetation and the fauna associated with it have been dramatically reduced from pre-settlement levels. In areas where irrigation is available, agricultural crops can be and are grown. With increased interest in biofuels, corn, and to a lesser degree other grasses (e.g., switchgrass) have been used for ethanol production. Thus, in areas with supplemental water, biofuel production may be a land use option in the future. Energy development of coal, oil, and natural gas is intense in certain parts of the region.

Ecological Considerations

Soil erosion and resultant nutrient and pollutant transport associated with row-crop production, and surface disturbance associated with energy development are recognized as potentially significant issues. In some areas of this ecoregion, groundwater withdrawal for agricultural irrigation and urban purposes is occurring on a massive scale. It can be anticipated that depleted groundwater resources will become increasingly problematic in the future.

Invasive species are a significant problem throughout this landscape. Numerous Eurasian exotics such as cheatgrass, several knapweeds, and Canada thistle, are widespread and negatively affect ecosystem form and function.

Mission Compatibility

Shortgrass landscapes can be compatible with many Army and other military missions. This landscape type can provide not only appropriate testing conditions but also training realism for warfighter actions in open and/or semi-arid environments.

Sustainability Goals and Regulations

As with other semi-arid landscapes, shortgrass landscapes require active management to minimize surface disturbance. Moisture and temperature conditions are such that disturbed sites do not recover quickly. Additionally, because of these same moisture and temperature conditions, the success of assisted ecological repair and site remediation can be difficult to predict. Longer term (10-20 yr interval), periodic prescribed fire may be advantageous to maintaining, preserving, and sustaining these landscapes. Management of these landscapes in accordance with scientifically established practice and the installation INRMP will help insure long term sustainability.

Managerial and Legal Constraints

Shortgrass landscapes contain diverse flora and fauna. In general, ESA concerns in this region are minimal. However, ESA species listing is not static and is also influenced by public interest. Thus, the potential exists for future significant ESA listing actions (e.g., prairie dogs and sage grouse). The presence of state-listed species is perhaps of more importance on a local scale.

Initiation and maintenance of protective measures to minimize surface disturbance may serve as a land management tool in conformance with goals and objectives identified in the installation INRMP and sub-component land management plans.

Water availability and water rights, including compliance with CWA provisions and state authorities regarding water appropriation and use, may also present managerial and legal constraints. These concerns can be expected to increase in the future.

Tall Grassland

Figure C-2. Tall grassland in Riley County, KS.

Tall grasslands, more typically referred to as tallgrass prairie, are composed of vegetation dominated by tall grasses (greater than 1 m tall) which are associated with subdominant broadleaf herbs (Figure C-2). These grasses are deeply rooted and form a continuous cover. These grasses also flower in spring and early summer, and the associated forbs in late summer. In the tall-grass prairie of central United States, typical grasses are big bluestem and little bluestem; a typical forb is black-eyed Susan. Trees and shrubs are almost totally absent, but a few may grow as woodland patches in valleys and other depressions. (As one progresses west in this ecoregion, the system grades to so-called mid-grass species, which in turn grade toward shortgrass prairie). Historically, precipitation levels on these lands were adequate to support grasses, and because of wildfire and grazing (primarily by bison), tree and shrub presence was minimal. With over 99 percent of this region converted to agricultural row crops or urbanization, woody vegetation is now much more widespread and prevalent.

As with all ecoregions, invasive species are prevalent and present management challenges. Control of invasive species at remnant tallgrass sites can be difficult, in part because chemical control, although perhaps the most effective practice, is the least attractive from an ecological perspective.

Products

Tallgrass lands are associated with rich soils and are located in northern areas that are primarily of glacial origin. These soils are very productive, and consequently, these lands have been almost entirely converted to row-crop agriculture

(primarily corn and soybeans). Native vegetation and the fauna associated with it have been dramatically reduced from original levels. With increased interest in biofuels, corn and to a lesser degree, other grasses (e.g., switchgrass), have been used for ethanol production.

Ecological Considerations

There are relatively few ecological considerations that are generally related to this landscape. However, soil erosion and the resulting nutrient and pollutant transport associated with row-crop production are recognized as potentially significant issues.

Mission Compatibility

The use of altered and disturbed tallgrass landscapes for agricultural or renewable energy production uses can be considered mission compatible (e.g., biofuel, wind electric generation).

Sustainability Goals and Regulations

Tallgrass landscapes are highly productive and, with appropriate management, can be expected to remain so into the distant future. Management of these areas in accordance with scientifically established practice and the installation INRMP will help insure long-term sustainability.

Managerial and Legal Constraints

Undisturbed or minimally disturbed tallgrass areas are one of the rarest habitat or vegetation types in North America. Consequently, any tallgrass areas that remain or have been restored on Army installations should be maintained as such. Support and recognition for those actions and activities are generally readily available from other federal and state agencies, such as the US Natural Resources Conservation Service (NRCS), as well as private interest groups such as The Nature Conservancy.

Administration of agricultural leases may result in managerial costs that outweigh the benefits derived. Lessees are interested in profit as opposed to land management per se. Initiation and maintenance of agricultural leases, however, can serve as a land management tool in conformance with goals and objectives identified in the installation’s INRMP.

Savanna

Figure C-3. Pine savanna in southeastern United States.

Savannas are areas with a sparse treecover which allows for a herbaceous understory (Figure C-3). The understory is typically dominated by grass, but forbs can be an important local component. In the United States, savannas include those found in the Southeast, on the West Coast, and in the Midwest. In the Southeast, the tree component is made up of various pines, while on the West Coast and in the Midwest, that component consists of various oaks. In most instances, savannas grade to and are interspersed with grassland and forest/woodland sites.

Savannas have their origin in regional fire regimes and in fact, fire (either natural or man-initiated) is necessary for the conservation and management of this landscape.

Products

Savanna old growth trees can be harvested for wood and related products. A drawback of this technique and approach is that adequate multi-age regeneration of the tree species has to be occurring in order for the savanna character and landscape to be maintained. Savannas have widespread use for grazing and to a lesser extent for “pine straw” and livestock feed.

Ecological Considerations

Savanna landscapes as a type are relatively uncommon. Particularly in the Midwest, most savanna has been altered or converted to primarily row-crop agriculture production. In the Southeast, longleaf pine savanna is relatively uncommon, with much of it in a degraded state due to woody understory invasion

and fire suppression. The West Coast savannas, while prevalent, have undergone considerable reduction, some of which is attributable to urbanization. The major ecological consideration is fire, which must occur at periodic intervals in order for this landscape to be maintained. Invasive species can be an issue, depending in large part on the region and site.

At a regional level, this landscape type is essential to a number of ESA-listed species, perhaps the most notable being the red-cockaded woodpecker.

Mission Compatibility

Savanna landscapes are compatible with Army missions. In fact the Savanna “character and appearance” is one which is highly desirable for many Army training missions (US Army 2009).

Sustainability Goals and Regulations

Savanna and savanna-like landscapes require active management to be properly maintained. Periodic prescribed fire, management and/or control of the woody understory, long-term rotation of trees (80–100 yr), and perhaps selected planting to the dominant tree species are all necessary for the preservation, conservation, and management of this landscape. Management of these areas in accordance with scientifically established practice and the installation’s INRMP will help insure long-term sustainability.

Managerial and Legal Constraints

The most important managerial and legal considerations associated with savannas are those related to ESA-listed species. Perhaps the classic example of this is the red-cockaded woodpecker and other species which are dependent on long-leaf pine habitat. To recover listed species populations, the ESA and resulting Biological Opinions may require active positive management of savannas. Initiation and maintenance of forest-timber harvest can serve as a land management tool in conformance with goals and objectives identified in the installation INRMP.

Shrubland

Shrubland is a broadly used term to describe landscapes dominated by low-growing woody species and short trees. The term shrubland is also used somewhat interchangeably with others such as chaparral, woodland, and savanna depending on the region,

climate, and vegetation. In a strict sense, shrublands are usually found surrounding deserts and grasslands. In these instances, xeric or desert scrublands occur in association with deserts and xeric shrublands ecoregions, or alternatively in areas of fast-draining sandy soils in more humid regions. These scrublands are characterized by plants with adaptations to the dry climate, which include small leaves to limit water loss, thorns to protect from grazing animals, succulent leaves or stems, storage organs to store water, and long taproots to reach groundwater.

However, shrubland is also generally used to describe areas of low-growing woody vegetation, usually with an herbaceous understory. In certain locales, shrublands grade to forests and vice versa. Shrubland, scrubland, scrub, or brush also are terms used to describe this community and landscape.

Products

Shrubland products are comparatively limited; these landscapes are commonly associated with areas of low precipitation, and human development to date is generally limited. Low-level, low-stocking-rate grazing is the dominant land use on this landscape. Because of geological conditions, liquid (e.g., oil and gas) and solid (e.g., coal, mineral) extraction also occurs on shrubland landscapes.

Ecological Considerations

Shrubland may either occur naturally or be the result of human activity. It may be the mature vegetation type in a particular region and remain stable over time, or it may be a transitional community that occurs temporarily as the result of a disturbance (most commonly fire). A stable state may be maintained by regular natural disturbances such as fire or browsing/grazing. Shrubland may be unsuitable for human habitation because of the danger of fire. Additionally, shrublands are frequently associated with areas of low precipitation and availability of water is commonly problematic.

In many situations, the shrubland community complex is degraded because of the presence of invasive species, with cheatgrass being a prime example. In some instances, shrubland communities have been created by introduced exotics such as the Russian olive. Additionally, because of anthropogenic fire suppression, many classic shrubland landscapes are declining in quality because of the abundance of old-growth, non-productive shrub

biomass which also contributes to increased fuel loads and increased wildfire danger.

Mission Compatibility

Shrubland landscapes are compatible with many Army and other military missions. For example, shrublands comprise large areas of important installations such as Fort Bliss, TX, and Fort Irwin, CA. This landscape type can provide training realism for warfighter actions in arid environments.

Sustainability Goals and Regulations

Shrubland species generally show a wide range of adaptations to fire. These adaptations include heavy seed production, lignotubers, and fire-induced germination. Fire frequency will vary with the region. In eastern regions, frequent fire is generally prescribed to reduce or limit this landscape. For example, one of the goals of savanna and forest management in the Southeast is to limit or reduce shrub or understory growth. In western regions, where growth is much slower, longer-term fire frequencies (e.g., 15–25 yr or longer) may be called for.

Managerial and Legal Constraints

The most important managerial and legal considerations associated with shrublands are those related to ESA-listed species. Many shrublands either contain or are in direct proximity to listed species. The ESA involvement and resulting Biological Opinions may require active positive management of shrublands to recover listed species populations. Initiation and maintenance of a multi-age vegetation structure may serve as a land management tool in conformance with goals and objectives identified in the installation’s INRMP.

Water availability and water rights, including compliance with CWA provisions and state authorities regarding water appropriation and use, may also present managerial and legal constraints.

Forest, including Commercial Forest or Plantation

A typical forest is composed of the overstory (upper tree layer of the canopy) and an understory (mixture of seedlings and saplings of canopy trees, together with understory shrubs and herbaceous vegetation).

Forests are differentiated from woodlands by the extent of canopy coverage; in a forest, the branches and foliage of separate trees often meet or interlock, providing a more or less complete canopy (there can be gaps of varying sizes within an area referred to as forest). A woodland has a more continuously open canopy, with trees spaced farther apart, allowing more sunlight to penetrate to the ground between them.

An old-growth forest mainly contains natural patterns of biodiversity in established seral sequence and arrangement, and species that are native to the region and habitat. The natural formations and processes in old-growth forests have not been affected by humans with a frequency or intensity to change the natural structure and components of the habitat. Secondary forest of old-growth often contains significant elements of species which were originally from other regions or habitats.

Forests sometimes contain many tree species, such as the temperate deciduous forests of the eastern United States, or relatively few species, such as in the coniferous (boreal) forests of northern North America.

Plantation, as defined by the Society of American Foresters,[13] is a term commonly used to describe a forest stand which is composed primarily of trees established by planting or artificial seeding. A plantation also may have tree or understory components that have resulted from natural regeneration. Depending on management objectives, a plantation may be pure or mixed species that have been treated to have uniform or diverse structure and age classes, and have wildlife species commensurate with its stage of development and structure. Plantations may be grown on short rotations for biomass, energy, or fiber production; or on rotations of varying length for timber production; or on indefinite rotations for other values.

Products

The classic definition of a forest product is any material derived from a forest for commercial use, such as lumber, paper, or fuel wood. On Army lands, forest products include, but are not limited to, standing timber/trees, downed trees, and pine straw (DoD 2011). On Army installations, the major forest

[13] http://www.safnet.org/index.cfm

product has been wood (for varying uses) and to a lesser extent, forage for livestock.

All other non-wood products derived from forest resources, which comprise a broad variety of other forest products, are collectively described as non-timber forest products. Non-timber forest products include fungi, edible nuts and fruits, and other natural products.

To a large extent, demands for forest products are driven by markets and economics. These demands and markets will vary by region. Marketable forest products requiring removal either must be disposed of by the Army or the value of those forest products must be deposited into the Army forestry account. Marketable forest products cannot be abandoned, destroyed, or donated. Forest products may be sold for salvage when their condition or value is adversely affected by natural disasters, insect damage, or other events. As with other natural resources programs (e.g., agricultural and grazing leases), installations and properties that are proposing to remove forest products must consider the environmental consequences of removal and prepare appropriate documentation as required by NEPA.

Crops grown on plantations most commonly include relatively fast-growing trees, often conifers. On Army installations in the Southeast, this typically includes loblolly and longleaf pines. In other regions, hardwood timber is more often the forest product.

In some instances, slash or residue from timber harvesting operations is used for firewood. Historically, wood waste from nearby lumber operations has been used to fire a central heat plant at Fort Stewart, GA. Ancillary plantation products such as pine straw (pine needles on the ground surface) can be locally important. In the future, the production and use of plantation-grown wood biomass for biofuel production may become more common and important. At present, the economics of such biofuel production is problematic.

Ecological Considerations

Ecological considerations related to this landscape can generally be associated with land management activities necessary to maintain the forest component and forest resource. In part because important forest species are long lived and grow comparatively slowly, forest rotations tend to be long (several decades). This requires long-term planning so that appropriate-ate forest types and conditions are maintained in the future. An

example of this can be that related to the ESA-listed Indiana bat, a species whose recovery may depend on the availability of a certain distribution and presence of old age or dead mature trees.

Ecological considerations related to plantation forestry can generally be associated with land management activities necessary to maintain the crop of timber products. Species used in these settings are typically comparatively fast growing. Depending on the final product and market rotations, this growth period is generally about 60 years, but can be much shorter (e.g., 20 yr). In addition to the relatively long timeframe of growing a timber product crop to marketable maturity, another consideration of this landscape is that it necessitates a long-term commitment to a single crop; generally, such systems are not noted for their biodiversity. Additionally, being a monoculture, these systems are more susceptible to disease or insect (or both) outbreaks. Such outbreaks, in addition to reducing the value of the "crop," may also call for management intervention with pesticides.

The true forest type is comparatively uncommon on Army installations and properties. Existent undisturbed forests should be managed with a goal to maintain and sustain their character and function.

Mission Compatibility

Forest landscapes are generally compatible with Army missions. In fact they may be essential when training for those environments in which warfighting has historically been a possibility (e.g., Europe). Perhaps a drawback of these landscapes is that they require the active development and maintenance of infrastructure (e.g., roads, trails) to ensure adequate access for training.

Forests per se are not generally fire dependent. However, periodic fire can be desirable to prevent fuel buildup which, in the event of fire, can substantially contribute to human health and safety concerns, as well as contribute to significant (but ecologically and geologically temporary) loss of forest attributes.

Tree plantations can be compatible with military missions. In some instances, they may provide a variation in the overall training landscape which can be an asset to training realism. Revenues generated from forest products sales can provide fiscal

support not only for mission compatible forestry activities but also to help rehabilitate degraded lands.

Sustainability Goals and Regulations

With appropriate rotation schedules, forests are indefinitely sustainable.[14] In forestry rotation analysis, economically optimum rotation can be defined as that age of rotation when the harvest of stumpage will generate the maximum revenue or economic yield. Foresters use the concept of maximum sustainable yield (MSY)[15]. MSY can be defined as the largest yield that can be harvested which does not deplete the resource (timber) irreparably and which leaves the resource in good shape for future uses.

Forest landscapes are productive and with appropriate management can be expected to remain so into the distant future. Management of these areas in accordance with scientifically established practice and the installation INRMP will help insure long term sustainability. Perceived as socially, economically, and ecologically sustainable, non-timber forest products represent alternatives to timber-based forest management strategies.

Tree farm/ plantation landscapes can be productive – albeit of a single crop and with appropriate management can be expected to remain so into the indefinite future. The concept of maximum sustainable yield is applicable to plantations also.

Management of these sites in accordance with scientifically established practice and the installation INRMP will help insure long term sustainability.

Managerial and Legal Constraints

As with other landscapes, perhaps the most important managerial and legal considerations associated with forests are those related to ESA-listed species; forest-dependent species such as the Indiana bat come immediately to mind. With the emergence of the so-called white-nose syndrome disease in bats, it can be anticipated that, as a group, these species will be receiving

[14] This assumes a static climactic situation, something which may not currently exist or which may be changing in part as a result of “climate change.”

[15] Another concept used to determine the optimal harvest age of timber is that of “mean annual increment” (MAI). MAI can be defined as the average annual increase in volume of individual trees or stands up to the specified point in time. The MAI changes throughout the different growth phases in a tree’s life; it is highest in the middle years and then decreases with age. The point at which the MAI peaks is commonly used to identify the biological maturity of the tree, and its readiness for harvesting.

increased regulatory consideration. The ESA and resultant Biological Opinions may require active positive management of forests in order to recover listed species populations. Initiation and maintenance of a multi-age vegetation structure may serve as a land management tool in conformance with goals and objectives identified in the installation INRMP.

Additionally, these landscapes require more attention to fire management. The intent of fire management is to allow for scientifically directed prescribed burning, as called for in established plans, to minimize the danger from and to control wild fires which can be caused by military munitions, among other things.

Revenues realized from forest products (i.e., timber products sales) must be deposited in the Army forestry account and used exclusively to fund activities that support forest stewardship in support of the military mission.

Wetland

A wetland is defined as an area of land where water covers the soil or is present either at or near the surface of the soil, and the soil is water-saturated either permanently or seasonally. [16] Water saturation largely determines how the soil develops and the types of plant and animal communities living in and on the soil. Wetlands may support both aquatic and terrestrial species.

While normally associated with freshwater, wetlands can also be found in saltwater and brackish water systems. Wetlands include swamps, marshes, bogs, fens, and other specific types. In many instances, wetlands occur along the periphery of river and lake systems.

Historically there have been several wetland classification systems, most notably those of Shaw and Fredine (1956), Cowardin et al. (1979), and Smith et al. (1995). Using Shaw and Fredine (1956) and Cowardin et al. (1979) the user can envision what a wetland looks like. Using Smith et al. (1995) and U.S. Department of Agriculture (USDA 2008) the user can envision how a wetland works.

[16] Wetlands means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (40 CFR 122.2).

Although dated, the National Wetland Inventory of the USFWS provides much more information about wetlands on Army installations and can be used to track changes or gains and losses of wetlands.[17]

Products

While specific and specialized wetland products can be identified (e.g., wild rice, marsh "grass" [*Carex* sp.] harvested commercially), wetland products can probably best be described in terms of ecosystem services. Far from being useless, nonproductive places, wetlands provide values that no other ecosystem can; these values include water quality improvement, flood protection, erosion control, opportunities for recreation, and natural products such as fish and wildlife. Individual wetlands or wetland systems can provide one or more of these functions. Thus, wetland products are very much related to wetland function.

Ecological Considerations

Wetlands provide a multitude of ecological, economic, and social benefits. They provide habitat for fish, wildlife and a variety of plants, and are nurseries for many saltwater and freshwater fishes and shellfish of commercial and recreational importance. Wetlands are also important landscape features because they hold and slowly release floodwater and snowmelt, recharge groundwater, act as filters to cleanse water of impurities, recycle nutrients, and provide recreation and wildlife viewing opportunities for millions of people. Additionally, Army wetlands as a whole contain a significant number of ESA-listed plant species, which has caused the Army to allocate significant resources toward their management and recovery. For example, in FY 2005 the Army spent over $375,000 on conservation of the Huachuca water umbel plant (US Army 2006).

Wetlands are not typically fire dependent. However, periodic fire can be beneficial for nutrient recycling and overall temporary vegetation removal. Nonetheless, some wetland types are definitely related to fire (see discussion of pocosins in the section below on mission compatibility).

[17] http://www.fws.gov/wetlands

Mission Compatibility

As a whole, wetland landscapes and environments are sensitive sites with inherent use constraints. Some of these constraints are directly related to the standing water and/or saturated soils common to these environments, conditions not particularly conducive to military training. Furthermore, wetlands and wetland use is regulated under provisions of the CWA and counterpart state statutes and regulations. These regulations generally place limits on activities and actions conducted that may impact or affect wetlands.

While wetlands can be found on most if not all major Army installations and properties, perhaps the most notable example of wetlands is the pocosins found in the Atlantic Coastal Plain. Usually, there is no standing water present in a pocosin, but a shallow water table leaves the soil saturated for much of the year. Because pocosins are found in broad, flat, upland areas that are far from large streams, they are similar to northern bogs in that rainfall provides most of their water. Also like the bogs of the far north, pocosins are found on waterlogged, nutrient-poor, acidic soils; the soil itself is a mixture of peat and sand containing large amounts of charcoal from periodic burnings. These natural fires occur because pocosins periodically become very dry in the spring or summer. The fires are ecologically important because they increase the diversity of shrub types in pocosins. On Army installations where pocosins are present (e.g., Fort Stewart, GA), entry to those sites for training purposes is restricted.

Sustainability Goals and Regulations

Wetland areas in the United States have been dramatically reduced from pre-settlement days. In recognition of the value of wetlands and perhaps concurrently the extent of wetland alteration and loss, numerous authorities are in place to work nationally toward the goal of “no net loss.” These authorities include Small Wetland Acquisition Program, Water Bank, the Swampbuster provisions of various farm bills, the National Wetland Priority Conservation Plan (required under the Emergency Wetland Resources Act of 1986[18]), the Emergency Wetland Resources Act, the North American Waterfowl Management Plan (a joint agreement and treaty between the United States, Canada, and Mexico) and the North American Wetlands Conservation Act[19].

[18] P.L. 99-645 100 Stat. 3582

[19] P.L. 101-233 103 Stat. 1968; 16 USC. 4401-4412

With proper and scientifically based management, such as that appropriately identified in the installation INRMP, existent wetlands on Army lands are sustainable.

Managerial and Legal Constraints

The Army has a positive mandate to protect and preserve wetlands. Executive Order (EO) 11990 directs federal agencies to "provide leadership and…take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities…" (EO 11990 1977).

Section 404 of the CWA directs USACE and the US Environmental Protection Agency (USEPA) to regulate the discharge of dredged and fill material into "waters of the United States," which are defined to include wetlands, even when they are isolated from navigable bodies of water. Authorization from USACE must be obtained before beginning work in wetlands, which almost always involves discharging dredged or fill materials into US waters. However, Section 404 regulation is not a narrow, technical regulatory process but rather is a public review procedure that allows all interested parties to comment on potential adverse impacts from the proposed wetland conversion (Alvayay and Baen 1990). In this regard, the Section 404 process acknowledges the public-good aspects of wetlands and allows the affected public to weigh potential negative effects against competing interests of the private (or public) permit seeker.

The Army has agreed to use a hydrogeomorphic (HGM) approach as a basis for wetland functional assessments (Federal Register 1997; Brinson 1993). Other agencies adopting the HGM approach include the US Department of Transportation's Federal Highway Administration, US Department of Agriculture's NRCS, US Department of Interior's Fish and Wildlife Service, and the USEPA. The National Action Plan to Implement the HGM Approach to Assessing Wetland Functions outlined a process by which USACE would develop regional HGM guidebooks for selected HGM classes across the United States. At the time of this report, USACE lists 24 national and regional guidebooks available for use in the United States.[20]

[20] http://www.usace.army.mil/wetlands/guidebooks/cfm

Perhaps the biggest restraint on wetland use is wetland site conditions themselves. As mentioned previously, standing water and saturated soils pose significant use constraints.

Agricultural Crops

Figure C-4. Cornfield on an Army installation.

Row cropping is not so much a landscape term as it is a term to describe agricultural crops typically planted in rows or to describe a method of planting crops in rows wide enough to allow cultivators between the rows (Figure C-4). Most farm crops now are drilled (planted) in rows rather than broadcast (not planted in rows).

Products

Typical row crops are those common to agricultural settings (e.g., corn, soybeans, grain, and cotton). These crops tend to have a relatively high value, and are planted and harvested annually (in contrast to forest/wood products). These agricultural products are not routinely used on nor are part of military installation or property management programs. Rather, if they exist, they are products of outlease agreements and associated revenues fund natural resources programs or activities.

Ecological Considerations

Row crops generally require fertile soils. Additionally, because of equipment limitations and associated planting and harvesting constraints, larger acreages are preferred although they can be adapted to smaller sites. In part because of the high value, but also because of the need to actively manage these crops, large

inputs in terms of fertilizer and agricultural chemicals, if not required, are highly desirable. Pesticide use on Army installations is allowed but is not necessarily encouraged, and thus pesticide use in agricultural settings has to be balanced against the installation's pesticide use goals and anticipated returns for the agricultural product. Instances where row crops may be appropriate include those where their application as firebreaks can contribute to wildfires or prescribed fire controls. On the whole, areas suitable for row crops are also invariable suitable for other, less intense agriculture (e.g., grazing) or forestry practices.

Mission Compatibility

In the appropriate setting, row crops can be considered compatible with military missions. However, the presence of row crops usually precludes human activity during the growing and harvest seasons since activity during those periods can greatly reduce or even destroy crops yields.

Row-crop agriculture is productive and with appropriate management can continue to be productive on appropriate sites into the indefinite future. Management of these sites in accordance with scientifically established practice and the installation's INRMP will help insure long-term sustainability. With this land use approach, considerable expertise is available from other federal and state agencies such as the NRCS and state- or county-level agricultural agents.

Sustainability Goals and Regulations

Perhaps the greatest sustainability risk associated with row crops is related to soil erosion and subsequent potential effects on water quality. Because of the planting arrangement, row cropping results in large areas of exposed soil which in turn are subject to water and wind erosion. However, compliance with identified installation-level INRMP management practices should keep these issues to a minimum.

Prime farmland is a designation assigned by the USDA to define land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is concurrently available for such use. Any prime farmland under Army control should arguably remain in such use. If it does not, alteration to non-prime farmland use is generally considered a potentially significant negative impact (US Army 2010).

Managerial and Legal Constraints

Revenues realized from agricultural leases must be used exclusively to fund natural resources management program requirements and the administrative expenses of agricultural leases. Authorized uses of agricultural outlease funds include personnel salaries (limited to professional and technical support of the agricultural outlease programs in support of management goals and objectives), implementation of INRMPs, and equipment and improvements to the land if they provide a net benefit to the installation’s natural resources programs.

Additionally, as with grazing leases, each outlease must require lessee adherence to a conservation plan and the installation’s Integrated Pest Management Plan (IPMP) that details the best management practices to sustain and protect natural resources. Also, leases must be consistent with federal contracting guidelines known as Federal Acquisition Regulations (FAR).

APPENDIX D

ABBREVIATIONS

Term	Spellout
ACSIM	Assistant Chief of Staff for Installation Management
AEDB-EQ	Army Environmental Database – Environmental Quality
AR	Army Regulation
CECW	Directorate of Civil Works, United States Army Corps of Engineers
CEMP-CE	Directorate of Military Programs, United States Army Corps of Engineers
CERL	Construction Engineering Research Laboratory
CFR	Code of the Federal Regulations
CONUS	Continental United States
CWA	Clean Water Act
DoD	Department of Defense
DoDI	Department of Defense Instruction
EO	Executive Order
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
FAO	Food and Agriculture Organization (of the United Nations)
FAR	Federal Acquisition Regulations
GIS	geographical information system
HGM	hydrogeomorphic
HQUSACE	Headquarters, United States Army Corps of Engineers
I & E	Installation and Environment
INRMP	Integrated Natural Resources Management Plan
IPMP	Integrated Pest Management Plan

Term	Spellout
MCE	multi-criteria evaluation
MSY	maximum sustainable yield
NEPA	National Environmental Policy Act
NRCS	National Resources Conservation Service
POC	Point of Contact
PWTB	Public Works Technical Bulletin
TOE	Table of Organization and Equipment
USACE	US Army Corps of Engineers
USAEC	US Army Environmental Command
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
USFS	US Forest Service
USFWS	US Fish and Wildlife Service

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